BHARAT
KRISHAK
SAMAJ
YEAR BOOK
1972

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NEW DELHI-13

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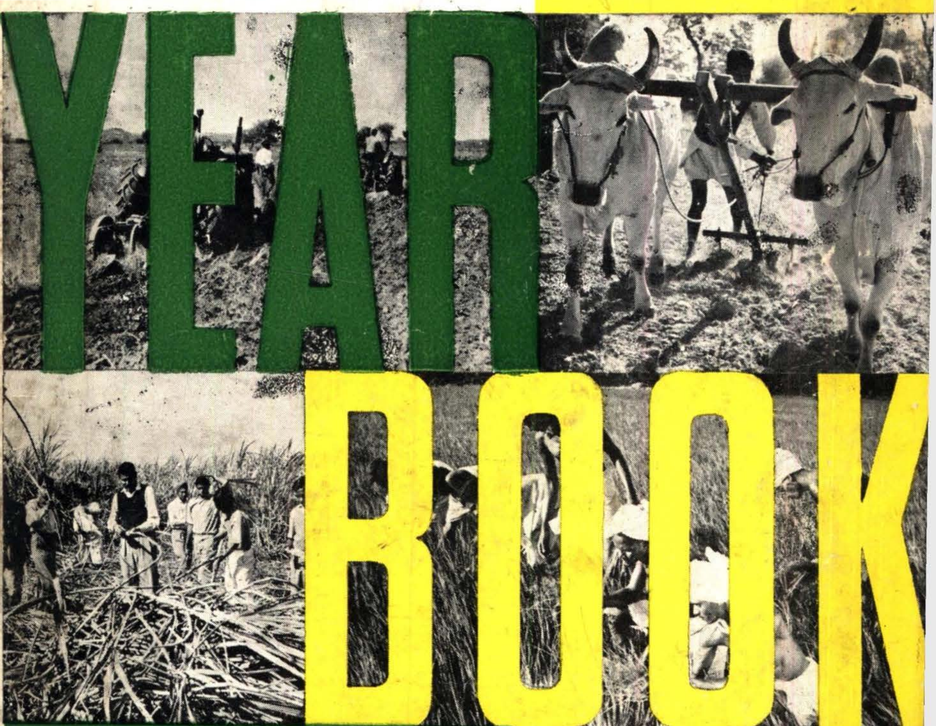

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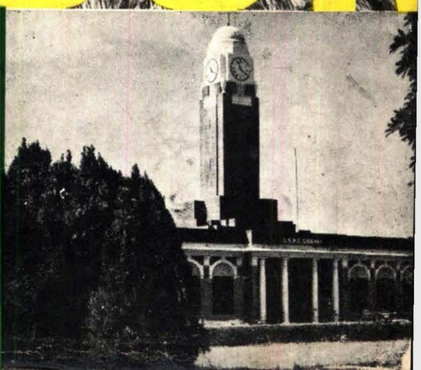

BHARAT KRISHAK SAMAJ YEAR BOOK 1972

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DEDICATED TO

SRI C. SUBRAMANIAM

Minister for Planning, Govt. of India, New Delhi

Who is largely responsible for having successfully
ushered in the green revolution in the country by
introducing nitrogenous responsive high yielding
varieties of cereals thus causing a phenomenal
breakthrough in Agricultural production which
has largely paved the way for the country to
become self - sufficient.

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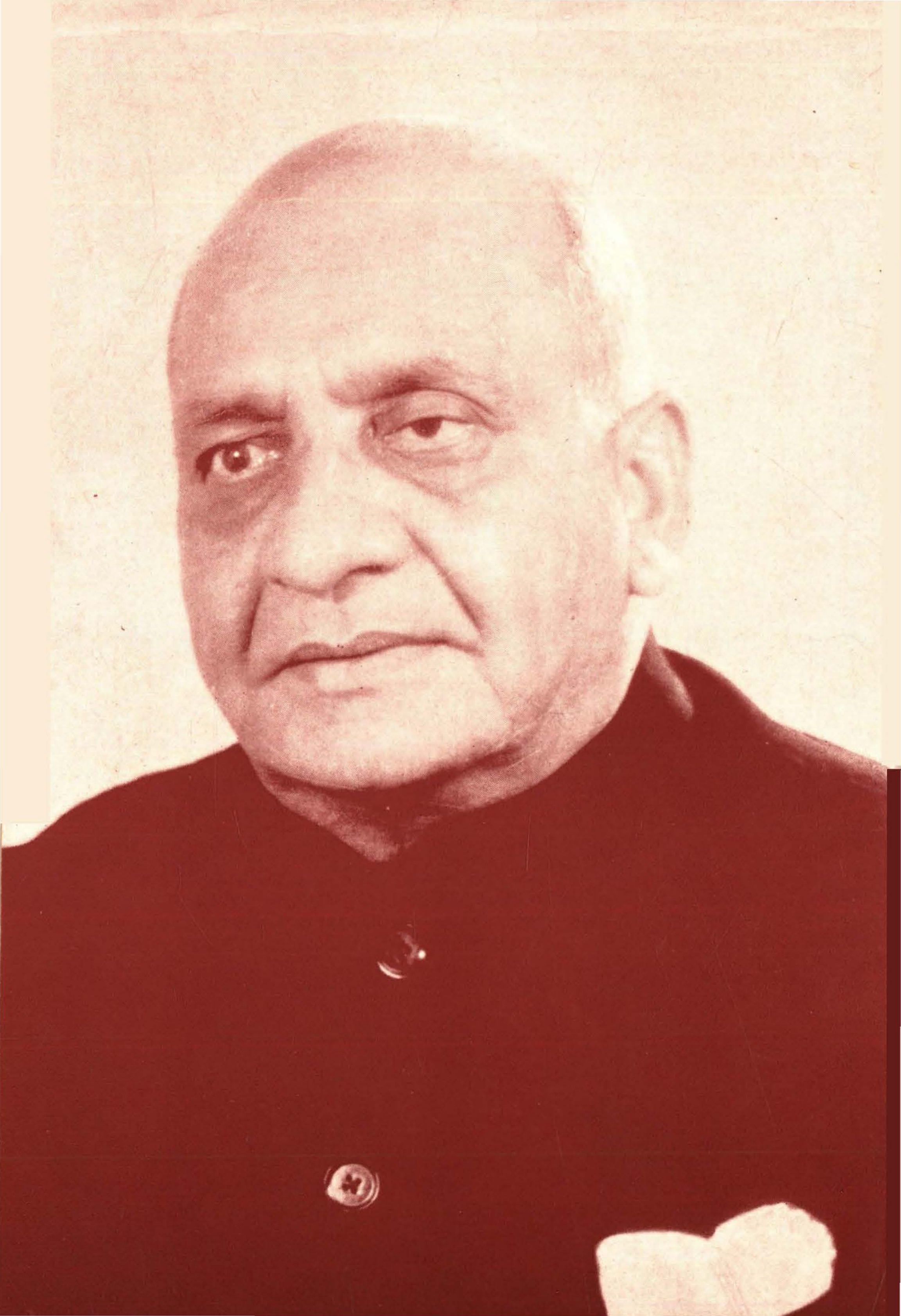
Part II Agricultural Statistics

DR. PANJABRAO S. DESHMUKH

Our Founder President



PREFACE

The goal of two decades of our Agricultural Planning has been self-sufficiency in food grains and to do away with all imports of food-grains from foreign countries. With the spectacular and rapid development of the use of nitrogenous responsive and hybrid varieties of cereals by the farmers, the time has come when we will not only be self-sufficient but will also have an exportable surplus. The presentation of this book at this juncture is to kindle to greater heights the enthusiasm of the progressive farmer-be he big or small-to increase his productivity keeping an eye on certain fundamental principles and cultural practices that one has to adopt in successfully growing the new high-yielding varieties of cereals. It is also a token of our humble tribute to Shri C. Subramaniam (to whom this work is dedicated) who during his stewardship of the Union Ministry of Food and Agriculture introduced these new high-yielding varieties that are largely responsible for ushering in of the green revolution.

A day existed in the history of our country when many heard with disdain our cry of self-sufficiency in food. It should be said of our kisans, like the jawans, undaunted they continued their efforts to increase production in spite of odds, and have succeded greatly in making this country, less and less dependent on foreign food. Agriculture is the occupation of a sector of humanity in this country, which does not change by fits and starts; and the green revolution for its success depends upon the millions of small farmers taking to improved seed and technique. It is not easy to be a good farmer; but it is very easy to be a poor one.

In the end the farmer who is ill equipped and without a knowledge of the great general principle upon which sound agriculture is built, may find himself driven by economic necessity into more and more bad farming practices hurting not only his life on the farm but also the land owned by him.

Here, our extension people, be they the research worker or scientist or progressive farmer or gramasevikas and sevaks or others—they have a job to do. In that great task we hope this publication will be useful to them as a guide and book of reference. The future research work will no doubt rightly concentrate on improving not only the quantity yield, from an acre but also the quality viz-protein content in cereals.

We owe a debt of gratitude to the various authors who contributed at our request several articles on various aspects of cereal production. Coming as it does from these stalwarts who are specialists in their field, we hope the information contained will be useful to one and all alike, who are interested in the progressive development of cereal production in our country.

Madras - 4,
13 - 1 - 1972.

R. SRINIVASAN,
President.

PART I

SPECIAL ARTICLES

AN INTEGRATED APPROACH FOR INCREASING AND STABILISING AGRICULTURAL PRODUCTION UNDER DRY FARMING

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&
N. G. P. RAO
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M. S. SWAMINATHAN

Unirrigated farms occupy nearly 80 per cent of the total cropped area of 138 million hectares. Out of this area, about 41·6 million hectares have an average rainfall of 1,150 mm and above and about 49 million hectares receive a rainfall ranging between 750 and 1,140 mm. It is the areas where there is neither dependable irrigation nor adequate rainfall that cropping offers both poor returns and great instability. Research on dry farming practices has been in progress for about 30 years and certain useful practices for moisture and soil conservation have been developed. Studies have also been conducted at several research centres on the selection of varieties which perform better under conditions of low rainfall, on the methods of application of nutrients to crops and on suitable cropping patterns. However, no attempt has so far been made to apply an integrated package of technology involving the simultaneous application of all the results of research. Consequently, the individual practices developed by scientists working in different disciplines have not found wide adoption because of their marginal impact on productivity and income. It is only when the different procedures like better tillage, soil and moisture conservation, better varieties and better nutrition are made to interact that an yield and income jump of a larger quantum per unit area is likely to arise.

The unirrigated areas contribute as much as 42 per cent of the total food output. Also, in these areas the relative proportion of landless labour is high with the result that whenever crops fail due to drought, there is considerable unemployment and misery. The introduction of a new agricultural development strategy for such areas based on the available research information is, therefore, an immediate necessity. The emphasis in this paper is on the development of suitable varieties of crops, cropping patterns and the necessary package of practices for such areas.

TRADITIONAL DRY FARMING

Major dry farming areas in the country are confined to the deccan plateau, the plateaus of the Central India and the desert areas of Rajasthan and Kutch. The soil types and climatic conditions of these regions provided the basis for the traditional *kharif* or *rabi* cropping seasons during which a single crop is taken. Most of the available varieties in case of crops like *jowar*, *castor*, *arhar*, *cotton*, etc. are late maturing and frequent occurrence of drought results in crop failures. Almost the total absence of the practice of fertiliser application and plant protection measures and the tradition of growing such crops only under low populations imposed further limitations in realising higher yields even in years of relatively well distributed rainfall. Thus, apart from the limitations imposed by low and uncertain moisture levels, the missing links in elevating and stabilizing yields of rain-fed agriculture have been non-availability of suitable varieties, the maintenance of optimal plant populations and the lack of application of fertilizers and pesticides.

VARIETAL IMPROVEMENT FOR A SUCCESSFUL GENETIC RELATIONSHIP WITH CLIMATE

General emphasis in dry farming research has been on soil and water conservation measures which formed the major ingredients of recommendations for elevating yield levels of such areas. Analysing the problems of crop production in the low rainfall *rabi* areas of *Rayalaseema* region in A. P., Krishnamurty (1968) felt that the traditional and orthodox practices like bunding and fertilization proved ineffective in improving yield levels and the weakest link in the chain of factors affecting production was the crop varieties in vogue.

An ideal variety is one which combines high yields with stability of performance over several environments. Some of the recent developments in varietal improvement are of particular significance to dry farming. The consistency of yield performance of the Sorghum Hybrid C S H 1 has belied the general belief that the hybrids are for favourable environmental conditions only. C S H 1 has become very popular under extreme moisture stress in the Bellary district of Mysore state as a result of organised extension effort and has attracted public attention. Similarly, the *bajra* hybrids HB I and HB 3, the new early castor variety *Aruna*, short duration varieties of *arhar* and *mung*, several varieties of wheat, cotton, etc., could provide the base around which a new package of dry farming practices could be built up to elevate and stabilise the production levels of most crops. A list of improved varieties is appended. Earliness coupled with hybridity as in the case of Sorghum and *bajra* hybrids, seem to confer an advantage with respect to fitness under environmental stress. Taking into account the mean evapotranspiration during a given season and based on the fact that no moisture is needed by the plant once it enters the maturation phase, the duration of suitable varieties could be computed for purposes of breeding varieties of suitable maturity and this in itself would provide an insurance and minimise the risk factor.

Thus, the ability of the genotypes to adapt to random and cyclic climatic fluctuations is inherited. Besides, agronomic limitations, the factors contributing to adaptive flexibility include basic efficiency of photosynthesis under different light, temperature and moisture regimes, the distribution of assimilates between seed and stalk and the developmental mechanisms for drought resistance all of which can be genetically manipulated. With an uncertain monsoon, the sowings are frequently premature or delayed and in either case face specific problems. While breeding varieties for such conditions, inbuilt flexibility though various buffering mechanisms and resistance to prevalent pests and diseases could result in stability of production.

ENVIRONMENTAL CONTROL THROUGH PACKAGE OF DRY FARMING PRACTICES

Dry farming has always been treated as subsistance farming. Intensive cultivation approach has been conspicuously absent. No convincing data on response to fertilizers was available and fertilizer application was not encouraged; low seed rates were consciously popularised; plant protection was considered a luxury. A new agronomy has, therefore, to play an active role if we are to elevate the yield levels of these regions.

Soil and moisture conservation

The available know how on the various means of soil and water management should be put to best use at the field level through provision and popularisation of the necessary equipment needed. Details are not discussed since there may be several papers on these aspects.

Stand establishment

Uniform stands are a pre-requisite for highyields. The moisture utilisation efficiency (MNE) under our rain-fed farming has always been low and never fully utilised. Problems of germination and seedling mortality further aggravate the situation and could be ameliorated through the use of good treated seed, suitable sowing equipment and plant protection, where necessary.

Fertiliser application and plant protection

There has been a general feeling that fertilization of dry land crops is uneconomic. The poor response of the earlier varieties, lack of equipment to place the fertilizer in relation to seed and want of moisture in top soil when late rains fail for *rabi* crops, are some of the factors responsible for little enthusiasm. The new varieties mentioned have all demonstrated response to fertilizer application. The grains yields of hybrid *jowar* and *hybrid* bajra were demonstrated to be 3-4 times more per kg. of nitrogen in comparison with locals. Most of the high yielding varieties presently available are fortunately of short-duration nonlodging and fertilizer responsive.

Broadcast application of fertilizer is frequently ineffective and is not available unless moved into the root zone by rain or irrigating water. Placement of fertilizer in relation to seed increases the response manyfold. Foliar feeding could also be useful in many instances.

During the *rabi* season if the late rains fail, application of even a basal dose of fertilizers gets frequently ruled out. If sowing dates are advanced with a possible rainy period ahead, this would fecilitate application of a heavy dose of basal application of Fertilizers. Some more rain could be anticipated during early growth period and there would also be a possibility of top dressing. Studies in the *Rayalaseema* region of Andhra Pradesh revealed that advancing planting dates of *rabi jowar* and *rabi* cotton resulted in substantially increased yields, but the available varieties were most susceptible to shoot fly or Jassids during this period. This limiting factor is no longer unsurmountable since powerful chemicals like carbofuran can control shoot fly of Sorghum even with seed treatment. Thus, one way to stabilise yield levels of scarce rainfall areas is to adjust planting dates in such a way that at least some rains could be received during crop growth. This coupled with plant protection and the feasibility of effective fertilizer application could raise yield levels.

INTENSITY OF CROPPING

In planting to stabilise yield levels of rain-fed crops it is necessary to increase the intensity of cropping in areas with good assured rainfall through practice of relay and double cropping patterns and to develop alternate cropping systems that could stand the stresses of an ill distributed monsoon in areas of scanty rainfall.

The tank-fed areas and areas where traditionally long duration varieties of 5-6 month duration are cultivated could be considered for increasing the intensity of cropping. Under the tank-fed areas where rice plantings are possible only in September, an early upland crop of *mung*, hybrid *bajra* or hybrid *jowar* are feasible. Alternatively, rice could be planted as a drill sown crop, irrigated subsequently, and a second crop is feasible after harvest of rice. In long duration *Kharif* area two crops in a season hybrid *bajra* and hybrid *jowar* to be followed by gram or linseed or any other crop is feasible. In the wheat belt, a *kharif* crop can be taken under rain-fed conditions. Similarly, in the single cropped *rabi* areas where plantings begin in September-October, an early *kharif* pulse crop is possible. The Setaria-cotton relay cropping is a good example of a relay system under rain-fed farming. Several alternative and specific systems could be considered for each of the regions. In areas with consistently low rainfall, efforts should be made to raise a good single crop with reasonable yield levels. Forage crops and perennials could find a place in appropriate areas.

INTEGRATED APPROACH

The agricultural fortune of India has so far been primarily regulated by weather. Whenever rainfall failed, crops withered and consequently, even before the current population explosion, we have had famines in 1770, 1784, 1802, 1824, 1837, 1860, 1865, 1868, 1875 and 1876. While in all regions weather is subject to fluctuation, perhaps in no other habitat is an organism subjected to such rigorous and aberrant climatic conditions as in the arid regions. These extreme conditions make the management of arid regions and the research needed for the sound use of them, a unique and challenging problem. The experience gained in countries like Australia, Israel and the United States makes it abundantly clear that science can help us to mitigate and even avoid the effects of aridity and drought. Making the desert bloom is now accepted as a realistic aim. Control of water from the time it falls on the earth until it reaches the root zone of the crop can now be attempted in a scientific manner. Various steps can be devised to forge new patterns of soil - plant-water-man relationships, so as to enhance the income potential of farms in dry areas. The rapid progress now taking place in weather forecasting would open up altogether new possibilities in the modification of the weather. New cropping patterns designed to enable the plants to escape drought can be evolved by the combined use of weather models and genetic engineering techniques. Research in these fields in our country is not only important for increasing production in the drought areas but is also vital for the economic upliftment of the people living in such areas and for banishing unemployment and underemployment.

Integrated application of available knowledge is the need of the hour, the variety together with soil and water conservation and management measures, fertilizer and insect control schedules together with the necessary equipment for effective and timely operations, adjustments in planting times, alternate crops and cropping systems could all provide the necessary package to stabilize the yield levels of dry land farms around 2,000 kg. of grain/ha as against the existing 200—500 kg./ha for most crops. The soil conservation centres could become integrated crop improvement centres.

IMPROVED VARIETIES FOR RAIN-FED CONDITIONS

Crop	*Variety*	*Recommendations*
Wheat *(T. aestivum)*	Kalyan Sona	A variety found suitable for cultivation under rain-fed conditions all over the country, besides being suitable for high fertility and irrigated conditions.
,,	HD 1467	
,,	HD 1467	Suitable for cultivation in the rain-fed areas of M. P., Gujarat, South-eastern Rajasthan. Consistently out-yielded the local check over a period of 3 years in the all India wheat Coordinated Trials. The variety has attractive amber grains.
,, *(T. durum)*	HI 6–23	Suitable for cultivation in the rain-fed areas of central India. Consistently found superior to the local variety in the trials conducted during the period 1966—69. The variety has attractive bold amber grains.
,,	A9–30–1	Another durum variety found suitable for cultivation in the black cotton soils of central India, having low rainfall.
,, *(T. aestivum)*	NI 5439	A variety developed by the Maharashtra Agriculture Department and was found consistently superior to the local in the rain-fed areas of Maharashtra, Mysore and Andhra Pradesh.
Barley	RS.6	This variety on an average gave 19% more yield over the local check, in the trials conducted under rain-fed conditions of central India, during 1966—69. The variety was attractive bold grains.
	IB 226	Another promising variety for the rain-fed areas of central India. The variety gave 15% more yield on an average over the best control, during the period 1966—69.
Jowar	CSH 1	*Kharif* areas all over the country with a rainfall of 20–25″; known for stress conditions; grow with recommended package of practices.

Crop	*Variety*	*Recommendations*
	Swarna	*Kharif* areas all over the country with a rainfall of 25–30″; Swarna has done particularly well in black soil areas of M.P., Mysore and parts of Maharashtra; package of practices essential.
	Expl. Hyb. 2219×IS 3691 (now under pre-release multiplication by the NSC)	do
Jowar	M. 35–1	*Rabi* areas of the Deccan in the States of Maharashtra, Mysore and A.P. Early sowing in mid September. with carbofuran treatment of the seed and adequate fertilisation.
Bajra	H.B.1	Low rainfall areas all over the country.
	H.B. 3	Limited rainfall areas in Rajasthan, Gujarat, South India etc. package of practices essential.
	H.B. 4	Areas with assured rainfall with the recommended package of practices.
Maize	*Ganga* 5	Earliest hybrid available with wide adaptability; could be grown under rain-fed conditions in areas where about 30″ of rain is received during crop growth with the recommended package of practices.
	Vikram	Earliest composite available and has *bassi* the rain-fed open pollinated variety in its parentage; could be grown as a rain-fed crop, with recommended package of practices.
	Others	Other released hybrids are also comparatively better than locals if the recommended inputs are given.
Oilseeds Castor	*Aruna*	*Chalka* soil areas of Telangana. Early and matures in 150 days against 240 days for earlier varieties. Superior in yields to available varieties besides some insurance against drought.

Crop	*Variety*	*Recommendations*
	Gujarat Hybrid	Earlier than *Aruna* and stands stress conditions.
Seff flower Sesame & Groundnut	Available varieties	Need attention from agronomic view point.
Pulses	Early selections of *Arhar*	Stress areas all over the country.
	Early selections of *Mung*	To enable double cropping under rain-fed conditions
Cotton	PRS–72 and new early, clustered boll varieties	Take less than 120 days, synchronised boll development and greater possibility of increasing plant population.
	Available varieties	Emphasis on fertilisation and other agronomic aspects to raise production of available varieties.

CULTIVATION OF CEREAL CROPS IN INDIA

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Cereal grains dominate agricultural production in any country because they directly or indirectly provide a large portion of the human sustenance. Many people in the rice growing States in our country depend almost entirely on rice for their subsistence. The inhabitants of some countries depend primarily on maize, rye, barley, sorghum or millets for their main staple food. But the large percentage of world population subsists on either wheat, rice or maize. Cereal grains popularly cultivated in India are Rice, Wheat, Barley, Maize, Sorghum (Jowar), Pear Millet (Bajra) and Finger Millet (Ragi). These crops, also known as food grain crops, dominate Indian Agricultural Production because :

(a) These are main items of diet.

(b) Cheap source of Calories.

The Production of these food grains in our country was insufficient to feed the entire population since the per acre yield is among the lowest in the world. So, a production explosion has become the need of the hour to meet the needs of the increasing population in our country. In recent years, a spectacular achievement in the production of food grains was noted and one could hope to achieve a break-through in Indian Agriculture. Thanks to the new high-yielding varieties of crops developed by our Scientists which played a key role in stepping up production. Now one can be optimistic that the release of these high-yielding varieties and the trend in increased production will not only solve the food problem of the teaming millions but also will have a bearing on the economy of the farmers which ultimately will result in the change in the attitude of the farmer from conservative and subsistence farming to modernization and productive farming.

Climatic factors mostly determine the areas in which the above crops are grown economically. Wheat, Barley, Rye, Oats are generally grown in north, north - western, central India and other cooler parts of the country, where as Rice, Jowar, Bajra and Ragi are important cereals grown in coastal areas and south India. Of the cereals, rice is best adopted to the high rainfall areas of India. Conditions such as hot moist climate and availability of wide areas of levelled land and irrigated facilities are favourable for rice cultivation. Crops like Jowar, Bajra and Maize that are also grown under hot moist conditions can compete with rice only in low rainfall areas.

The article describes in detail cultivation practices of high-yielding cereal crops in easy-to-understand style to serve as a useful guide to all those engaged in food production.

RICE

i. Adaptation

Cultivable in flooded, lowland, upland, deep water & saline conditions. Warm temperature and sufficient moisture is essential. It can be grown from below the sea level to an elevation of 8,000 feet. It can thrive between 45°N and 40°S. But highest yields are obtained between 30°S and 45°N of equator.

ii. Climate

1. Requires temperature of 20°C to 37·5°C for optimum growth during the growing season of 4 to 6 months.
2. Needs more water than any other cereal crop (8 to 35 acre inches)
3. High rainfall is essential to cultivate the crop in uplands.
4. Drought tolerance is less than that of other millets.
5. High humidity, and continuous drizzling of rain multiply the pest hazard.
6. High wind velocity in flowering time results in more white ears (Maximum of 27 MPH).
7. In cooler areas, the adverse effect of low water temperature can be offset to some extent by an increase in water depth to about 4 inches.
8. Favourable humidity ranges for early and late varieties are 83 to 85% and 67 to 68% respectively.

iii. Soil Types

1. All types of soils are suitable.
2. Soils having about 70% clay and silt particles are best.
3. The optimum pH is 6·5 and may range from 4·0 to 7·5.
4. Acidic soils present a poor root growth, considerable floret sterility and low grain yield.
5. Saline and Alkali soils do not favour good returns.
6. Heavy & shallow soils require surface drainage.
7. Light soils require an impervious sub-soil to retain much water in the field.
8. Peaty soils require heavy application of phosphorus, potassium and sometimes other mineral elements.
9. Optimum cation exchange capacity to get maximum grain yield is about 20 m. e./100 grams.

iv. Physiology

(a) Nursery Period

1. Dormancy period of seed varies from 1 day to 4 months.
2. Optimum temperature for germination is 29·5°C. Seed germinates from 5·5° to 47°C.
3. Germinates in typical soils when the soil moisture content is about 27% or more.

4. Rice requires less free oxygen supply for germination than other cereal seeds.

5. Seedlings can be kept alive under water for about 50 days.

6. Rice, sown on the surface soil submerged with water, germinates best. If the seed goes deep in the soil more than 4 cm., no seedling emerges out because of poor supply of oxygen.

7. Cool hours of the day (morning and evening) are best for sowing the seed as the cool water contains more of dissolved oxygen than the warm water.

The rice crop "Padma" recommended for certain areas of West Bengal and Assam

(b) After Transplanting

(i) Temperature :

1. Optimum temperature reported in Japan for maximum tillering is 32 to 34°C. Hence the tillering is high in the case of summer varieties.
2. Temperature for blooming is 26·5°C to 29·5°C for all varieties.

(ii) Photoperiodism :

1. Marked difference is found in response to different photoperiods.
2. Photo-sensitive, photo-insensitive and weekly photo-sensitive varieties are common in cultivation.
3. Short photoperiods (4 – 12 hours) generally hasten the floral initiation and heading, while long photoperiods (13-24 hours) tend to prolong the vegetative period.
4. The optimal photoperiod for floral initiation appears to vary between 9 and 12·5 hours and 8 hours photoperiods are detrimental to early varieties which delay the panicle, emergence and reduce grain yield.

v. Water Requirement

1. Methods of Cultivation

(a) Upland or Non submerged Rice

1. Even if irrigation water is not available, rice can be grown in uplands receiving more than 40 inches of annual precipitation.
2. The yield, however will be less than the crop grown in low lands.
3. Weed problem is too much in upland rices when compared to low rice.

(b) Low Land or Submerged Rice

1. A constant waterlevel is maintained in the field with proper inlet and outlet of water.
2. Continuous miantaining of water level in flowering and milk stage is essential.
3. Consumes more water than any other crop.
4. Becomes a problem in ill drained soils.

(c) Semi-wet Rice

1. Practiced in areas where the water is assured from later half of the growing period of rice.
2. Long duration varieties of 6-7 months are sown.
3. Seed is drilled or broadcast directly as other rain-fed crops.
4. Field is flooded continuously with water from 2–3 months after sowing.
5. The practices are similar to upland rice upto 3 months old and later similar to low land rice.

(d) Deep Water Rice

1. Varieties capable of elongating culms rapidly to keep the tops above the water surface are sown under such conditions.
2. Such varieties may even elongate from 6–15 feet or above.
3. The seed is sown directly before the flood season and the rice is harvested by hand from boats.

(i) Quantity of Water :

1. In monsoon season it requires less water.

2. Draining at the time of maximum tillering stage contributes high yield.

3. The average depth of water requirement is 3 to 4 cm. standing water.

4. The water consumption in a light soil is relatively more than a heavy soil.

5. The water consumption is relatively high in initial seedling stage, blossom period and dough stages.

6. The total water requirement varies from 38 to 75 hectare inches.

(ii) Quality of Water :

1. Water with salt content of 600 ppm is injurious to rice and the grain yield reduction at 600 ppm and 1,300 ppm is 25 and 70 per cent respectively.

2. Older plants relatively tolerate high salt content than the young seedlings.

3. Rice grown on clay soils may not be injured by salt water to the same extent as on lighter soils, because less water is used and less is lost by seepage.

4. When irrigated with water containing salt content of 850 ppm it adds 3 tonnes of salt per acre.

vi. Cultural Practices
Land preparation

1. Seedbed preparation can be started by ploughing with tractor or animal power or hand spading.

2. Secondary tillage is done by working disc harrows or hoes or puddlers.

3. Direct puddling (ploughing the land under water) is practiced in some parts of India, ploughing and then puddling is practiced in other parts of the country.

4. Building (Trimming and Strengthening) of bunds is practiced in low land rice.

5. Levelling with a plank is predominant in bunded low land so that water is spread uniformly in the field.

vii. Seeding Practices

(a) Methods of sowing

(1) Direct Sowing :

(i) Broadcasting.

(ii) Drilling with seed drill.

(iii) Dibbling behind country plough.

(2) Transplanting :

(i) Random transplanting (Popular Method).

(ii) Row transplanting.

(iii) Double row transplanting.

(b) Spacing

1. Varies with varieties. More spacing for long duration (20-25 cm. × 10-15 cm) and less spacing for short duration varieties (15 cm × 10 cm)

2. High plant density for high yielding varieties.

(c) Seed Rate

1. Heavy seed rate (110 - 140 kg/ha.) is adopted for broadcast method and a lower seed rate of 90-100 kg/ha. is used in drill method and 60 to 80 kg/ha. for dibbled sowing.

2. Seed rate is minimised in transplanting method. About 40–80 kgs. of seed is used to transplant a hectare. A quantity of 40 kgs. of certified seed is sufficient in the case of high yielding varieties for one hectare.

(d) Sowing Seasons

(i) Summer : April–May.

(ii) Monsoon : June–July.

(iii) Late Monsoon : August–September.

(iv) Winter : December–January.

(e) Seedling Production

(Nursery) :

(i) Dry nursery.

(ii) Semi-wet nursery.

(iii) Wet nursery.

(iv) 'Dapog' nursery.

(f) Age of Seedling

(i) One week for one month crop period.

(ii) In case, the planting is delayed, restricted water supply to the nursery prevents further tillering in the nursery itself.

viii. Fertilizers

1. Addition of organic matter and Farm Yard Manure improves the water holding capacity of light soils.

2. Traditional varieties lodge to higher dose of N. whereas dwarf photo-insensitive varieties respond well to high dose of fertilizers.

Double row planting in paddy areas method for increased yields

3. Grain yield response to phosphate is spectacular in low phosphate soils.

4. Full dose of P & K must be applied in the last puddling. However the response to split application of K may be significant in light soils.

5. Two split applications of N is a general rule for heavy soils where as 3 split applications of N to light soils, viz.

   (i) Basal.

   (ii) Tillering.

   (iii) Panicle initiation.

6. Rice absorbs N better in ammonical form and takes more quantities of N.

7. The response to K is limited in most Indian soils, but the increase in grain yield is significant in light soils.

8. The response to micro nutrients, either applied in foliar spray form or direct to the soil, has got little scope to increase the grain yield except where the soil, is deficient in micro-nutrients. In certain soils the response to Zinc application appears to be significant in case of high yielding varieties.

9. Calcium application to acidic soils reduces the floral sterility.

10. Blue-green algae fixes the atmospheric N in rice fields.

11. The rice plant requires high quantity of Manganese and has high tolerance to it. In submerged soils (Flooded rice fields) the availability of Manganese is free and if organic amendments are applied in large quantities the uptake of Iron increases and reduces the availability of Manganese and thus reduced yield.

12. Different doses of NPK are recommended for each category of soil by different State Departments of Agriculture. The following are general recommendations.

Fertilizer recommendation for High Yielding Varieties.	N 70–140 kg/ha. P 45– 75 kg/ha. K 35– 70 kg/ha.

13. Application of N in flowering stage increases the protein content of the grain and not the grain yield.

ix. Weed Control

(a) Cultural Methods

1. Weed infestation is severe in upland rice.

2. If planted in rows, interculitivation is done with push hoe or if drilled, with the same seed drill.

(b) Chemical Methods

1. Sodium or amine form of 2,4–D application 20–30 days after transplanting reduces the broadleaved weeds.

2. Stam-F 34 application @ 3 kg/ha. sprayed 2–4 weeks after sowing, or mixing one litre of stam F-34 in 3% urea solution, controls weeds in rice fields. For dicot weeds, ½ kg. of stam F-34 and ½ kg. of MCPA spray 3–4 weeks after transplanting gives good results.

3. Weedicide application should be done after draining the field and allowing the land to dry for two to three days after spraying.

x. Harvelting & Threshing

1. Harvesting is done by cutting the shieves with sickles. Reaper binders and combine harvesters are being tested at present in rice harvesting.
2. The cut shieves are allowed to dry in the field itself for some days and then transported to the threshing yard in the conventional method.
3. The shieves are hand threshed or threshed by Japanese thresher or by running the tractor over the shieves on a level ground.
4. The grain is then dried and winnowed.

xi. Yield

1. The size of grain, number of grains, length of the panicle, number of productive tillers, efficiency to N application, non-lodging co-efficient, resistance to pests and diseases are important plant characters which contribute to grain yield.
2. Dwarf varieties give more yield as compared to locally improved and traditional varieties.
3. Usually summer varieties give more yield.
4. Rice grown in upland gives less yield than the crop grown in low land conditions.
5. All India average grain yield 1968—69 : 10·76 Q/ha.

   National demonstration grain yield 1969—70 :

   Average : 55·37 Q/ha.

   Maximum : 128·00 Q/ha.

xii. High Yielding Varieties

1. Taichung (Native) 1

Dwarf Indian variety, native. of Taiwan. Cosmopolitan in adaption. Photo-insensitive. Highly responsive to heavy manurial doses. Susceptible to bacterial leaf blight. Duration: Kharif season 115 to 120 days; Winter season 135 to 140 days, yields more in summer. Grain yield: 5,000 to 6,000 kg/ha. Cropping area in all parts of the country dwindled due to poor grain and cooking quality.

2. IR-8

A dwarf and photo-insensitive variety. Released from Phillipines. Matures in 135 to 140 days. Grain yield: 6,000 to 7,000 kg/ha. Seed bold and semi translucent. Cooking quality fair. Susceptible to bacterial leaf blight, tungro virus and blast diseases. Suitable for entire country.

3. Jaya

High Yielding than IR–8. High response to heavy doses of fertilizers. Matures earlier by 10 days than IR-8 i.e. 125–130 days duration. Cosmopolitan in adaption except Kashmir valley, Himachal Pradesh and Hilly regions of Uttar Pradesh, West Bengal and Assam since it is thermosensitive. Grain Yield: 6,500 to 7,500 kg/ha.

4. Padma

Matures in 105–115 days. Grain quality superior to Taichung (Native) 1, Jaya and IR–8. Yield potential is 8% less than Taichung (Native) 1, Adapted to all places except hilly and Kashmir Valley areas. Susceptible to Tungro Virus and not suitable to Bihar, Coastal Andhra Pradesh in Kharif season, summer crop of Bihar and Boro crop of West Bengal and Assam.

5. Hamsa

Released in Andhra Pradesh. A cross between T (N) 1 and HR–12. Suitable in areas of cold temperatures also. Photo-insensitive dwarf variety matures in 110 to 130 days. Long slender grain with market acceptability. Grain Yield: 5,000 to 5,500 kg/ha.

6. Pankaj

Suitable for late sowing in kharif season of South Tanjore in Tamil Nadu, Krishna, Godavari Delta in Andhra Pradesh, Eastern Madhya Pradesh, Orissa and West Bengal. Matures in 140–150 days. Grain long bold. Average grain yield: 4,500 to 5,000 kg/ha. Cooking quality acceptable. Moderately resistant to bacterial leaf blight and moderately susceptible to stem borer.

7. Jagannath

Adaptable to Orissa, South Eastern Madhya Predesh, Coastal Andhra Pradesh, West Bengal low lying water logged areas. Matures in 140 to 170 days. Grain medium slender with good cooking quality. Grain yield : 4,000 to 4,500 gk/ha. Moderately resistant to bacterial leaf blight and moderately susceptible to stem borer.

8. Annapurna

Released in Kerala. A cross between PTB-10 and T(N) 1, A dwarf photo-insensitive variety with red Kernals. Matures in 95 to 105 days. Grain yield : 5,000 to 5,500 kg./hectare. Cooking quality superior to T(N) 1.

9. Karuna

Released in Tamil Nadu to replace the lodging ADT-27 variety. Lodging coefficint negligible. Matures in 110 to 120 days. Suitable for May planting. Grain Yield : 5,000 to 5,500 kg./hectare.

10. Sabarmati

Adaptable to Delhi, Haryana, Western Uttar Pradesh, Bihar, Chambal Canal area in Rajasthan and Madhya Pradesh. Cross between T(N) 1 and Basmati. Photo-insensitive, matures in 110 to 120 days. Grain Yield : 4,000 to 5,000 kg./ha. Non-cohesive after cooking. Reaction to bacterial leaf blight is similar to IR-8 and Jaya.

11. Jamuna

Similar to Sabarmati in adaption. It is also a cross between T(N) 1 and Basmati. Matures 7 to 10 days earlier than Sabarmati. Long slender grain with no scent, non-cohesive after cooking, slightly less yielder than Sabarmati. Similar to Sabarmati in pest and disease tolerance.

12. IR-20

It is a cross between IR-262 and TKM-6. Recommended for cultivation in East coastal areas, and Assam for monsoon season. Weekly photo-sensitive in both the seasons. Matures in 120-140 days. Moderate response to nitrogen. Tends to lodge at higher levels of fertilizers. Moderate resistance to tungro virus disease. Less resistance to stem borer than TKM-6. Medium slender translucent grain with high yield potential.

13. Bala

Developed at Central Rice Research Institute, Cuttack. It is a cross of N–22 and Taichung Native–1. Plant height is 95 to 100 cms. leaves upright. It is drought resistant, non-shattering with seed dormancy of 5 to 7 days. The variety is short, bold grain type with good cooking quality. It is drought resistant, susceptible to blight, moderately resistant to blast, susceptible to gall-midge and moderately susceptible to stem borer. Maturity 100 days in transplanting and 85 to 90 days in direct sown conditions. Yield potential 35 to 40 Q/hectare. The variety is suitable for non-irrigated areas of Uttar Pradesh, Bihar, Orissa, West Bengal and Assam.

14. Krishna

Developed at Central Rice Research Institute, Cuttack. It is a selection from the cross of GEB–24 and Taichung Native–1. It has plant height of 85 to 90 cms. profuse tillering and shows high photosynthetic efficiency. The grains are medium slender. The cooking quality is good. The variety is blast resistant helminthosporium resistant. It is moderately susceptible to blight, moderately resistant to stem borer and susceptible to gall-midge. Duration is 115 to 130 days. The variety is suitable for the Tarai area of Uttar Pradesh, part of Madhya Pradesh and Gujarat.

15. Ratna

Suitable for growing in Tamil Nadu, Andhra Pradesh, Punjab, Uttar Pradesh (Tarai), Assam, West Bengal, Madya Pradesh and Orissa. It was developed at C.R.R.I., Cuttack, from the cross of TKM–6 and IR–8. Plant height of 75 to 80 cms. with erect leaves. Highly resistant to lodging. It can tolerate drought and highly responsive to fertilizers. The variety is resistant to blast, leaf blight and helminthosporium, stem borer, and moderately resistant to gall-midge. Maturity 105 to 110 days. Due to short duration it can be included in multiple cropping pattern.

16. Vijay

Developed at C.R.R.I., Cuttack, It is a selection from the cross between T–90 and IR–8. Plant height 80 to 85 cms. with erect leaves. Resistant to lodging and shattering, good tillering and photoinsensitive. It has short, bold, long grains. It is highly responsive to fertilizers. The veriety is resistant to tungro virus, blast, stem borer, susceptible to bacterial leaf blight and gallmidge. It is superior to IR–8 in yield and matures in 135 days. Suitable for growing in West Bengal, Orissa, Andhra Pradesh, Mysore, Kerala, Bihar, Maharashtra and Gujarat. It is not adapted where there is shortage of water during the stages of plant growth.

17. Kaveri

Developed at the Paddy Breeding Station, Coimbatore, Tamil Nadu. It is a progeny cross between Taichung Native–1 and TKM–6. Plant height 85 to 88 cms. The plant is erect, resistant to lodging, frost and drought and high resistance to shattering. The grain is short, bold, and has a very good cooking quality. It is highly responsive to fertilizers. Matures in 100 days. The variety is susceptible to gall fly and blast. Suitable for early planting as in Uttar Pradesh and Tamil Nadu. Due to short duration it adjusts in multiple cropping pattern. Yield 40 to 50 Q/hectare.

18. Co-34

Developed at Paddy Breeding Station at Coimbatore. It is cross between Taichung Native–1 and Co–29. Plant height 84 to 87 cms. The plant is erect, non-lodging, resistant to shattering. The grain is bold with good cooking quality. The variety is highly responsive to fertilizers. It is susceptible to blast and bacterial blight. Maturity 110 to 115 days and yield potential 40 to 50 Q/hectare. Suitable for growing in Gujarat, Uttar Pradesh and Tamil Nadu. Because of its short duration, it is suitable for inclusion in multiple cropping pattern.

xiii. Nutritive Profile

1. The dwarf varieties are nutritively better than the local tall varieties.
2. The amino-acid profiles of rice are superior to wheat and maize.
3. ADT-27 is the richest variety in protein content so far developed in India.
4. The lysine content in IR-8 and Sabarmati are 3·01 and 4·00% respectively.
5. The exotic varieties are inferior in grain cooking quality.
6. The protein content ranges from 8 to 14%.
7. The losses of protein on milling is about 11%, whereas the losses of fat is 84·6% of the total content of grain.
8. The parboiled rice contains more of vitamins (Thiamine= 2·57 mg. per gm.) than the raw milled rice, (Thiamine= 0·6 mg. per gm.)
9. The coarse varieties are suitable for popping.

WHEAT

i. Adaptation

Temperate zones are best for wheat cultivation. Wheat is grown in cool season or at high altitudes in hot regions. Warm humid regions are congenial to pests and diseases. Winter sowing is successful in dry subtropical regions.

ii. Climate

1. Cool Season is essential
2. Frost infested areas are uncongenial.
3. High temperatures combined with humidity may encourage the spread of rusts and cause a reduction in yield.
4. Temperature requirements :

	Germination	*Growth*
Minimum Temperature °C	4	3–4
Optimum Temperature °C	20–22	25
Maximum Temperature °C	35	30–32

iii. Soils

1. Well drained medium to heavy soils produce good yields.
2. Soil pH range: 5·0 to 7·5.

Cultural Practices

Frequency of irrigation within days after sowing.

iv. Water requirements

1. 1st irrigation: 20—25 days (Crown root initiation stage).

   2nd irrigation: 40—45 days (Tillering stage).

   3rd irrigation: 70—75 days (Late jointing stage).

   4th irrigation: 90—95 days (Flowering stage).

   5th irrigation: 110—115 days (Dough stage).
2. Frequency and amount of water depends on type of soil, variety and winter rainfall.
3. Excessive irrigation results in water logging and encourages powdery mildew.

v. Land Preparation

1. Pulverised, weed-free seed bed ensures better plant population.
2. Fine tilth is obtained by ploughing and harrowing with

country ploughs, blade harrows, tractor drawn plough and disc harrows.

3. Presown irrigation a week ahead of sowing ensures good germination.

4. Broadcasting 25 kg. of BHC 10% dust or 17·5 kg. of chlordane 5% dust or 12·5 to 15·0 kg. of Aldrin per hectare prevents infestation by soil insects.

5. Incorporation of this chemical with a harrow helps better killing effect of soil insects.

6. Levelling the land with a plank or a tractor drawn superleveller helps in uniform spread of irrigation water.

vi. Seeding practices

A. Sowing

1. Drilling behind a country plough.

2. Drilling with a bullock drawn seed drill.

3. Tractor drawn seed-cum-fertilizer drill.

B. Seed rate

100 - 125 kg./ha. (Early sown crops).

125 - 140 kg./ha. (late sown crops).

C. Spacing

15 - 22·5 cm. between rows.
10 - 15 cm. within rows.

D. Seeding time

1. Early sowing results in early ear emergence without proper vegetative phase which consequently reduces grain yield.

2. If sown late, premature drying of plants is visible due to high temperature. For such late sown crops, selection of short duration varieties may reduce the adverse effect to some extent.

3. *Dwarf Varieties*	*Probable date of sowing*
Kalyansona Lerma Rojo P.V. 18	10th to 20th November
Sonora 64 Sonalika Sharbati Sonora Sonalika R.R.21	15th to 30th November

vii. Fertilizers

1. Nitrogen requirement is heavy. About 100 to 120 kg. of N/ha. in case wheat is sown after Jowar, Maize, Bajra, other cereal crops and 80 kg. of N/ha. if sown after leguminous crop or fallow.

2. Nitrogen increases yield, protein content, and sedimentation value.

3. Half the dose of N is applied as basal along with full dose of P & K and other half is applied just prior to first irrigation.

4. 50 to 60 kg. of P_2O_5/ha. is required to have a better yield in low phosphatic soils.

5. 40-50 kg. of K_2O/ha. may increase the grain yield if deficient in potash content.

6. If the soil is tested, recommendations should be followed.

viii. Weed Control

1. Cultural Practices

Removing the weeds by hand reduces the struggle for existence of

Farmers happy with their Wheat harvest

the plants and utilizes the plant nutrients effectively.

2. Chemical Control

(i) 1·2 kg. of a. e. 2-4-D dissolved in 700 litres of water is sprayed 4 to 6 weeks after sowing in one hectare of the cropped land.

(ii) Avoid spraying of 2·4-D before and after this period helps in preventing malformation of earheads.

(iii) Spraying with a low volume sprayer operated by a tractor will be more effective.

ix. Harvesting and Threshing

1. Harvesting in time helps in preventing grain losses due to shattering, birds and rodents.
2. Grain yield varies with varietes.
3. Threshing is done by olpad threshers or power threshers or thresher-cum-winnowers.

x. Nutritive Profile

1. The protein content varies from 11% to17%.
2. The triple gene dwarfs of U.P. 301 (16%) and Hira (14%) are richest varieties of wheat released so far in India, with regard to protein content.
3. Amber coloured grain is preferred in the market.
4. Chapati making quality is an important factor in breeding good varieties suitable to Indian conditions.

xi. High Yielding Varieties

1. Sonalika

This variety is a selection from wheat variety no. 308 introduced from Mexico and is a single gene dwarf. It was released by Indian Agricultural Research Institute, New Delhi, in 1967. This single gene dwarf takes about 125 days to mature and is suitable for normal to late sowing. The grain, in appearance Chapati making qualities, and resembles Indian Varieties. It is moderately resistant to leaf rust and under adverse conditions there could be some damage due to lodging. U.P. Agricultural University has purified and improved this variety into Sonalika RR-21. Yield upto 70 Q/ha.

2. Kalyan Sona : 227

It is an amber seeded, rust resistant selection with uniform plant type and grain characters. It is an improvement over S-227 and matures in about 135 days. This 2 gene dwarf is resistant to loose smut and leaf rust. It resembles Indian varieties in grain appearance and Chapati making qualities as it is amber hard grains. Yield upto 84 Q/ha.

3. Chhoti Lerma : Selection from S-331

Two gene dwarf variety with high resistance to lodging and shattering has been reported to be successfuly evading all the important diseases of wheat prevelent in the country. It is adaptable for all wheat growing area. It takes about 130 days to mature. Yield upto 60 q/ha. of white semi hard grains.

4. Safed Lerma

It is closely related to Lerma Rojo and has similar adaptability, maturity, disease resistance and plant type. The shape, size and texture of the grain too are similar. The only difference being that where as Lerma Rojo has red grains, Safed Lerma has white grains. It is one gene dwarf and suitable for normal sowing to all wheat growing areas of the country. It takes about 130 days to mature and is suitable for normal as well as medium late sowing. Yield upto 50-60 Q/ha.

5. Sharbati Sonora

This amber mutant of Sonora 64 has all the characteristics of Sonora 64 in plant type and behaviour. It can be sown upto first fortnight of January. This 2 gene dwarf, stiff strawed variety takes about 120 days to mature. Yield upto 50-60 q/ha.

6. U. P.-301

This three gene dwarf is resistant to lodging even under heavy rains and wind. It has amber coloured bold grains, richest in protein content 16% and ideal for Chapati making. It is the dwarfest 75 cm. of all the wheat varieties released so far. It takes about 135 days to mature. It can tolerate high dose of fertilizer and can give a yield of 50-65 Q/ha. Resistant to diseases and ideally suited for mechanical combining. Can be grown in Western Uttar Pradesh, Haryana, Delhi, Punjab, Tamil Nadu, Mysore and Andhra Pradesh.

7. Lal Bahadur (EA. 222-1)

Grain amber coloured, bold, lustrons - susceptible to rusts - resistant to loose smut, alternaria and Helminthosporium. Also resistant to brown wheat mite. Suitable for cultivation in Haryana, Delhi, Rajasthan and South-Western Uttar Pradesh, where rust is not prevalent. Height 60-75 cm. triple dwarf with profuse tillering. Matures 125-145 days. Resistant to lodging. Tolerates late sowing. Grain yield is about 50 Q/ha. Protein content 11·2 to 13·0%.

8. Hira (HD-1941)

Hira, developed by Indian Agricutural Research Institute, New

Delhi from the parents P-61 IV-132 ×Son 64, has recorded high yields in the north-western plains and also Jammu and Kashmir in the hills. High field resistant to yellow rust and tolerant to other diseases. It is non - lodging type and responsive to high dose of fertilizer. It heads in 90 days and mature in 140 days. The grain is amber, hard and medium long. This triple dwarf is recommended for all parts of country (high fertility, irrigated conditions) except Rajasthan. Yield 60 to 70 Q/hectare and high protein content of 14 per cent.

xii. High Yielding Varieties Suitable for Rain-fed Farming

1. Kalyansona

Suitable for all over country.

2. HD-1467

Suitable for Madhya pradesh, Gujarat, South-Eastern Rajasthan. Amber coloured grain.

3. HI-6-23

Suitable for central India. Attractive bold amber grains. 'Durum' variety.

4. NI-5439

Suitable for Maharashtra, Mysore and Andhra Pradesh.

5. Narbada-4

Tall wheat variety suitable for unirrigated areas. Yield 10 to 20 Q/ha.

6. A 9-30-1

is 'Durum' or macroni wheat suitable for dry forming regions of central India having low rainfall. Yield 10-20 Q/ha.

MAIZE

i. Adaptation

1. Can be grown between latitudes of 58°N to 40°s.
2. Raised from below sea level to altitudes of 12,000 ft. (3,660 Metres).

ii. Climate

1. Warm weather & diurnal high temperature in the growing season is ideal for good yields.
2. Susceptible to frost if it occurs after the plant attains a height of 15 cm.
3. Optimum temperature :

   21°C for germination.

   32°C for Good growth.
4. High temperature at tasseling stage is injurious.
5. It can thrive in high rainfall regions of 10 inches to 200 inches.
6. Hailstorms between jointing and silking stages cause severe yield reductions.
7. Photoperiod has got its influence in early growth of the crop.
8. Combinations of high temperature, low rainfall, low relative humidity, and high evaporation are conducive to low yields.
9. Cool nights reduce the rapidity of growth and thereby extend the time for onset of flowering.

iii. Soil

1. Well drained, fertile loamy soils give best returns.
2. Sensitive to poor soil aeration, when caused by excessive soil

water, poor tilth or impervious sub soil.

3. The pH preference is 5 to 8. The oplimum pH is 6·0 to 7·0.
4. The yield gets reduced adversely in highly acidic soils (pH less than 5·5).
5. Saline soils (pH 7·5 to 8·5) may produce average to good yields under irrigation.

iv. Water Consumption

1. The transpiration ratio varies from 261 to 445 depending upon seasons.
2. The highest water requirement is from tasselling to Kernel formation.
3. It can utilize soil moisture even at the depth of five feet at Karnel formation.
4. Moisture stress prior to silking reduces corn grain yields by 25%, at silking by 50% and after silking by 21%.
5. Root spread gets reduced when soil moisture tension increases from 1 to 12 atmospheres.
6. Drought tolerance depends on the stage of the crop at which it is experienced to drought and varietal characters.
7. The amount of water used in season is ordinarily 16-25 acre inches.

v. Land Preparation

1. Ploughing and harrowing should be done for getting a mellow seed bed of not less than 15 cm. deep.
2. Levelling with bullock drawn implements or super leveller helps in uniform irrigation.

vi. Seeding Practices

1. Seed rate : 15 kg/ha.
2. Methods of planting :
   (i) Hand Dibbling.
   (ii) *Dibbling* behind country plough.
   (iii) Sowing by maize planter.
3. Spacing : 75 cm × 25 cm.
4. Depth of planting : 3 to 5cm.

5. Sowing time

	Region	*Probable date of sowing*
(i) Kharif	North East Himalayan Western Himalayan Northern Plains Peninsular India	June — July.
(ii) Rabi	Peninsular India	October—November.
(iii) Spring	All over India	February.

vii. Fertilizers

1. Fertilizer Schedule

(i) Irrigated cropping:
N : 75 to 150 kgs/ha.
P_2O_5 : 45 to 90 kgs/ha.
K_2O : 0 to 75 kgs/ha.

(ii) Rain-fed cropping :
80 : 40 : 20

2. Time of Application

(i) Full dose of P & K and 1/3 of N as basal.

(ii) 1/3 of N when plants attain a knee hight (one month after sowing).

(iii) 1/3 of N, 2 months after sowing.

3. Method of application

(i) Basal dressing

(a) Band placement 5 cm. away from plant and 5 cm. deeper.

(b) When placed too nearer the soluble salts of chlorides nitrates etc. may delay germination or reduce plant population.

(c) When the soil moisture availability is limited from soil surface, the phosphorus is applied deeper.

(ii) Top dressing

Broadcasting or side dressing.

4. Other nutrients

(i) If soil is deficient in Zn, basal dose of Zinc sulphate @ 15 kg/ha ensures good growth.

(ii) If leaves present a pale green colour and plants stunted, foliar application of zinc sulphate @ 5 kg. with 2·5 kg. of lime in 1,000 litres, relieves the deficiency.

viii. Weed Control

(i) *Cultural method*

1. Two to three weedings and two intercultures are effective in controlling weeds.

(ii) *Chemical method*

1. Pre-emergence application of Tafazine @ 1·2 kg. per hactare.
2. The soil should not be disturbed for 3 weeks after application.

ix. Harvesting and Threshing

1. When the husk cover turns pale-brown and grains are too hardy by pressing with finger nails, the crop is ready for harvest.
2. Hybrids present a green colour even after maturity.
3. The cobs should be stripped off and dried.
4. Shelling is done either by beating with sticks or by maize shellers.
5. When the grain attains a moisture percentage of 22 to 25, it is ready for harvesting.

x. Yield Potential (Q/ha.)

Hybrid of Composite		Local	
1. Irrigated	Dry	Irrigated	Dry
75 - 100	30 - 37	25 - 37	8 - 10

2. (a) All India average grain yield 1968—69 : 9·997 Q/ha.

(b) Average grain yield recorded in National demonstrations 1969—70 } 38·55 Q/ha.

(c) Maximum grain yield recorded in National demonstrations 1969—70 } 74·30 Q/ha.

xi. Types of Maize

1. Sweet Corn.
2. Pop Corn.
3. Dent Maize.
4. Flint Maize.
5. Floury Maize.
6. Poddy Maize.
7. Waxy Maize.

xii. Nutritive Importance

1. Protein content of maize is 10 to 11%.
2. Improvement over the amino-acid content (Lysine) is made possible by introducing genes upto 4·2 gms. per 100 gms. of protein (Ganga-3 contains 1·6 gms. of Lysine).

xiii. Methods of Corn Breeding

1. Mass selection
2. Ear to row selection
3. Varietal Hybridisation

Types of Hybrids	*Percentage*
(a) Simple cross	(M×N)
(b) Three way cross	(M×N) (O)
(c) Double cross	(M×N) (O×P)
(d) Multiple cross	(M×N) (O×P) (Q×R) (S×T)
(e) Top cross	(M, N, etc. × open Pollinated type
(f) Back cross	(M×N) (M)
(g) Synthetic or Composite	Germ Plasm Complexion

BARLEY

i. Adaptation

Adaptation to all types of climates. Some varieties grow even at height of 15,000 feet. The crop is tolerant to drought. frost and alkali soil conditions.

ii. Climate

1. Withstands dry heat but does not tolerate hot humid climate.
2. Needs less water than wheat and oats.
3. Hot winds induce premature ripening.
4. High humidity may hinder the maturity.
5. Prematuring due to hot winds and high humidity affects the malting quality.

iii. Suitable Soil Types

1. Deep loams with pH 7 to 8.
2. Sandy soils tend to low yields.
3. Fertile soil tend to lodging, resulting in very low yields.
4. Tolerates moderate salinity.
5. Acidic soils are more sensitive.

iv. Physiology

1. Optimum temperature for germination : 20°C.
2. Minimum temperature for germination : 3° to 4°C.

3. Maximum temperature for germination : 28° to 30°C.

v. Seedbed Preparation

1. Loose seedbed is required.
2. Three to four ploughings with country plough. One ploughing with Iron Mould Board Plough. One Harrowing.
3. Ploughing with Mould Board Plough and Disc Plough is to be done in 2 : 1 ratio.
4. Harrowing with Offset Disc. Harrow and Gang Harrow in 1 : 2 ratio.

vi. Seeding Practices

(*i*) *Method of sowing*

Seed drilling.

(*ii*) *Depth of sowing*

2-3 inches (7·5 cms).

(*iii*) *Spacing*

9 inches apart in rows (22·5 cms).

(*iv*) *Seed rate*

Average 80 lb./acre (85kg/ha).
Delayed sowing : 120 lb/acre (120 kg/hectare).

vii. Time of Sowing

(a) Spring Season : March - April
(b) Winter Season : October-December

} Late Sowing results in low yields

viii. Irrigation

1. Presown,
2. 45–50 days after sowing,
3. 80–85 days after sowing,
4. Irrigation interval in lighter soils of peninsular India is 10 days.

} In irrigated areas of India.

5. No irrigation, if the crop is grown as rain-fed.

ix. Fertilizers

1. Similar to manuring of wheat.
2. Lodges to higher dose of N.
3. Responds to NPK under humid conditions.
4. Responds to top dressing with N in lighter soils.
5. Spring crop is remunerative in fertile soils.
6. Lesser than 30 lb. N/acre (30 kg. N/hectare) is desirable.
7. Addition of phosphatic fertilizers improves the quality of malting.
8. Higher N. reduces malting quality (brewing quality), P_2O_5 helps to neutralise this deleterious effect.
9. 22-25 lb. P_2O_5/acre (22-25 kg/hectare) is optimum.
10. Basal application of N or top dressing where plants attain a height of 6" improves the yield.
11. Foliar application of Urea N does not give higher yields.
12. 40 : 30 : 30 (NPK) is followed in India.
13. For acidic soils add 450 lb. lime per acre.

x. Weed Control

1. If weed infestation is severe, intercultivate once.
2. *Chemical weed control*
   (i) Spray 2, 4-D at 1·2 kg. acid equivalent/ha. in amine form.
   (ii) Tillering (6-8" tall) and jointing stages are optimum for spraying 2,4-D (4-6 weeks crop)
   (iii) If 2,4-D is sprayed on a crop of 1" to 5" tall or at

boot stage, malformation of the crop is seen and finally yield gets reduced.

(iv) Vegetative abnormalities are visible if sprayed at 5 leaf stage.

xi. Yield

1. More earheads per unit area gives better yield than more No. of plants.
2. Small seeded varieties yield better than large grain varieties.
3. In an experiment conducted in England, 290 grains sown per sq. yard resulted in the survival of 100 plants/sq. yard until harvest.
4. If sterility percentage is greater than 25-30, the reduction in yield is spectacular.
5. Average yield ranges 675-945 kg/hectare in rain-fed crop and double in irrigated lands (1,350-1,990 kg/hectare)
6. All India average grain yield 1968-69 : 879 kg/hectare.

xii. Harvesting should be done

1. When grain is ripened and become golden yellow, but still the straw is slightly green.
2. Early in the morning to prevent shattering.
3. Case of combine harvesting or by reaper binder.

xiii. Chemical Composition of Barley

Protein : 7·5 to 15·0%
Starch : 50 - 60%
Moisture : 10 - 20%

Mealy or mellow kerneles are high in starch. Translucent kernels are high in protein. Diastic power is a measure of the ability of the kernel to convert starch to maltose (malt sugar).

Diastic power is greater in small grained barleys because the scutellum is as large as other one.

Thin barleys contain high protein percent.

xiv. (a) Preference for Malting

1. Clean, bright, and free from foreign material.
2. Uniform, medium sized, mellow, plump kernel instead of very large or slender kernels. Straw coloured barleys indicate well ripened, free from damage due to weather, storage or disease.
3. High germination capacity.
4. High diastic power with 12% protein.
5. Under-ripe barley with green tinge is unsuitable for malting.
6. Average kernel weight and bushel weight association with malt extract.
7. Medium test weight desirable, 1·2 to 1·4% on dry weight basis.

(b) Malting, Brewing and Milling Processes

Malting

(i) Steeping Barley in water: 45-65 hrs. absorbing. 45-48% moisture.

(ii) Germination : 5-7 days at 60-70°F.

(iii) Drying of the malt.

xv. **Improved varieties**

RS-6

Developed by Department of Agriculture, Rajasthan, in the State Research Stations. It is a result of crossing RS-17 with NP-21. It is suitable for Rajasthan, Madhya Pradesh, South Western Uttar Pradesh. It has straight ears, shining golden grains with bluish tinge. It matures in 125 to 130 days. It is moderately susceptible to rusts and tolerant to helminthosporium, susceptible to aphids. It is high yielder, non-lodgiug widely adaptable under irrigated and rain-fed conditions.

IB-226

1. Gives 16% more yield than local varieties.
2. Suitable for rain-fed cropping.
3. Cultivable in Central India.

P-113

A stiff strawed variety suitable for Punjab, Uttar Pradesh, Bihar, Rajasthan and Delhi. Yields 57 Q/ha. under irrigated conditions with 26% increased yield over local.

RDB-1 : (Rajasthan Dwarf Barley-1)

It is a mutant from RS-17, height 65-70 cm. with erect dark green leaves and erect ears. Matures in 120-130 days. Non-lodging variety. Grain yield: 50-60 Q/ha.

Russian Barley E. C. 24882

Suitable for rabi sowings in arid zone of Rajasthan under irrigation. Matures in 70 to 75 days. Tolerates late planting and salty to saline irrigation water.

Ratna

It is highly adapted to eastern Uttar Pradesh and Bihar regions under rain-fed and irrigated conditions. It has bold and uniform type of grain with very light yellow coloured tinge. Developed by Indian Agricultural Research Institute, New Delhi, it has high degree of tolerance to loose smut and is moderately susceptible to yellow rust. It is medium tall (70 to 75 cms.) with board dropping leaves and long lax ears. It matures in 105 to 110 days in rain-fed and 110 to 115 days under irrigated conditions. It is highly drought resistant and highly tolerant to saline conditions. It moderately responds to fertilizers and is highly resistant to shattering. The variety is good for distilling malt.

Jyoti

Jyoti, developed by Uttar Pradesh Agriculture Department, is a result of cross between K-21 and C-251. It is suited for north-western and north-eastern plains. It is 80 to 85 cms. high, erect, vigorous, with good tillering. It takes 118 to 122 days to mature. It is susceptible to yellow rust, tolerant to brown rust and stripe and aphids. Fertilizer requirement is 40 kg. each of Nitrogen and phosphorus and and 70 kg. of potassium per hectare.

GRAIN SORGHUM (Jowar)

I. **Adaption**

Soraghum adapts well in hot and dry regions. It is a good drought tolerant crop.

II. Climate

	Germination	*Plant Growth*
Minimum temperature	7·3°C to 10°C	15·6°
Optimum temperature	21·1°C	26·6 to 29·4°C
Maximum temperature		48·9°C to 60°C

III. Soil

1. All types of soils with the pH range of 5·5 to 8·5 are suitable. Optimum pH range 6 to 7.
2. It can tolerate salinity.
3. In moist seasons, it produces highest yield on heavy soils & in dry season high yields on sandy soils.
4. It is sensitive to water logging.

IV. Land Preparation

(a) Rain-fed Cropping

1. Deep ploughing once in two to three years helps in better moisture conservation.
2. Harrowing thrice either by bullock drawn harrows or tractor drawn disc harrows conserves more moisture.
3. Weed-free seed bed helps in good plant population as the seedlings are small for several weeks after emergence.
4. Listing helps in better conservation of soil moisture.

(b) Light irrigated cropping

1. Dry-cum-wet cropping programme is localised in certain project areas.
2. Preparation of land is similar to rain-fed cropping.
3. Levelling is to be resorted by means of bullock drawn levellears, buck scrapers, floats or by tractor drawn levellers like multipurpose blade terracer, and super leveller.

(c) Irrigated cropping

1. This practice is followed in wetland areas of rice follows under assured irrigation facilities.
2. Land preparation is similar to other crops.

V. Seed Practices

(a) Methods of sowing

(i) Broadcasting

(ii) Drilling

(b) Seed rate

10-12 kg/ha. depending on spacing, moisture expectation.

(c) Seeding time

(i) *Rain-fed cropping*

July-August (Kharif).
October-November (Rabi).

(ii) *Irrigated cropping*

January-February.

N. B. : For rain-fed cropping the flowering time should not coincide with rainy period.

(d) **Spacing**

1. 45 cm. × 10 cm.
2. Narrow rows through better use of light, soil nutrients, and less weed population give high yields.

(e) **Depth of sowing**

3 to 5 cm.

(f) **Soil temperature**

Above 21°C is ideal for Sorghum germination.

VI. Fertilizers

1. Adopting manurial schedule:

   (a) For High Yielding Varieties: 100 N : 60 P : 40 K.

   (b) Rain-fed crop: 60 N : 40 P : 30 k/ha.

2. Copious supply of water after manuring helps in better absorption of plant nutrients.
3. P & K with half dose of N applied as a basal dose, increases the yield production.
4. Top dressing of N is to be done 30 days after sowing.
5. Top dressing of N can be done in rain-fed cropping when there is adequate moisture supply in the soil.
6. Higher plant population at higher dose of NPK with adequate moisture, results in higher grain yield.
7. Band placement of NPK fertilizer at root zone helps efficient use of plant nutrients.
8. Fertilizer schedule recommended in Kg/ha. for high yielding varieties.

	Minimum	*Maximum*
N	40	125
P	25	50
K	25	50

VII. Water Requirments

1. Even though Sorghum is a drought tolerant crop, it responds well to supplemental irrigation.
2. If the land is slopy, corrugated irrigation method is advisable.
3. Conservation of monsoon showers is essential in case of Rabi sowing of Sorghum.
4. Varieties of different maturity periods require different moisture levels.
5. **Irrigation Requirement**

Stage of crop	Approximate water requirement in inches per day
(a) Germination	0·05 to 0·1
(b) Late boot & Early heading stage	0·33
(c) Dough stage	0·25

6. *Irrigation is needed every 10-15* days or when 50% of available moisture is removed from top two feet.
7. Frequent irrigations are needed for sandy or shallow soils.
8. When the Sorghum plant enters the boot stage, the soil must be near field capacity. This is true for narrow rowed plants because water used by narrow row Sorghum is somewhat higher in early growth stages than it is for wide row Sorghum.

VIII. Weed Control

(a) **Cultural methods**

(i) Hand pulling

(ii) Interculture implements

(b) **Chemical methods**

(i) Atrazine or Propazine @ 5 kg./ha. in 900 litres of water before sowing.

(ii) Lower dose for late sown crops.

(iii) If seed is drilled, it is better to select harbicides of low water solubility, lest it gets concentrated in furrows resulting in Crop Damage.

(iv) Herbicides give the most satisfactory results on surface or bed planted sorghum when applied to seed beds free of clods, trash and weeds.

IX. Harvesting and Threshing

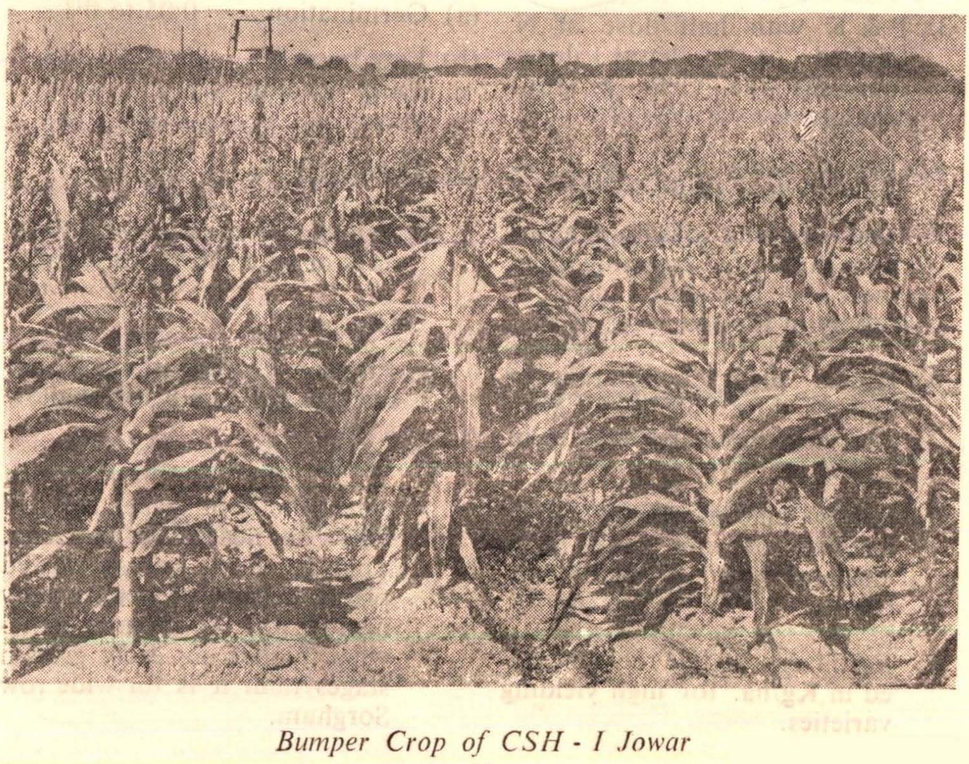
1. High yielding varieties will be green in colour even if matured.
2. Harvesting is done by sickles first separating the ears or by cutting the crop and then separating the ears.
3. Ears are dried in hot sun and then beaten with sticks or rollers or thresher-cum-winnowers to separate grain from ears.
4. Safe moisture storage level for sorghum grain is 11 per cent.

X. Grain Yield

All India average grain yield 1968-69 : 5·23 Q/ha

Average grain yield obtained in National Demonstration 1969-70 : 42·26 Q/ha

Maximum grain yield obtained tn National Demonstration 1969-70 : 95·00 Q/ha



Bumper Crop of CSH - I Jowar

xi. **Chemical Composition** *

Character	CSH–1	CSH–2	Local improved Strains.
Moistare (%)	10·9	10·8	9·9
Protein (%)	9·7	11·1	8·9
Fat (%)	2·8	2·2	2·5
Minerals (%)	1-7	1·5	1·8
Carbohydrates (%)	74·9	74·4	76·9
Calories/100 g	364	362	366
Calcium (mg/100 g)	34·3	—	32·0
Phosphorus (mg/100 g)	327·3	314·2	311·4
Iron (mg/100 g)	6·3	5·7	8·7

xii. **High Yielding Varieties**

A. **CSH-1**

(Co-ordinated Sorghum Hybrid-1)

1. It is particularly suited to the irrigated summer tracts of Tamil Nadu and Andra Pradesh and the early and medium duration Kharif areas all over India.
2. Its duration is 90 to 100 days and it permits multiple cropping such as jowar after rice or wheat or jowar.
3. In rabi season it requires 100 to 110 days. It is dwarf variety (140 to 160 cm) with long ears, and resistant to lodging.
4. Grains are cream pearly coloured and of satisfactory taste and nutritional quality.
5. Fodder is juicy and leafy.
6. It is susceptible to shoot fly and needs timely control measures.
7. Average grain yield is over 2,000 kgs/hectares under rainfed conditions and over 4,000 kgs/hectares under irrigation.
8. Maximum yield of over 6,000 kgs/hectare is possible under adequate fertilization and irrigation.

B. **CSH-2**

1. It is suited to mid late to late Kharif areas in the country. In Kharif season it requires 115 to 120 days to mature but in rabi season, it requires only 100 days.
2. It is taller than CSH–1 (150 to 200 cm) and slightly more subsceptible to lodging than CSH–1.
3. Grains are of pearly cream-coloured of good taste and nutritional quality.
4. It is susceptible to shoot fly, like CSH–1.
5. It yields upto 60 to 70 quintals per hectare under optimum conditions.

C. **Swarna**

1. It is a pure-breeding selection. Hence farmers can produce seeds for their use provided the seed plot is isolated from other jowar. It is adopted in early

* Source : "New Vistas in crop yield," ICAR, 1970, p 92.

duration Kharif areas all over the country.

2. It is suitable mainly for the area receiving annual rainfall of 25" to 30". In periods of drought and under less moisture conditions it's capacity to withstand is much better.
3. Plants are medium dwarf (120 to 150 cm) with juicy stalks, resistant to lodging.
4. Its duration is 100 to 110 days.
5. Grains are bold, creamy white, hard, roundish and of good taste.
6. It is tolerent to downy mildew but susceptible as CSH-1 and CSH-2 to stem borer.
7. Yield ability as in CSH-1 but Swarna is capable of benefiting from a larger plant population and then it out-yields CSH-1.
8. Swarna has done particularly well in black cotton soil areas of M.P., Mysore, Andhra Pradesh, and parts of Maharashtra.

D. 2291 × IS-3691 Hybrid

1. Suitable to all places of India with rainfall of 25"-30".
2. Variety is at present in pre-release multiplication stage by National Seeds Corporation.

E. CSH-3

Developed at Regional Station of the IARI, Coimbatore. It is suitable for cultivatiom during the kharif season for the assured rainfall areas of Maharashtra, Tamil Nadu and monsoon areas of Andhra Pradesh (Telangana Region) Malwa Plateau of M. P. and the Bundelkhand region. Matures in 100 to 120 days. It is resistant to rust and other leaf spot diseases, downy mildew. The hydrid is intermediate in maturity between CSH-1 and CSH-2. Yields 60 to 70 Q/hectare.

PEARL MILLET (BAJRA).

I. Adaptation

1. It is a crop of scanty rainfall regions, even in desert soils of only 5-7 inches of annual rainfall it can be grown.
2. However, it responds very well to irrigation.
3. It is a better crop on poor soils.

II. Soils

1. All types of soils are suitable.
2. Does not tolerate water logging.
3. Saline and alkaline soils are unsuitable.
4. The optimum pH range is 6·0.

III. Land Preparation

1. Smooth, clean, fine seed bed of 15 cm. deep is essential.
2. Ploughing twice or thrice or harrowing with bullock drawn or tractor drawn harrows.
3. Under light irrigation system or irrigated cropping, levelling, is to be resorted either by bullock drawn levellers, buck scrapers, float or tractor drawn implements like multi-purpose blade terracer, super leveller.
4. If ill-drained, drainage arrangements should be made.

IV. Seeding Practices

A. Sowing methods

1. Direct seeding

(i) Drilling.
(ii) Broadcasting.

2. **Transplanting**

(i) Furrow transplanting.

(ii) Random transplanting.

B. Seed rate

1. **Drilling or Broadcasting** : 5 kg/ha.
2. Transplanting : 3–4 kg/ha.

C. Depth of sowing :

Not deeper than 5 cm.

D. Age of seeding for transplanting :

20–25 days.

E. Spacing :

45 cm × 15 cm.

F. Seeding time :

1. Flowering should not coincide with rainy period.
2. Monsoon sowing : June–July. Winter sowing : January–February.

V. Fertilizers

1. Fertilizer schedule for high yielding varieties :
   N : 45 to 100 kg/ha.
   P : 20 to 80 kg/ha.
   K : 0 to 40 kg/ha.
2. The schedules vary from soil and State to State.
3. P & K with half dose of N have to be applied as basal and the half dose of N, 30 days after sowing or transplanting.

VI. Water Requirements

1. Furrow irrigation is suitable in wet-land conditions and border strip method of irrigation for light irrigated cropping.
2. If land is slopy, contour irrigation helps much.
3. Irrigation interval in sandy soils is one week and in heavy soils the interval is two weeks.
4. Irrigation is essential in critical periods of flowering and grain formation.

VII. Weed Control

A. Cultural methods

1. by hand,
2. by intercultural implements.

B. Chemical methods

1. a pre-emergence application of either Propazine (80% W. P.) or Atrazine (80% W. P.) @ 2·0 kg. per hectare will control weeds.

VIII. Harvesting and Threshing

1. When ears become matured, they are separated by sickles and allowed to dry.
2. Threshing is done by flailing with stone rollers.

IX. Grain Yield

All India average grain yield 1968—69 : 3·15 Q/ha.

National demonstrations (1969—70) grain yield: average 34·15 Q/ha. Maximum 67·10 Q/ha.

X. High Yielding Varieties

1. **HB–1**

This hybrid is characterised by vigorous growth, sweet stem, medium plant height (175 cm), profuse tillering and produces a large number of uniformly maturing earheads per plant. It is resistent to green ear disease, drought and high population pressure. Moderately non-lodging and requires 50 days to flower and 80–85 days to mature. Grains are of medium size and slate-grey coloured. It responds very well to irrigation good management and high fertility levels. It can give 40–50 quintals of grains and 70 to 80 quintals of fodder per hectare. It has wide adaptibility and recommended to all *bajra* growing areas.

2. **HB-2**

It is especially suitable for dry regions of Gujarat, Kutch and Rajasthan. Plants are 160 cm. high, leafy and remain green even at harvest. It matures earlier than HB-1 i. e. within 80 days. Grains are bold, medium sized, slate-grey coloured. It yields 20–25 quintals per hectare in rain-fed area and about 40 quintals in irrigated area.

3. **HB-3**

It can also withstand water scarcity and matures within 80 days. Plants are about 150 cms. height with juicy, leafy and non-lodging stalk. Ears are compact with slate-grey coloured medium sized grains. It is resistant to green ear, rust and to some extent to smut. Under inadequate moisture conditions it is capable to yield 25 to 30 quintals per hectare. It is recommended for rain-fed areas in Gujarat, Maharashtra, Mysore, Western Rajasthan and Eastern Uttar Pradesh. The grain size is 11% bolder than that of HB-1 and HB-2.

4. **HB-4**

Its plants are 200 cms. tall, but resistant to lodging with juicy stem and have uniform tiller maturity. Ears are long, rod shaped with greenish - yellow coloured, bold grains. Protein content in grains is high. It is resistant to green ear and moderately resistant to smut, rust, leaf spot and blast. It is recommended for Uttar Pradesh, Andhra Pradesh, Madhya Pradesh, Haryana, Tamil Nadu and parts of Rajasthan with assured rainfall to replace HB-1. It has out-yielded HB-1 by about 20% i. e. it can yield upto 60 q/ha.

5. **K-559 Hybrid Bajra**

Adaptable to arid conditions. Grain yield double than the local varieties under moisture stress conditions. 20% superior to HB-1 in yield and range of adoptation. Produces 31 kg. of grain per day per hectare.

XI. Comparative Performance of Hybrids with Local Varieties*

Variety	Average yield Q/ha.		Days to Maturity	Plant height in cm.	Ear Length in cm.	Grain Colour	Protein Percentage
	Grain	Fodder					
Local	15·14	72·04	86	176	Variable	Slate-grey	12·2
HB-1	21·01	64·67	86	177	19·0	Slate-grey	9·0 to 12·31 †
HB-3	25·39	67-19	81	159	19·3	Slate-grey with green tinge	9·3 ‡
HB-4	32·96	75·71	81	202	25·1	Greenish yellow	15·7

HB: * In limited moisture area.
† In assured moisture areas with 80 kgs. N/hectare
‡ Source: Indian Farming XIX 1969; pp 13–14.

FINGER MILLET (Ragi).

I. Adaptation

It thrives in a moist climate but not where there are very heavy rains in contrast to other millets. It can be grown even at altitudes of 6,000–7,000 ft.

II. Soil

(i) Tolerates salinity.

(ii) All types of soils are suitable.

III. Land Preparation

(i) Ploughing twice or thrice.

(ii) Weed free seed bed is essential.

IV. Seeding Practices

(a) Sowing methods

1. Direct Sowing.
   (i) Drilling.
   (ii) Broadcasting.

2, Transplanting.

(b) Seed rate

(i) 4—5 kg/ha. (Transplanted crop.)

(ii) 10—30 kg/ha. (Broadcast crop.)

(c) Age of seedlings

20—25 days.

(d) Spacing

12·5×15 cms.

V. Fertilizers

1. 75 : 37 : 25 kg/ba. of NPK is recommended dose.
2. Half dose of N and full dose of P & K are applied as basal and rest half dose of N is applied 30 days after planting.
3. It responds well to potash.
4. It responds well to FYM and sheep penning.

VI. Water Requirements

1. Under irrigated conditions, irrigation interval is 7 to 10 days in light soils and 15 days in heavy soils.
2. Irrigation is critical in flowering and grain formation.
3. Life irrigation is essential 3–4 days after planting.
4. One or two supplementary irrigation to rain-fed crop results in better yields.

VII. Weed control

(a) Cultural method

1. Coupled with hand weeding, intercultivation with a toothed harrow 20–25 days after transplanting helps in better plant growth.

(b) Chemical method

1. Either Fernoxone or Hedonal (M) at 3 kg. per hectare were effective in maximum control of weeds with least toxicity to crop when sprayed ten days after transplanting.
2. The herbicides are more effective during dry periods.
3. High dose results in malformations of floral parts and poor root system.
4. Pre-sown application is detrimental to the crop.

VIII. Harvesting and Threshing

1. Matured ears are harvested with sickles and heaped for 2–3 days in the threshing floor for threshing.

2. Threshing is done by flailing with the stone rollers or cattle treading.

3. The grain is winnowed, dried and stored.

4. For seed purpose, heaping, and flailing of the ears by stone rollers should not be done as otherwise the germination percentage gets affected.

IX. Grain Yield

All India average grain yield (1968–69): 736 kg/ha.

X. High Yielding Varieties

1. Purna Ragi

This is a fertilizer responsive variety. Uniformity is seen in ear maturity with non-shedding habit. Tolerates disease complex. Grain yield about 30 to 40 quintals / hectare under irrigated conditions. Matures in 100–110 days.

2. Hamsa Ragi (HR-1)

This is a white grained variety with high nutritional and high yielding traits. Suitable for both monsoon and summer seasons. Dwarf, erect, good tillering habit with more productive tillers, medium long and compact earheads densely set. Matures in 100–120 days. Grain yield about 30 to 35 Quintals/hectare.

3. Co. 7

It is brown seeded variety suitable for cultivation under

irrigation in parts of Andhra Pradesh, Tamil Nadu, Mysore. Matures in 105–110 days. Grain yield about 40-55 Q/hectare. The protein content is 7%.

4. **Co. 9**

It is a white seeded variety with high protien content of 11·8 per cent. Rich in phosphorus and calcium. Grain yield increase ranged from 20 to 140%. Matures in 103 to 105 days. Medium in height (78 cm). Responds well to high does of fertilizers. Grain yield is about 45 Q/hectare.

5. **Sarada Ragi**

Suitable for Eastern, Western and Southern India. Matures in 100 to 105 days. Yields 23% more than local best variety. Average grain yield: 27·20 Q/hectare.

HIGH YIELDING VARIETIES OF MAJOR FOOD CROPS AT A GLANCE

Name of the Crop & Variety.	Duration in days.	Expected grain yield (Quint./Hect.)	Suitability of Cultivation
1. **Rice**			
I. R. 8	135–140	60 to 70	All over India except Kashmir Valley, H. P. and hilly region of Uttar Pradesh, Bengal, Assam where cold temperature prevails from October onwards.
T (N)-1	115–120	50 to 60	A.P., Orissa, M. P., U. P., Maharashtra, Gujarat & Punjab.
Jaya	120–125	60 to 75	All over India except Kashmir Valley, H. P. and hilly region of Uttar Pradesh. Bengal, Assam where cold temperature prevails from October onwards.
Padma	110–115	40 to 45	Summer crop of Bihar, West Bengal, Assam, Coastal Andhra.

Name of the Crop & Variety	Duration in days.	Expected grain yield (Quint./Hect.)	Suitability of Cultivation
Hamsa	105–130	50 to 55	Andhra Pradesh.
Pankaj	140–160	45 to 50	South Tanjore, Krishna, Godavari delta, Eastern M.P., Orissa & West Bangal.
Jagannath	140–170	40 to 45	Orissa, South Eastern M.P.. coastal A.P., West Bengal low lying water logged areas.
Sabarmati	110–120	40 to 50	Delhi, Haryana, Western U.P., Bihar, Chambal Canal Command area in Rajasthan & M.P.
Jamuna	105–110	35 to 40	Delhi, Haryana, Western U.P., Bihar, Chambal Canal Command area in Rajasthan & M.P.
Karuna	110–120	50 to 55	Tamil Nadu.
Annapurna	95–105	50 to 55	Kerala.
I.R–20	120–140	50 to 55	East coastal area, Bihar & Assam.
Bala	90–100	35 to 40	Non-irrigated areas of U.P., Bihar, Orrissa, West Bengal and Assam.
Krishna	115–130	40 to 45	Tarai area of U.P. and parts of M.P. and Gujarat.
Ratna	105–110	35 to 40	A.P., Assam, Orissa, M.P.. Punjab, U. P. (Tarai) and West Bengal.
Vijay	130–135	40 to 45	A.P., Bihar, Gujarat, Kerala, Orissa, Maharashtra, Mysore and West Bengal.
Kaveri	105–110	40 to 50	Early plantings in Tamil Nadu and Uttar Pradesh.
Co–34	110–115	40 to 45	Gujarat, Tamil Nadu and Uttar Pradesh.

Name of the Crop & Variety	Duration in days	Expected grain yield (Quint./Hect.)	Suitability of Cultivation
2. Wheat			
Sonalika	125	60 to 80	Haryana, Delhi, U.P., Bihar, West Bengal, Orissa, M.P. A.P. ,Gujarat, Maharashtra, Tamil Nadu, Mysore and for thc late sowing in Punjab.
Safed Lerma	130	60 to 75	All Wheat growing areas.
Kalyan Sona	135	70 to 80	Well-adapted to timely sown conditions in all areas except Gujarat, Assam and South India.
Sharbati Sonora	120	60 to 65	Punjab, Haryana, Delhi & Western Uttar Pradesh.
Chhoti Lerma	130	60 to 65	All Wheat growing areas.
U. P. 301	135	50 to 65	Western U. P., Haryana, Delhi, Punjab, Tamil Nadu, Mysore and Andhra Pradesh.
Lal Bahadur (EA-222-1)	125–145	50	Haryana, Delhi, Rajasthan and South Western U. P. where rust is not prevented.
Hira (HD-1941)	135–140	60 to 80	North-Western wheat belt of India *i. e.* Punjab, Haryana, Western U.P., Delhi and Jammu & Kashmir.
3. Maize (Hybrids)			
Ranjit	100–110	45 to 55	Southern Rajasthan, Gujarat, and Maharashtra.
Deccan	105–115	50 to 60	Peninsular India.
Hi-Starch	95–100	55 to 65	major maize growing areas.
Ganga-101	100–110	40 to 45	Northern plains.
Ganga-Safed-2	100–105	65 to 70	White maize growing areas of Uttar Pradesh, Bihar, West Bengal & Rajasthan.

Name of the Crop & Variety	Duration in days	Expected grain yield Quint./Hect.)	Suitability of Cultivation.
Ganga-3	90–95	45 to 55	Northern Plains.
Ganga-5	100–105	45 to 55	Northern Plains,
Himalaya-123	105–115	55 to 65	Himalayan hills.
Maize			
(Composite)			
Sona	90–100	50 to 60	Punjab, Haryana, Western U. P., and Rajasthan.
Kissan	95–100	40 to 50	Eastern U.P., Bihar, Bengal and Orissa.
Ambar	110–120	60 to 70	Himalayan hills.
Jawahar	95–100	50 to 60	Northern Plains.
Vikram	90–100	50 to 60	Haryana, U. P. & Rajasthan.
Vijay	100–110	50 to 60	Punjab, Haryana, Western Uttar Pradesh.
4. Jowar			
(Sorghum)			
CSH-1	90-100	50 to 60 **(20 to 25)	Kharif areas all over the country.
CSH-2	115-120	60 to 70	Kharif areas all over the country.
Swarna	95-105	50 to 60 **(20 to 25)	All kharif areas, it has done well in black soils of M.P., Maharashtra, Gujarat and Mysore.
CSH-3	100-120	60 to 70	In assured rainfall areas: A.P. (Telengana), Maharashtra, monsoon areas of Tamil Nadu, Malwa Plateau of M. P., and the Bundelkhand region.
2219×IS-3691 Hybrid	(Pre-release multiplication stage by N.S.C.)		All over India with rainfall of 25″ to 30″.

N.B: ** Indicates yield expected under rain-fed conditions.

Name of the Crop & Variety	Duration in days	Expected grain yield (Quint./Hect.)	Suitability of Cultivation.
5. Bajra (Pearl Millet)			
HB-1	80-85	40 to 50	Low rainfall area all over the country.
H-B-2	80	40 to 50 **(20 to 25)	Suited especially for dry regions of Gujarat and Rajasthan.
HB-3	80-85	**(25 to 30)	For rain-fed areas of Rajasthan, Gujarat, Maharastra, Mysore, Eastern Uttar Pradesh.
HB-4	80-85	50 to 60	Madhya Pradesh, Uttar Pradesh, Haryana, Tamil Nadu, Andhra Pradesh and part of Rajasthan.
K-559 Hybrid Bajra	80-85	25 to 30	Suited especially for arid conditions.
6. Ragi			
Purna Ragi	100-110	35 to 50	High yielder under irrigated and heavy fertilization. All Ragi growing areas.
Hamsa Ragi (HR–1)	105-120	30 to 35	Both in monsoon and summer seasons in Ragi growing areas.
Co-7	110-120	40 to 55	Under irrigated conditions in Tamil Nadu, Mysore and parts of A. P.
Co-9	110-120	35 to 40	do
Sarada Ragi	100-105	25 to 35	Southern, Eastern and Western Ragi growing areas.
7. Barley			
RS-6	125-130	—	Widely adaptable, under irrigated and rain-fed conditions.
Ratna	105-110	—	Eastern U. P. and Bihar under irrigated and rain-fed conditions.
Jyoti	120-125	—	north - western and north-eastern plains.

N.B : ** Indicates yield expected under rain-fed conditions.

REFERENCES

1,	Dwarf Varieties of Wheat How to get High Yields.	1969	Escorts Farm Extension Series Booklet No. 1.	Escorts Limited Faridabad (Haryana.)
2.	Handbook of Agriculture	1969	—	I. C. A. R., New Delhi.
3.	Cultivation of Improved Rice Varieties.	In Press	—	To be released in 1971 by Escorts Ltd. Faridabad (Haryana) as part of Free Farm Extension Service.
4.	Cereal Crops	1968	Leonard, W.H. and Martin J.H.	Macmillian & Co., New York.
5.	Maize Hybrids & Composites–How to get High Yields.	1970	Escorts Farm Extension Series Booklet No. 2.	Escorts Limited Faridabad (Haryana).
6.	Punjab Agriculture Handbook	1970	—	Punjab Agricultural University, Ludhiana (Punjab).
7.	State Reports (20)	1970	—	Escorts Limited Faridabad (Haryana).

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WORLD CEREALS SITUATION

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Despite the successes achieved in several countries with high yielding cereal varieties over the past few years, advances in world food production continue to be small and hard-won.

Thus, the latest information available to the Food and Agriculture Organization shows that in the calender year 1969 total food production in all developing areas rose by only two per cent. Since population also rose about two per cent, per caput, food supplies had thus, not risen above the previous year's levels. In Africa, Latin America and the Near East, food production had hardly changed from the previous year and so per caput supplies actually fell.

In the Far East, food production rose four percent providing for an appreciable increase in per caput supplies over the previous year. India achieved a remarkable increase in food production of over five percent and the four percent rate of growth in Pakistan also represented a notable achievement. In both countries earlier progress had been maintained and food production in 1969 was about 20 per cent greater than previous two years.

The slackening in the rate of growth of food production, after promising crop results in 1967 and 1968 raise some important questions regarding the high yielding cereal varieties. FAO has repeatedly warned that, despite their remarkable success in a few countries, such as India, these varieties merely presented a hope, and not a promise, for a permanent improvement in the food situation of the developing world. This warning seems amply confirmed by the latest data. A recent FAO survey of progress in improvement of cereal varieties and of the extent of adoption of the high yielding types shows that out of 140 developing countries about 25 were using them on a large scale in 1968 and only one-third of these had also established adequate seed multiplication and other essential supporting services.

A number of factors hold down technical progress in this field. These include limitations imposed by climate and inadequate water control, unsatisfactory price and support policies, insufficient supplies of necessary inputs like fertilizer and insecticides, and the lack of adequate credit to finance these inputs. Furthermore, improved strains suitable for a wide variety of soils and climatic conditions, in particular for use on semi-arid rain-fed land, have not yet been developed on the required scale. In many countries, institutional and structural factors, such as traditional forms of land ownership and land tenure are additional factors delaying progress in food production.

Many of these handicaps will, no doubt, be overcome in time. Over the medium term, however, the present situation is not expected to change drastically. The Far East will continue to be the region where most of the progress with the high yielding varieties is likely to be made, although the extremely high growth rates initially recorded in wheat could not be expected to continue year after year. Further progress can be expected also in the Near East with the development and use of improved local strains as well as of imported varieties, both of which have already given good results in the past. For other developing regions, the available information does not suggest a major change in the cereal situation over the next few years, and in many countries, food production may barely keep pace with population growth. The improvement in yields will probably continue to be largest for wheat, as the areas sown to the new varieties expand and the use of fertilizer and other inputs on these crops is increased. Continued progress is also expected for rice, particularly since some of the earlier problems connected with quality and consumer acceptance seem to have come closer to a solution with the development of better strains. The lack of controlled irrigation on a large part of the total rice area poses problems of a different nature which it will be more difficult to overcome, although progress is being made also in this field.

Over the next few years, the effect on trade of the efforts of developing countries to accelerate food production growth will probably take largely the form of an increase in their self-sufficiency, rather than a rise in export availabilities. This is partly because Government commitment to the goals of stepping up food production is greatest in food deficit countries. The latest FAO review of the medium term food outlook, for 1973, forecasts a fall in the net imports of cereals into 16 major developing countries of 50%. Although the emergence of exportable surpluses of wheat as well as of rice in a few of these countries in years of particularly favourable weather cannot be ruled out, especially in the very large producing countries which are already on the border-line of self-sufficiency–this is likely to be the exception rather than the rule over the next two or three years. The impact on trade will probably be felt more on the commercial markets for rice than for wheat, since the Far East, where most of the improvement is expected to occur, accounts for more than half of world rice imports.

In the face of an apparently shrinking commercial import market for rice a situation could arise where supplies in developing countries could exceed effective import demand. Since Japan already possesses heavy surplus rice stocks, this possibility calls for greater efforts towards harmonisation of national production plans and policies.

Wheat import requirements of developing countries as a whole should continue to account for a substantial, through declining, share of world trade, but the upward trend in imports of those countries which do not grow much wheat themselves is likely to continue. Moreover, substantial fluctuations in production due to unfavourable weather in one or more of the large developing countries, might well give rise to unexpectedly heavy temporary requirements in addition to normal imports, at least part of which might have to be met by food aid.

Early indications for 1970 point to another large world wheat crop, although production may decrease in several major exporting countries. As there are no indications of a significant increse in world trade, competition between major exporters will remain keen.

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THE INDICATIVE WORLD PLAN FOR AGRICULTURAL DEVELOPMENT

Food and Agriculture Organisation of the United Nations

A. The General Strategy

1. The indicative world plan strategy for the progressive intensification of agriculture envisages use of quantity seed, fertilizer, pesticides and mechanical equipment and acclerated use of those elements to modern production technology in cunjunction with programes to develop land and water resources. On this will depend not only the crop production objective but also the attainment of satisfactory returns on investments in the development of physical resources and to an increasing extent the expansion of employment opportunities in agriculture and related industries.

2. Nevertheless, considerable differences in levels of use of inputs, and in the speed of their adoption are envisaged not only within countries, but within and between regions during the period covered by IWP. These differences relate first and foremost to differences in the potential for tapping new land resources, and to the pressure of population on the total quantum of physical resources which can be brought into productive use. In much of Asia, the Near East, and North Africa, more intensive use of existing resources represents practically the only road to meeting the production objectives. A gradual process of intensification is also likely to be necessary elsewhere, but because pressures are lower, the weight placed on purchased inputs as a means of dealeving objectives can be less, and their distribution between food and non-food crops is likely to be different, with less weight on the former than in areas facing serious problems of food supply.

3. The general aim of IWP policy has been to introduce purchased inputs in tune with the physical potential, the technical skill of the farmers, and the economics of their use on the dominant crops, but on an increasing scale of complexity over time until the optimum blend of complementarity is achieved. In so doing the " opportunity costs " of their use in relation to foreign exchange requirements, and the creation of employment have been important considerations and the possibilities of meeting demand by the expension of cultivated area and the use of labour as an input to raise productivity have been exploi-

ted wherever circumstances permitted.

4. However, human labour is seen as a substitute for material inputs only to a limited extent; since substitutability becomes less as production grows more intensive, and labour and cash inputs then *interact* to raise productivity per worker and per hectare. The role of material inputs is to raise the ceiling on the expression of the production potential by the removal of limiting factors and in this connection irrigation and drainage would also play a crucial role. For this reason irrigation operation and maintenance have been included in the recurrent costs of inputs, although the actual development programmes in land and water resources are discussed in Chapler 2.

5. In order to stimulate the rapid expension of input use required to achieve the production objectives, and to obtain the maximum benefits from complementarity of inputs, the IWP proposes that special "package" programmes be launched to spearhead development in certain key crops and areas, supported by reinforced credit and marketing services. In Asia, the Near East, and North Africa the main weight of such efforts would be directed to food and fodder crops, with particular emphasis on high yielding cereal varieties and multiple cropping systems in irrigated and "Class A" rain-fed land. In Africa, South of the Sahara, a number of important commercial crops, (such as oil palm, rubber sugercane, tea and tobacco), would receive priority and in some Latin American countries special programmes are likely to be required to improve pasture productivlty, in addition to those linked to the introduction of high yielding varieties and to export promotion.

6. The *total* annual expenditure on all current inputs under the plan would rise from US$4,735 million in 1962 to $17,203 million by 1985, an overall growth rate of 5·8 percent compound. The increase in inputs would be somewhat faster then that of gross output, so that the value of inputs as a percentage of crop value would rise from 11·8 percent in the base year to 19·2 percent in 1985. In addition there would be vast cumulative capital investments in tractor parks, workshops, fertilizer plants and so on. Although the establishment of domestic input manufacture wherever economically feasible would somewhat reduce fereign exchange requirements, the latter would still be a heavy burden, (although less than that of major food imports).

7. It is, therefore, of crucial importance to avoid waste and inefficiency in input use or manufacture in developing countries, and for this reason the IWP has stressed the need for most careful planning, and has proposed a number of supporting measures to ensure the effective employment of each input. Research to determine the optimum type, quantity, and method of application for fertilizer and pesticides, and the correct machine and mode of operation in the case of power equipment is accorded special priority: but well designed demonstration and training programmes both for farmers and for specialist opertors would be essential to incorporate the lessons of research into farm practice. A major increase in credit, and an improvement in credit services, would also be required, and in some areas additunal incentives such as transport subsidies might be ncessary to get agriculture moving.

8. Because of differences in the physical potential for effective eco-

nomic use of inputs, and because the inputs themselves and the trained technical personnel needed to teach farmers their successful use are usually scarce and expensive resources, the IWP advocates a selective strategy for input distribution between crops and areas of high and low potential, in a way which would achieve the greatest overall benefit to the economy. Where potential for raising productivity through use of cash inputs was low, emphasis would be placed on labour and the use of improved varieties and cultural techniques as a means of increasing output, but parallel efforts in training farm population for work in other sectors, and the creation of employment opportunities outside agriculture might have to be undertaken to avoid widening income disparities with better areas.

9. Considerable emphasis is placed on concorded and balanced action at all levels in the production and use of inputs since this can also offer advantages in economy and efficiency. International co-operation to standardize quality and safeguard end-users of inputs is one aspect, but the plan stresses the need for greater assistance from governments and industries in advanced countries to all aspects of research and development of input use in Zone C countries, including loans for purchase of inputs or to establish domestic manufacture. A vast market potential exists in the developing countries so that this could be regarded as enlightened self-interest! In the longer-term a mueh greater dcgree of co-operation between developing countries in the manufacture of inputs is envisaged, either through individual agreements, or through group action.

10. The plan also highlights the need for symbiosis within countries between the public and private sectors. The provision of the necessary funds and technical services for the rapid increases in input use proposed in the plan would throw a heavy burden on governments if it had to be supported entirely by the public seetor, and whilst government services are expected to play the leading hand in *initiating* input use, the plan considers the increasing participation of the private sector to be indispensable. This would involve not only action by commercial enterprise in relation to distribution and promotion of input use, but also co-operative or group action by farmer in production, purchase, and use of inputs.

B. Policies and Objectives for Specific inputs

11. In interpreting the IWP proposals for specific inputs it is essential to recognize the weakness of the planning base partly because of inadequacies in present statistics on consumption and partly because the methodology for determining future requirements is still in a formative stage. There is clearly an important field for research here, and one in which developed and developing countries could fruitfully cooperate. The IWP represents a pioneering enterprise in this aspect of agricultural development, and the figures must be regarded in this light.

1. Seed Production and Distribution

12. The need to develop efficient seed organizations has been given special priority in the plan because so much depends on providing adequate quantities of genetically pure seed of the high yielding varieties.

13. Whilst adequate arrangements often exist for production of sufficient *quantities* of seed (particularly of

cereals), relatively few countries are able to provide such seed to farmers at adequate standards of *quality*. To do this is a much tougher task than merely bulking up seed, requiring a high degree of specialization, and considerable capital and recurrent expenditure. Failure to appreciate that the development of an improved variety is only a first link in the chain and needs to be backed by a properly equipped and staffed seed production and distribution programme is a basic reason for lack of impact of improved varieties on crop yields.

14. The IWP proposes a series of measures to provide a suitable framework for the production of basic and certified seed in sufficient quantity to replace a calculated proportion of farmer's seeds of the key annual crops at regular intervals, and to standards of quality which would ensure adequate genetic purity, vigour, and freedom from disease or mixtures with undesirable seeds. Programmes would be initiated with priority crops presenting relatively straightforward problems of production, processing, storage, and distribution, i.e. self-pollinated cereals (wheat, barley, rice), pulses and certain annual oilseeds, progressively widening the scope with increasing experience to include hybrid seeds, vegetables, and bulky crops such as potatoes and groundnuts. Importation under appropriate guarantees of quality might be looked on as an interim solution whilst a seed organization was built up. The IWP envisages considerable opportunities for agreements between developing countries in the provision of seed, but this would require conformity to international seed regulations.

15. In addition it is emphasized that parallel steps need to be taken to provide nursery stocks of high yielding planting material for perennial crops such as rubber, tea, cocoa, coconuts, oil palm, olives, and fruit trees. In many countries there is a bottleneck in supply here, whilst standards of quality and hygiene in tree nurseries are often deplorable. However, it did not prove possible to quantify requirements for these crops as was done in the case of annual crops, for lack of data on present capacity.

16. The IWP recommends that private enterprise should be encouraged to play a progressively more active role both in respect of quality seed supply and the provision of improved planting material. The total value of certified seeds to meet calculated requirements would be nearly US$900 million in 1985 (roughly 40 percent of total value of all seed to be utilized by farmers), and this should provide a major incentive to the private sector. Greater private participation would release government resources for research, and for action to regulate and improve standards of production.

17. However, because of the considerable capital costs of providing an efficient service, adequate price incentives and credit would have to be given to encourage seed firms of the right type, as well as to farmers producing seed (whether for government schemes or for private firms). Both because of their important bearing on future production and their specific nature, seed production programmes appear particularly well suited to support by international financing agencies.

2. Fertilizers

18. Fertilizers are the key to modern agriculture, and as such are expected to play on increasingly

important role in all developing countries. Expansion of fertilizer use is foreseen not only for food and industrial crops, but in some regions also for grasslands, and for irrigated pasture and fodder production.

19. Very fast rates af growth are proposed for fertilizer, particularly in the first period of the plan, when an overall annual increase of 14·3 percent compound is composed. Whilst this might seem exceedingly optimistic it is not, in fact, much more rapid than that in the recent past which averaged 12·7 percent, but which in some countries has reached 25 percent. Total value of fertilizer applied would rise from $664 million in 1962 to $7·8 billion in 1985, 45 percent of the total value of all current inputs in that year.

20. In the immediate future it is expected that the strongest impetus for increased fertilizer use will come from the continued expansion of area under fertilizer responsive high yielding varieties of cereals, and of improved planting material for perennial export crops. The expansion of irrigated area, and of area under multiple - cropping systems is likely to provide a basis for the longer-term growth of fertilizer consumption. Improvements in fertilizer distribution systems, subsidies, and guaranteed prices for some selected products are also expected to stimulate consumption as they have done in countries which have experienced the most rapid increase in fertilizer use since 1962.

21. The increases proposed by IWP would result in an average per hectare use of 60 kg. by 1985, compared with only 6·7 kg/ha in 1962. Even this would be well below levels currently achieved in the more agriculturally advanced countries, and considerable scope remains both for increasing area fertilized and leavels of use per hectare.

22. Although the IWP proposes a considerable expansion of domestic production of nitrogen and phosphate in the developing countries as a whole, a cautious approach is advocated in the smaller countries. To meet total demand of 26 million nutrient tons of NP by 1985 would require an investment of approximately $12,000 million, with a fairly high foreign exchange component of over 50 percent. The employment creating capacity of fertilizer industries is not high in relation to capital requirements compared to many other industries, and if economies of scale could not be achieved the farmers would have a high priced product with litte compensation to the economy as a whole. Unless intra-regional manufacturing agreements can be reached it is, therefore, suggested that smaller countries should continue to import until they have built up sufficient internal demand, possible until after 1975. This would also enable them to utilize the latest manufacturing techniques.

3. Crop Protection

23. The provision of an assured water supply and freedom from deep flooding, combined with quality seed of improved varieties and adequate supplies of fertilizer, are first essentials for the transformation of traditional agriculture. However, experience in countries which have travelled a considerable distance along the road towards a modern intensive agriculture shows that once high yielding varieties and multiple-cropping are adopted on a wide scale together with irrigation and complementary inputs, pest and disease problems begin to

escalate, and can become a major limiting factor to further increases in productivity.

24. The IWP, therefore, considers that an expanded campaign to prevent losses from crop diseases, insect pests, weeds, and other destructive forces such as rats, will have to be launched if the production objectives are to be met. The loss of potential production in the developing countries has been estimated at US$50 billion in 1965, more or less equal to the proposed increase in the value of crop output between 1962 and 1985 to meet IWP objec tives. Under the more favourable environment provided for pest attacks by the intensification of agriculture, losses could well represent a much higher proportion of production by 1985 if more attention were not paid to control measures. Looked at in this light the proposed annual expenditure of $2,000 million by 1985 (although ten times that in 1965) must be regarded not merely as a cheap insurance policy, but as a necessity for maintaining a fast rate of growth in crop production.

25. Particular emphasis is placed on treatment of cotton, sugar crops. and beverages in the export and industrial sector, and on rice, maize, sorghum and groundnuts amongst foodcrops. Not only are these crops of major economic or nutritional significance, but they are also amongst the most widely attacked by pests and diseases. Fruit and vegetables being produced for export, processing or urban consumption also receive high priority in the plan.

26. For cereals and pulses *seed treatment* is considered to be of special importance because of the ease of application and high benefit : cost ratio. Protection against storage pests and diseases, including prevention of rat damage is also accorded priority for these crops. However, such measures would generally have to be supported by treatments during the growing season. The main emphasis here is placed on insect control, although for certain crops (including potatoes. tea, and bananas) application of fungicides assumes major importance. Chemical weed control has spread rapidly in developed countries, but the IWP proposes that its use in developing countries would be confined to crops or stages of growth where handweeding was difficult (wheat, barley or broadcast rice) or labour was tied up with other tasks.

27. Although in the immediate future no effective alternative to the use of chemicals appears possible for many, majar pests and diseases, an important long-term role is foreseen for the integration of biological and cultural methods of control with chemical measures, The plan draws attention to the potential short and long-range toxic hazards of many of the chemicals in current use, and stresses the need for enhanced research to develop cheap and effective crop protection products and methods of application which would neither present risks to the user nor contaminate the environment.

28. Whilst few developing countries have industrial capacity for the synthesis of technical crop protection materials, the IWP proposes that every effort be made to estabish local industries for *formulating* and packaging agricultural pesticides in order to avoid importing bulky formulated products with a high content of inert matter. Foreign technical and industrial expertise could be particularly valuable in guiding developing countries as to imports of suitable technical grade materials, and methods of formulation to meet their main needs. In the past crop

protection has been a relatively neglected field for international or bilateral aid ; the IWP recommends that it be given much greater weight in future programmes.

4. Agricultural Mechanization

29. Agriculture in the developing world as a whole is seriously deficient in power to work the land, especially at critical periods when time is all important, such as seed-bed preparation, sowing and harvesting. Although additional inputs of human labour and better animals and animal draft equipment are expected to contribute more to the total pool of power during the plan period, a wide gap between availability and theoretical requirements would remain. To bridge this gap, and facilitate the higher yields and cropping intensities necessary to meet the plan objectives, power mechanization will have to be adopted on an increasing scale.

30. The IWP recognizes that mechanization generally saves labour. at least for the operation involved, and considers that this issue must be faced squarely in planning a strategy for the wider use of tractors and related equipment in developing countries. A gradual and selective expansion is, therefore, proposed concentrating especiality on tasks which cannot effectively be done by other means (for example, land clearance and certain crop protection tasks), or which would raise yields (timely planting, adoption of "dry farming" cultivation techniques in low rainfall, pumping irrigation water), or facilitate more intensive land-use (removal of sowing and harvesting bottlenecks in areas suited to multiple-cropping, elimination of follow in class A rain-fed land). By these measures it is believed that mechanization would help to *increase* labour requirements overall, since manpower released from one operation would be utslized for others for which it was better suited within the farming system as a whole—for bettcr weeding, more frequent crop protection operations, pruning, more careful irrigation, improved marketing of produce, and integration of crop and livestock enterprises.

31. In addition mechanization would also provide work outside farming for maintenance and spare parts services, for rural workshops for manufacturing parts, tools, and the simpler kinds of implement and eventually for domestic manufacture of farm machinery.

32. The IWP proposals would result in an annual growth of tractor numbers over the period 1965—85 of 3 percent compound in North Africa, 3·9 percent in Latin America, 4·8 percent in Africa, 6·2 percent in the Near East, and 13 percent in Asia. In Asia two–wheel "motor cultivators" would also increase rupidly—at nearly 20 percent annually. By 1985 a total of 3,15,000 four—wheel tractors would be required to meet *annual* needs for new machines and replacements, of which 59 percent would be in Asia, and 30 percent in Latin America. The cumulative investment involved over the plan period in those two regions alone would be US$37 billion. Current inputs for operation and maintenance would rise overall at 5·3 percent per annum to a total of $2·6 billion by 1985.

33. Differences in the growth rates proposed are related partly to present levels of mechanization, which are highest in North Africa and Latin America, partly to the existence of suitable conditions for mechanization, (both physical and institutional), and partly to the

degree of urgency. Thus, in the Andean and Amazon rain forest areas of Latin America, and in Equatorial Africa, only a slow rate of mechanization is anticipated : whilst in the Class A rain-fed and irrigated areas of the Near East and South Asia, and in much of South-East Asia where intensive cropping is feasible a faster rate of growth is proposed. However, even the very high rates of expansion foreseen in some Asian countries would still leave serious power deficiencies. In India sufficient mechanical power would be available to cover only about 20 present of the area to be cultivated (compared with an estimated 1 percent in 1965), and the vast population of draft animals would not be diminished. The design of improved animal draft equipment and its production at prices acceptable to the smaller for-

Pusa Giant Napier, a high yielding fodder grass.

mers would be an important aim of agricultural policy in many developing countries, but particularly in Asia and Africa.

34. To obtain the maximum benefits from power mechinization as well as to facilitate the adoption and use of machinery by farmers, the plan stresses that certain conditions must be fulfilled. Of these, the most important are to provide conditions for efficient economic operation; to ensure that tractors and implemants in use are earlly suited to their working environment; and to develop the servicing and spare parts organization which will give reasonable assurance of a long working life, provided machinery operators are adequately trained.

35. A considerable increase in multi-farm use of tractors and equipment is foreseen as a means of developing economic operation and efficient servicing and maintenance; and here the private sector, through the establishment of contracting service is expected to play the main Government action will be necessary to stimulate such operations, and also to assist the private sector in providing satisfactory dealer service. It is considered advisable, at least in the early stages of mechanization, to restrict the number of makes and models imported in order to facilitate servicing and training of drivers and mechanics. Despite the high foreign exchange component involved, it is not envisaged that many countries other than a few in Asia and Latin America would be able to undertake domestic manufacture before 1985 for lack of a large enough market and the necessary supporting industrial infrastructure.

SUMMARY OF ROCKEFELLER FOUNDATION ACTIVITIES IN AGRICULTURE IN INDIA

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The Rockefeller Foundation's Indian Agricultural Program came into legal being in April 1956 when a Memorandum of Understanding was signed by the Government of India and The Rockefeller Foundation. This agreement provided for cooperative efforts in developing a postgraduate school in agriculture at the Indian Agricultural Research Institute, (IARI), New Delhi, and for cereal improvement research with particular emphasis on hybrid corn, sorghum and millets, and subsequently extended to include wheat and rice. As a result of the progress in the cereal improvement programs, the Foundation became involved in seed production activities, primarily through the National Seeds Corporation and more recently the new Division of Seed Technology at the I. A. R. I.

Under this Memorandum of Understanding the two principal phases of program - research and postgraduate training - have been conducted in close interrelationship. The Government of India and the Foundation have specific responsibilities in all of this cooperative work.

The Government of India on its part arranges for the necessary land and facilities and the budget for local staff and for recurring costs of the program.

The Foundation assigns to the program permanent staff members, who are speclalists in agricultaral research and education, and appropriates funds for certain items of equipment and library materials. There are now 11 permanent Foundation staff members assigned to this program, who are resident in India. In addition, a limited number of well-known scientists from the USA serve as temporary staff members in the capacity of visiting professors with the Post Graduate School and as consultants in the crop improvement work. Further, a number of temporary appointments are filled by young men on one or two-year post-doctoral assignments. An important aspect of the Foundation's contribution is the in-service trainning provided by having a limited number of young Indian scientists directly associated with the staff members of the Foundation through temporary appointments.

In additon to the cost for providing the services of its staff members resident in India, the Foundation has appropriated annually sums of the order of $ 2,00,000 to $ 4,00,000 for equipment and other expenses in direct support of the field operating program. The Foundation has also made grants to selected agricultural institutions in various parts of India, and provides scholarships for a limited number of Indian scientists to pursue postgraduate and postdoctoral study and research in the USA each year.

Emphasis is being placed on training for scientific research and teaching, on development of leadership in agricultural sciences, and on strengthening and improvement of the institutions concerned.

Graduate Education in Agriculture

The initial and principal focus of the Foundation's participation in graduate education in agriculture in India was the Post Graduate School at the Indian Agricultural Research Institute. However, through the All-India Coordinated Cereal Improvement Projects attention is directed to Agricultural Colleges and Agricultural Univei ties in the States.

A demonstration plot of medium dwarf hybrid bajra in IARI, Delhi

The Post Graduate School at the Indian Agricultural Research Institute was inaugurated in October, 1958. There are at present over 400 post graduate students in residence, about half of whom are candidates for M.S. degree and the other half for the Ph. D. degree. The 1,000th student received his advanced degree at the IARI Convocation in 1969. The institute has autonomous authority for developing its instructional program and granting of degrees.

The Instructional program has been developed along a pattern similar to that followed in American Universities. Formal courses are organized on a trimester basis, and the individual instructors are primarily responsible for the assessment of progress of the student in their respective courses. Each student's program is planned with an advisory committee consisting of representatives from his major field of studies and from the supporting minor fields. External examiners are brought in to work with the local staff members in the comprehensive examinations, and in the assessment of the students' theses. Students have been admitted from all States of India and several other countries.

Cereal Crop Improvement

Cereals constitute the major share of India's food. Adequate increases in production of these crops, with a concomitant improvement in nutritional quality, can overcome the country's food deficit in large measure. All-India Coordinated Cereal Improvement Projects with a multi-discipline approach have been established to provide the improved varieties and associated technology to permit this increased production of higher quality cereals. These projects, sponsored by the Indian Council of Agricultural Research, are jointly planned, financed and operated by ICAR and State institution.

Since the inception of the coordinated cereal improvement projects emphasis has been placed on a teamwork approach. It is recognized that it is not enough just to develop strains or hybrids of cereals that have a high-yielding potential. It is equally important to have corresponding results and materials that permit effective utilization of the improved crops. These include control measures for disease and pests, and information on cultural practices such as fertilizer requirements and water management.

The importance attached to an interdisciplinary approach is reflected in the research program of the cereal improvement projects and the specialization of the scientific personnel provided, or to be provided. It is also reflected in the composition of the specialists provided by the Rockefeller Foundation. Included in the latter are several plant breeders, a plant pathologist, an entomologist, an agronomist-soil scientist, an agricultural engineer, a seed specialist and an agricultural economist.

Maize

The coordinating headquarters of the Maize Improvement Project is located at the Indian Agricultural Research Institute, and research is conducted at 17 stations in the country representing different ecological zones. Breeding materials have been introduced from all maize-growing areas of the world and evaluated for performance under Indian conditions. In 1961 four hybrids namely, Ganga 1, Ganga 101, Ranjit and Deccan were released from this program and put into production. Three additional hybrids were approved for release in 1963 and to date a total of ten hybrids have been released. Additionally, six composite varieties were released to growers in 1967.

Under good cultural practices the hybrids have the capacity to yield up to 50% more grain than local varieties commonly grown under the same conditions to these areas. Further, they have been developed with a grain type and quality which are acceptable to Indian cultivators, and they are developed from inbred lines which are sufficiently vigorous and well-adapted to permit dependable seed production under Indian conditions. Some of the composites have demonstrated a yield potential approaching that of the best hybrids and further improvement of these plus several other composites is in progress by the use of several breeding procedures. Considerable emphasis is being placed on incorporation of the Opaque 2 and Floury 2 genes for improvement of the nutritive quality of the grain since these contribute to better protein balance in the maize grain.

Less than 40 hectares of double cross seed production were carried out in 1961 and 454 in 1962. The approximate area under hybrid maize for 1968-69 was 3,95,000 hectares.

There are about 5 million hectares of maize in India. The U. S. Agency for International Development is likewise intimately involved in the seed production and in the educational and demonstrational work which form a part of maize improvement through their APP extension programs.

Sorghum

More than 16 million hectares in India are devoted to the cultivation of sorghum. Under the cooperative program with the Government of India and the Indian states. a systematic program of collection and evaluation of the various varieties of sorghum grown in India was undertaken. In addition, a large number of varieties have been introduced from Africa, the USA and certain other countries. The total collection, consisting of some 10,000 entries, has been planted at several locations in India, and has been made available to sorghum research workers in other countries.

Under the Coordinated Sorghum improvement Program uniform varietal tests have been established in various parts of India and a systematic program undertaken for selecting and proving the most productive and useful varieties for Indian use. The more promising ones are being crossed on to male sterile lines to produce hybrids with potential for higher yields and better performance under local conditions.

Two hybrids CSH-1 and CSH-2 were approved for release in 1964 and 1965. These hybrids are, to a considerable extent, photo-period insensitive, and perform well from the southern tip of the country to Punjab in north. Yields up to six tons per hectare have been obtained under good cultural practices. An improved variety "Swarna" has been released and shows much promise. The estimated area under these high yielding sorghums in 1968—69 is 6,80,00 hectares. The shootfly and stem borer are serious pests of sorghuuı and efforts are being made to identify and utilize sources of resistance from the world collection.

A progressive farmer in Maharashtra with his hybrid Sorghum crop CSH-1

Millets

Collectively millets constitute an important group of cereals in the country. The estimated area and production for 1966—67 were 16 million hectares and 7·5 million metric tons, respectively. The two most important millets are *bajra (Pennesetum typhoides)* and *ragi* (*Eleusine coracana*). Bajra alone occupies around 10 million hectares.

Research activities of the All-India Coordinated Millets Improvement Project produced two hybrids which were released in 1965 and 1966 making use of male sterile seed parents developed by Dr. Glenn Burton at the U. S. D. A. station in Tifton, Georgia. Since then additional hybrids have been developed and released. Although traditionally bajra is grown in low rainfall areas and under relatively low levels of management, the new hybrids bid to receive more prominent attention. Under good cultural practices yields of 3-5 tons of grain per hectare have been obtained. Approximately 7,36,000 hectares were seeded with hybrid bajra in 1968—69.

Dwarf lines of bajra look very promising and prospects seem good for early development and release of high yielding dwarf varieties and hybrids. This crop in the dwarf form would seem to land itself for use under intensive rotations.

Wheat

Until recently the chances for increase in wheat production were severely limited by the characteristics of the varieties to use. The local varieties were tall—with the associated tendency for lodging under high levels of fertilizer and irrigation. Dwarf materials from Mexico provided the basis for a breakthrough in production.

The Coordinated Wheat Improvement Program, begun in 1961 and revamped in 1964, made use of this introduced germplasm in its breeding program. Six varieties were released=Kalyansona, PV 18, Sonalika, S 331, Safed Lerma and Sharbati Sonora. The breeding program has greatly expanded and large numbers of Indo-Mexican crosses have been made and are in different stages of advance. Yields of 5-7 tons per hectare, and occasionally more, have been achieved by several farmers. Correspondingly work on Agronomy, Plant Pathology, Physiology, Entomology and quality has increased. Agronomy has, in particular, kept pace with new developments side by side with breeding.

In *rabi* 1966-67 about 20,00,00-3,00,000 hectares were seeded to dwarf wheats. This acreage was made possible by an original import of 250 tons of seed from Mexico in 1965, its increase, followed by an 18,000 ton import in 1966. In 1967-68 about 2 million hectares were estimated under dwarfs and by 1968-69, this had increased to about 4·7 million hectares with probably a half in amber or white-grained varieties. The production in 1968—69 is estimated at 18·65 million tons as compared with the "pre-dwarf period" record of 12·3 million tons set in 1964-65. It is anticipated that somewhere between 5 and 6 million hectare will be under dwarf wheats in 1969-70. This comprises most of the irrigated wheat acreage. Because of near absence of winter rainfall, production may not exceed 20 million tons.

Rice

As with wheat, increases in yield of rice were limited, to a large extent, by the tall, leafy characteristics of the varieties traditionally used in India. The introduction of high-yielding, and breeding materials from Taiwan and the International Rice Research Institute has greatly enhanced the opportunities here for increased production through higher yields.

The All-India Coordinated Rice Improvement Project (AICRIP), with headquatrers at Hyderabad, has mounted a country-wide program to identify, develop and evaluate improved varieties making use of the recently introduced materials. Already yields of up to 10 tons per hectare of paddy have been obtained on experimental plots and in some farmers' fields. Yields in cultivators' fields of 6-7 tons per hectare are fairly common. The performance of the introduced Taichung (Native) 1, and Tainan 3 from Taiwan, and IR 8 from the IRRI has been particularly outstanding. However, these varieties have certain limitations such as susceptibility to bacterial leaf blight (especially Taichung (Native) 1) and a poor acceptance by consumers.

In 1968 the first varieties from AICRIP were released: Jaya and Padma. Both resulted from a cross between Taichung (Native) 1 and T 141 - a variety from Orissa. Jaya yields about 10% more than IR-8 and is about one week earlier in maturity. Padma, developed at Cuttack (CRRI) is considerably earlier than Taichung (Native) 1 and has a comparable yield potential. Its grain quality is superior to that of IR 8 or Taichung (Native) 1. In kharif 1969 there were about 8,000 hectares of Jaya and 20,000 hectares of Padma. Materials in AICRIP under advanced development with promise to provide a continuing supply of high yielding varieties with improved quality of grain with improved disease and insect resistance. It is estimated that some 26 million hectares were in high yielding varieties of rice in 1968-69.

Seed Production

Associated intimately with the development of the maize hybrids in 1961 was the recognition that inadequate provision existed to rapidly capitalize on those hybrids. There was a lack of organization, personnel and resources to permit and promote production of quality seed to meet the expanding scale of anticipated needs. In response to this situation the National Seeds Corporation was formed in 1963.

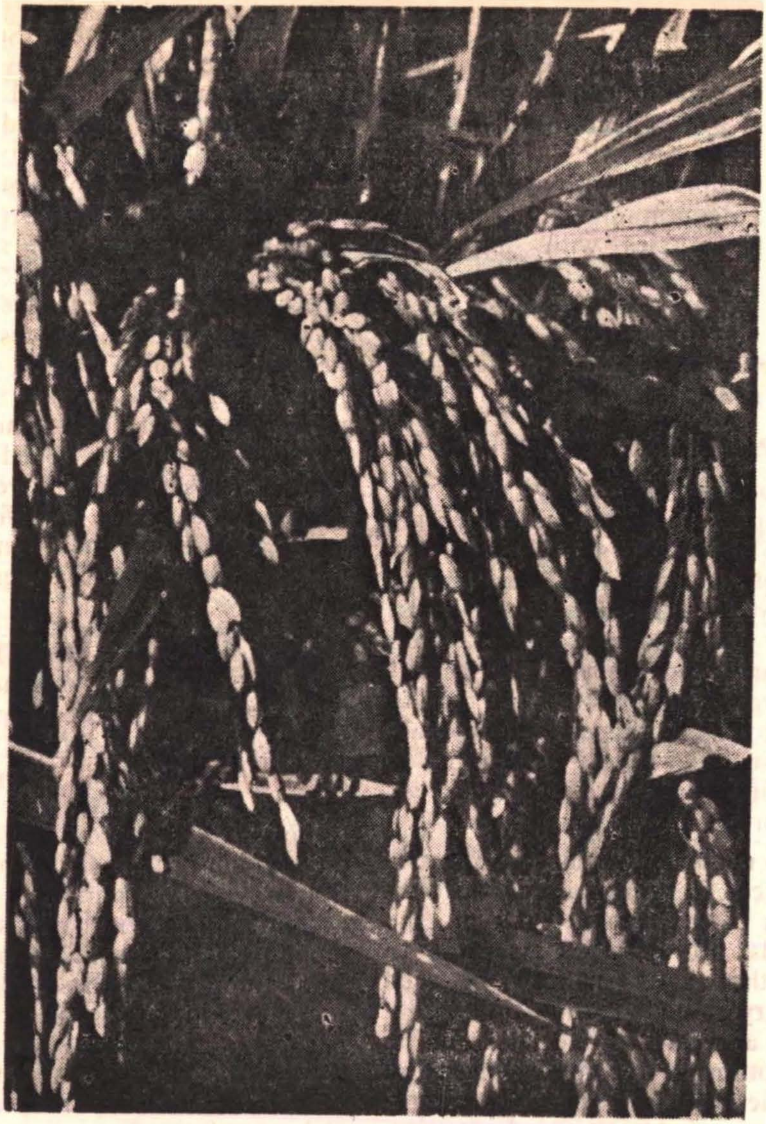
The major emphasis of the National Seeds Corporation was on foundation seed production of the hybrids. Its purpose also was to help the development of a seed industry, seed certification programs, a seed law and assist in the promotion of the new hybrids and varieties. It has leased seed processing equipment to seed organizations, established seed processing plants of its own, produced adequate supplies of foundation and limited supplies of certified seed, assisted new seed growers and producers, and temporarily functioned as a seed certification agency of the hybrids.

Seeds shifted from a subsidized commodity to a price level substantially above grain prices. State governments have encouraged seed growers by offering to buy and distribute their seed. New seed companies, corporations and partnerships have been formed. Seed production rose from less than 40 hectares of hybrid maize seed to over 28,000 hectares of hybrid maize, sorghum and bajra in 1968—69. Inadequate marketing programs have resulted in reduced production currently, but the present situation is helping all concerned to recognize the need for a total seed industry which produces, processes and markets seed. The Central Government and many States are strongly encouraging the development of a private seed industry. Seeds of new dwarf wheats and rice have moved in limited quantities in official and private seed channels and have spread rapidly from farmer to farmer.

An Indian Seed Review Team in 1967—68 helped to outline guidelines for the future development of the seed industry. Many of these points are currently being implemented. A Seeds Act and its Rules came into force across the country on October 1, 1969. Implementation provides for minimum limits of germination and purity plus truthful labelling of seeds sold commercially. In addition a legal base is provided for a voluntary seed certification program. The seed certification work is being shifted from National seed Corporation to official agencies.

Over 800 persons have participated in more than 30 training programs of 3-7 weeks duration. Assistance has been given in numerous ways to these seed production, processing, certification, testing and law enforcement programs. A Seed Technology Division is being formed at I.A.R.I. for offering M.Sc. and Ph.D. degrees. U.P.A.U. is planning to initiate a B.Sc. program in Seed Technology.

The modern seed industry is in its infancy but growing stronger.



The new rice crop "Jaya" released by ICAR

Private plant breeding has been initiated. Seed production of the future covering 8,00,000 hectares is a possibility. The present 140 seed processing plants of various sizes can grow to over 1,000. Hundreds of seed organizations and thousands of seed specialists will be needed in the seed industry of tomorrow.

Grain quality

Recently a decision was made to intensify the work on grain quality. A laboratory has been established at the Indian Agricultural Research Institute which is equipped to determine the quantity and quality of protein in grain. Through identification of promising materials that have a high level of protein and favourable amino-acid balance, it is anticipated that breeding procedures will be modified to permit incorporation of these quality factors into the high-yielding varieties and hybrids.

USAID ASSISTANCE FOR CEREAL PRODUTION, PROCESSING AND STORAGE IN INDIA

RUSSELL O. OLSON

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The very impressive progress in wheat production in India in the last few years has laid to rest the gloomy view that Indian agriculture could not meet its future food needs. Not long ago it was widely believed that food production could not keep pace with the rising needs of an expanding population. To many observers a major catastrophe was imminent-famine and starvation seemed in prospect without massive imports of food. But this gloomy prospect has changed dramatically. There is now hope and confidence that Indian farmers can and will expand production fast enough to become largely independent of food imports and provide larger and more nutritious diets within a few years.

The cause for the new optimism about food prospects is founded in the progress made in establishing the crucial infrastructure needed to sustain a high rate of growth in agricultural productivity. Programs of the 1950's resulted in the organization and development of a basic agricultural extension apparatus necessary for getting improved technology to the farmer. The more recent development of Agricultural Universities and reorganization of agricultural research have vastly improved the supply and effectiveness of well trained agricultural scientists and helped to mobilize this talent for working out the adaptation of new agricultural technology to local conditions.

Much progress has been made in expanding investment in capacity to produce key inputs such as commercial fertilizer, improved seeds, insecticides, power and farm equipment. Progress is being made in reorganizing input distribution facilities and in expanding and improving credit to facilitate adoption of better production methods.

The need for better management of soil and water resources is now well recognized and substantial improvement has been made in organizing services for development and use of water.

USAID has been associated with several aspects of these developments. Beginning in the mid 1950's USAID has supported a program for improvement of agricultural education and research institutions. This program, which has been carried out through arrangements with American State Universities, is now focused on development of nine state agricultural universities in India. Assistance has included supply of books and equipment, assignment of American specialists to these institutions and training for advanced degrees for selected staff members. Some of these Agricultural Universities have made excellent progress. They have assembled highly competent staffs and are making significant contribution in agricultural research and development of adopted technology. They have developed excellent programs of education and service for the rural areas of their states. They are playing an important part in the development of new, high yielding, disease resistant, consumer accepted varieties of seeds, and in the promotion of the adoption of these varieties, with appropriate cultural practices.

The introduction of new, high yielding varieties, with intensive cultivation practices, requiring a whole bundle of complementary inputs and practices, presents a great many problems that cannot be fully anticipated. This has necessitated expansion of the input distribution facilities and modification of research and extension programs to identify and solve quickly problems encountered in introducing new technology. USAID has assisted in programs in six states aimed at improving the linkage between the research and the development and supply agencies in order to hasten the rate at which new technology can be successfully adapted and adopted on a large scale.

Good quality seed is a critical element in maintaining a high growth rate in foodgrain production. USAID has provided technical assistance and processing equipment for the seed industry over the past 15 years. At the present time USAID is providing technical assistance to the National Seeds Corporation on seed processing, seed marketing and seed quality control and certification.

Commercial fertilizers are also playing a crucial part in increasing agricultural production. Fertilizer consumption in 1970 was over 2 million metric tons of nutrients as compared to less than 300 thousand tons ten years ago. USAID has assisted in training of Indian personnel in various aspects of the fertilizer industry, including manufacture and management as well as in distribution and marketing. USAID has financed a substantial part of the fertilizer imported in the last few years.

USAID is also providing technical assistance to the pesticide and plant protection industry and to the farm machinery industry and finances a considerable part of the import of technical-grade pesticides used in formulations in India. These industries are experiencing rapid development and are beginning to make a significant contribution to agricultural progress.

India has expanded the area under irrigation about 35 million acres in the last twenty years. More emphasis is now being given to efficient utilization of the water supply. USAID is providing assistance for development of additional water supplies and for improved management of soil and water resources. Experts are assigned to work with the water management unit of the Ministry of Food and Agriculture in developing programs and establishing standards for soil and water management on rain-fed and irrigated lands.

USAID is assisting some of the state governments to evaluate and demonstrate improved water management methods. Teams of specialists are working in three pilot projects in Punjab, Mysore and Uttar Pradesh help plan and apply programs for proper use of soil and water on land representative of major land use areas.

Many parts of India have considerable potential for irrigation if economic source of power for water lifting are available. Food production can be greatly increased if electric power is provided to such areas. USAID is assisting in establishing pilot rural electric cooperatives, based on very successful experience in cooperative distribution of electricity in rural United States. Last year the U.S. Government approved a grant of Rs. 105 crores, from proceeds from PL 480 grain sales, to the newly established Rural Electrification Corporation. Together with the Rs. 45 crores provided by the Government of India, the grant will help finance an accelerated program of rural electrification.

The Food Corporation of India was established in 1964 to implement government policies for supporting farm prices and stabilising food supplies. USAID has provided a modest amount of technical assistance to the Corporation. Imports of food grains under the concessional terms of PL 480 have been used to build up buffer stocks essential for stabilising grain supplies and prices. Some of the proceeds from the PL 480 sales have been used to finance construction of modern storage facilities.

In summary, USAID assistance in recent years has included technical assistance to help strengthen Indian institutions and programs that are needed to sustain a high rate of growth in agriculture and has helped finance importation of the most important inputs required for agricultural production, pending the development of sufficient indigenous capacity. Progress in development of strong research and education institutions and improvements in input production and distribution facilities are cause for optimism about India's ability to meet future food needs.

CEREALS – DEMAND AND SUPPLY

G. RANGASWAMI

(Dean, University of Agricultural Sciences, Bangalore)

Ours is a vast country with 326·8 million hectares of land of which 136·3 million hectares (41 percent) is cultivated. About 80 per cent of the cultivated land is sown to food crops, i. e., food grains and pulses and the remaining to oilseeds, sugarcane and other cash crops. Among the food grains rice occupies the foremost place with an area of 36·1 million hectares, (about 24 percent of the total area sown) followed by sorghum, wheat, bajra, maize, ragi and other minor millets. We are predominantly dependent on cereals for our main diet. Cereal production in India in recent years has been around 95 to 100 Million tons, falling short by about 5 to 10 percent of the total requirement to feed the nation.

Population Explosion

Our total population at the time of independence in 1947 was 350 million and to-day we are 511 million and in another 30 years we will double in number. The present rate of increase in population of 2·4 percent is expected to go upto 2·7 percent in another 15 years, before it levels up due to the steps already taken to check the increase in population through birth control measures. The problem is not merely population explosion resulting in increased number of mouths to be fed; it is also the progressive increase in the number of persons in higher age groups who need more food. Also, due to the growing economic conditions the calorie requirement is expected to increase considerably. The life expectation in India has risen from 27 years in 1920 to 51 years in 1968 and it is expected to increase to 63 years in 2,000 A. D. The death rate has reduced from 30/1,000 to 10/1,000 during the past 20 years. Because of the increase in total population and of the increase in calorie requirements of the average person the total food grain needed for human consumption in 1985 will be more than double the present amount, though the population increase will be only about 75 per cent. Besides, we have to divert a portion of land presently under cereals to other crop, such as legumes, oilseed, fibre crops, sugarcane and other commercial crops, not only to meet the growing demand but also to produce sufficiently large quantities for export, so as to build national economy through valuable foreign exchanges. This is posible if we can further increase the yield per unit area beyond 200 percent level, so as to reduce the present area under cereals.

Increasing Demands

Besides meeting the increasing demand of calorie requirements, the nutritional deficiency of the food we eat is to be rectified. It is well known that in India, as in most other developing and under - developed countries, about 60 percent of the population are under-nourished. They eat low quantity and poor quality protein. Besides, their diet is deficient in vitamins. calcium and other nutritional elements. Such a poor diet causes many nutritional disorders and lowered energy output and lowered production with bare subsistence income, with the resultant stagnation in the economic growth of the nation. Therefore, it becomes very important that we take adequate steps to produce the required quantity and quality of proteins and other nutritional elements to feed the nation. Since we derive about 50 percent of our protein requirements through cereals the quality and quantity of protein contained in the cereal grains we produce is of particular concern.

Not only agricultural land in the world is inequitably distributed among different countries of the world, but also among different regions of the same country. This disparity seems to grow all the time. To day about 50 per cent of earth's space is occupied by one-third population in the developed countries and the remaining 50 percent of land by the two-third population of developing and under-developed countries. This will change substantially by 2000 A.D. when only one-fifth of the population in developed countries will occupy 50 percent of land and the fourth-fifth population the remaining 50 percent of land, and this is due to slow population growth in the developed countries and 'population explosion' in the others. Therefore, the stress on land will be increasingly felt in India and other countries of Asia. As against 0·6 hectares of land per head to-day in India we will have about 0·4 hectares of land in another ten years. As the average land per head goes on shrinking with time, man becomes narrower in his outlook, and jealousies, bickerings and narrow-mindedness among people increase all the time. When there is untoward competition for food, and other essential requirements of man, there is bound to be increasing competition for survival. Man has to make progress in all spheres of activity, including scientific achievements, in spite of such attitudes on part of a majority of people.

The Challenge

It is possible for man to meet the challenge of producing the increasing quantities of food required by him in the years to come? Can we in India produce the required quantity of food grains to feed the increasing population and also substantially improve the quality of our diet? Is there enough know-how to increase our crop yields per unit area? If so, what is preventing us from doing so?

Today there is enough technical knowledge on hand to increase the average crop yields three to four folds. Introduction of high-yielding, dwarf, photo-insensitive, heavy fertilizer-responsive cereal crop varieties into the country from Mexico, the U.S.A. and the Philippines has brought in 'Green Revolution' in the country. As against the conventional, age-old subsistence farming seen in our village, today we see several farmers in some villages adopting intensive cultivation practices to grow the high-yielding crop varieties. The various dramatic achievements through the high-yielding crop varieties of rice, wheat, maize, sorghum and bajra, during the past three or four years give us confidence to meet the challenges of the future.

The Achievements

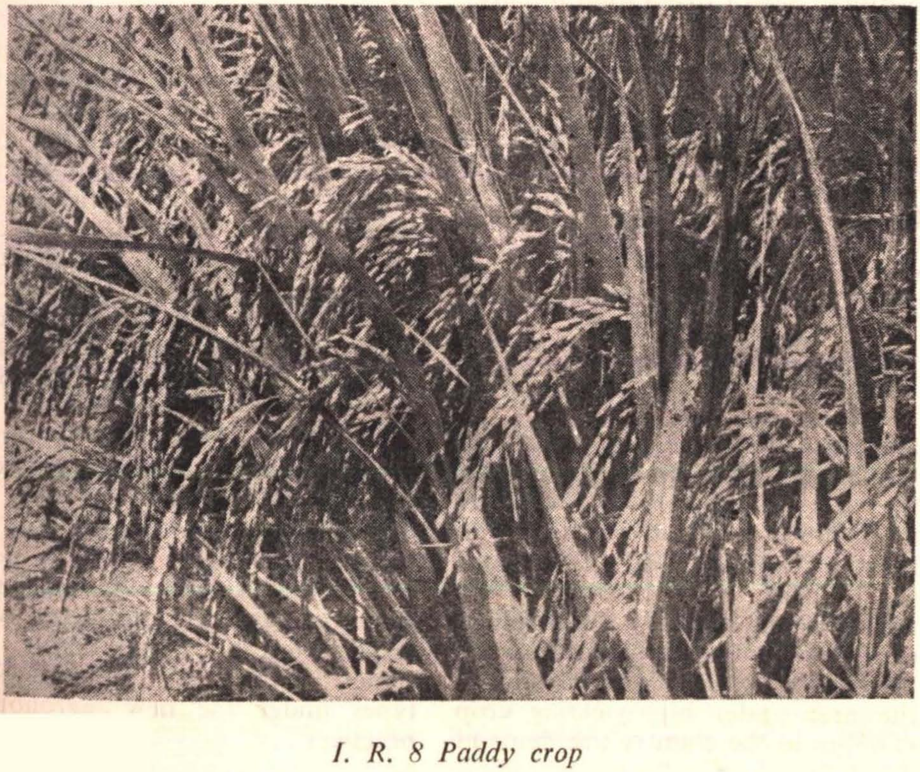
In 1964-65 through the introduction of the high-yielding rice varieties, T.N. 1 followed successively by T.N. 65, IR 8 and IR 5 during 1965-69 we learnt the way to intensify our rice production. The package of practices involving better seeds, high doses of fertilizers, systematic chemical control of pests and diseases, and other farm management practices have been evolved for these crops. The new high-yielding varieties evolved subsequently, Adt. 27, Padma, Jaya, Hamsa and Kusuma are becoming popular with the farmers. The high-yielding varieties have already spread to about 3 million hectares in India and it is expected to cover 10 million hectares in the next one or two years. The high-yielding dwarf wheat varieties Sonora 64 and Lerma Rojo 64, were introduced in some parts of India during 1964-65. Subsequently four new varieties (Kalyan Sona, Safed Lerma, Chhotti Lerma and Sharbati Sonora) were evolved through the joint efforts of the Rockefeller Foundation, United States Department of Agriculture and the Indian Scientists. These varieties are fastly becoming popular in the wheat growing areas of north India and are also spreading to other generally non-wheat areas in Tamil Nadu, Andhra Pradesh and south Mysore. In all, about 5 million hectares are growing these varieties and it is expected that the entire wheat area in the country will be replaced by the high-yielding varieties in the next couple of years Sorghum is grown in an area of about 18 million hectares in India and it is one of the common rain-fed crops in most areas of the country. It is also cultivated under irrigated conditions with certain intensive cultivation practices. Though efforts were made for many decades to evolve improved high- yielding varieties of sorghum there was a break through only in 1964 when the hybrid sorghum CSH-1 was evolved. This was followed by CSH-2 in 1965, another hybrid, and more recently by some new high-yielding varieties including Swarna which have many good qualities. The yield of sorghum per hectare can be increased ten folds through these varieties. Nearly 6 million hectares are grown to hybrid sorghum at present and the area is expected to increase substantially during the next few years. Maize is rapidly becoming popular among Indian farmers, thanks to the introduction in 1954 of some promising hybrid varieties from the United States of America.

In 1957 the Reckefeller Foundation helped Indian Government to initiate intensive work on this crop, which resulted in the emergence of three highly popular hybrids, Deccan, Ganga 101 and Ganga 5. Soon 'synthetics' were developed and the two new 'synthetics' AMBAR and VIJAY are spreading rapidly in many parts of India. The total acreage under maize has increased rapidly during the past four years and presently it is grown in about 5 million hectares. The minor millets including bajra and ragi are noted for their richness in calcium and iron content together with fairly high quantities of protein. One of the hybrids of bajra, HB-1 released in 1965 yields as high as 60 to 70 quintals per hectare. This bybrid was followed by three more hybrids, HB-2, HB-3, and HB-4. Such a breakthrough in ragi is long overdue though some new varieties such as **Purna** and **Annapurna** and S-929 have given yields more than double that of the local varieties.

Thus, the introduction of high-yielding varities, followed by identification of potential germ plasms and breeding of newer varieties to suit Indian conditions is revolutionizing our agriculture. Not only it has enthused the farmers to take to intensive farming but also inspired many agricultural scientists to undertake extensive and intensive research work on many aspects of crop production to solve the present problems and to meet the future challenges.

Immediate Problems

The data on the yields of cereals so far obtained from several parts of India give one confidence to state that the rate of increase in crop production will continue to grow at five percent a year, or even more, during the next five to ten years, This would mean that we will not only be able to wipe out the present marginal deficit in cereal



I. R. 8 Paddy crop

requirements but also be to meet the demands of 200 percent grain production during the next 30 years to produce more of cereals through intensive cultivation practices in as much area of land as possible. Also, we need to have all the required inputs for such a programme. What are the inputs? Improved seed, adequate quantity of fertilizers, required quantity and quality of insecticides, fungicides and herbicides, irrigation water, electricity, farm machinery, etc. We also need the technical manpower to disseminate the knowledge in crop production technology as applicable to high-yielding crop varieties in different soils, and agro-climatic zones of the country. Are these inputs available in adequate quantities?

Improved Seed

India has made a big stride in seed production. Not only the National Seed Corporation but also many enlightened and progressive farmers and other private agencies have helped the Nation to meet the increasing demands of seeds of improved crop varieties. The existing loopholes and deficiencies in the production and distribution practices of improved seeds should. however, be administration and the public.

Agricultural Chemicals

During the past five years the amount of fertilizer used by Indian farmers has gone up from six lakh tons to 1·5 million tons. The target for 1970 for fertilizer production in India is 2 million tons of nitrogen and 1 million tons of phosphate. We are expected to achieve self-sufficiency in fertilizer production by 1975. With the rapid expansion of the area under high-yielding crop varieties in the country the demand for fertilizer has been increasing at a tremendous rate and we need to expand our production capacity in line with, and ahead of, the demand. The package of practices adopted for growing the high-yielding crop varieties include proper and timely use of insecticides, fungicides and herbicides. The area to be covered with these pesticides is expected to touch hundred mllion hectares in the near future. At present over 50 percent of the required quantity of pesticides is produced within the country but we need to expand the production capacity of these chemicals and also produce newer agricultural chemicals to meet with the future demands.

Soil and Water Management

The gross irrigated area in the country has increased substantially since Independence and today nearly 20 percent of the cultivated area is irrigated. The high-yielding wheat and rice varieties are mostly grown in areas with assured water supply and the yields upto 60 or 70 quintals per hectare obtained. Though this has given us encouragement, inspiration and confidence, there are many problems on soil and water management which require solution. We are yet to rationalize and regulate use of irrigation water for these crops under different agro-climatic conditions. Not only there is wastage of water due to excess irrigation but also certain problems like reduction in yield due to ill-timed irrigation and ill-drainage and consequent accumulation of salts in the soil, etc. are created due to such wrong usage. There is need for further studies on soil and water management problems with respect to the newer crop varieties grown in different soil types under the new agronomic practices.

Other Inputs

The problems of electricity, transport, and farm machinery involved in increasing crop production are also of great magnitude. They all involve upliftment of economic conditions of the farmer. The economic conditions could be lifted up, if the farmer is given timely and adequate financial help to acquire all the inputs for intensified farming. The State and Central Governments are taking measures to help the farmer in this regard, though these are largely inadequate. There is need to carry out research work on the various aspects of these input requirements so as to arrive at solutions to the problems.

Price Policy

In order to continue the interest on the part of the farmer to grow high-yielding cereal crop varieties he should be assured of a reasonable price for the produce. While keeping in mind the interests of the consumer, those of the producers should be adequately protected. The Government has been fixing from time to time the minimum and maximum prices for food grains and also procurement prices which are expected to serve as incentives as well as protection of the farmers' interest. The offer of the Central Government to purchase any quantity of food grains at procurement price has helped in removing the fear of price slumps even in such surplus wheat areas like the Punjab. It is, therefore, expected that with support prices, assured inputs and growing technical knowledge we will be able to maintain the rate of 5 percent annual increase in the production of cereals in the country. However, this will level off in the course of next five to ten years, by which time most of the areas with assured water supply will be covered by the high-yielding crop varieties.

Social Justice

Consequent on introduction of the high-yielding varieties of cereals in the areas with assured irrigation facilities, there has been a growing awareness and fear in the minds of farmers in the dry farming areas that the measures taken so far by the Government lead to the rich farmer becoming richer and the poor, by comparison, becoming poorer all the time. More recently steps are being taken to improve the lot of the farmers in the dry farming areas. About 80 percent of the India's cultivated land is rain-fed and exposed to the vagaries of the Monsoons. Of the 80 per cent, about 42 million hectares receive more than 115 cm or 45 inches of annual rainfall, largely assuring good harvest of a single crop. The remaining areas receive rainfalls ranging from 8 to 40 inches and also their distribution is so variable that there is considerable risk in raising a crop in such areas. Not only for social reasons, but also to obtain better yields of the badly needed cereals, pulses and oil-seeds we have to improve the lot of the farmers in the low rainfall areas. Water conservation measures, coupled with evolving drought resistant, short duration, high yielding crop varieties would help the farmer to be assured of a crop harvest, though not a bulky one. We need to have an integrated approach to evolve package of practices to include efficient water and soil management practices, better crop varieties and improved cultivation practices, including fertilizer practices and pest control measures, for various dry farming areas of the country.

Newer Approaches

Besides increasing the yield per unit area of cereals, both under irrigated and rainfed conditions, we have to aim at minimizing the loss in the field due to newer pests and diseases which invariably set in under newer intensive crop production programes. This is to be done not only through chemical and cultural means of control but also through pest and disease resistant crop varieties. Several studies are going on to select insect pest and/or disease resistant varieties of rice, wheat, maize, sorghum, bajra and ragi and these are expected to yield fruitful results. Since we depend on cereals as one of the main sources of protein the possibility of improving the quantity and quality of protein in the grains has been engaging the attention of our breeders. The possibility of increasing the quantity of protein in rice and wheat through heavy doses of fertilizers has already been shown. Newer varieties of rice have been shown by the breeders to carry genes for high protein content to account for 10 percent protein in the grain as against 8 percent in other varieties. The protein content of *Triticale* wheats has been shown to contain as high as 20 percent protein in the grain as against 10 to 16 percent in the other high-yielding varieties. Most of the presently cultivated varieties. of rice, wheat and maize are poor in lysine content, one of the essential amino acid components of proteins. Besides, rice is also deficient in methionine and maize in tryptophan. Attempts have been made to identify genes which carry high lysine content and to utilize this knowledge to evolve new maize and wheat varieties which contain high quantities of lysine, besides other economic qualities. The possibilities of combining in such varieties high nutrttive values of straw for use as cattle feed, are also being looked into. Studies are being intensified to evolve crop varieties which are drought resistant, responsive to fertilization under rainfed cultivation, shorter in duration and with high yielding qualities for the low rainfall areas. The hybrid sorghum CSH-1, which has shown eapacities to withstand moisture stress is being utilized as one of the parents to evolve such varieties. Studies on evolving rice varieties for direct sowing under semi-wet or rainfed conditions are in progress. Besides, many problems pertaining to agronomic practices suited to different crops, soils and agro-climatic regions are to be tackled in an intensive manner and work on this is going on all over the country. The need for the use of herbicides to control weeds in both irrigated and rainfed farming is increasingly felt and work in this line has also yielded valuable results and these are being transmitted to the farmers' fields. More work in this line is being continued. With intensive cultivation practices being adopted in many parts of the country, there is scarcity of farm labour and this is especially acute at the time of planting, weeding and harvesting. Small and medium sized labour saving farm implements and tools are required by many farmers and research work on this is to be intensified. The problems of storage, transport and marketing of farm produce under the changing agriculture, need to be solved on priority basis, and some studies have been undertaken in a few centres to understand these problems and to evolve methods to solve them.

In conclusion, it may be stated that there has been a breakthrough in Indian agriculture during the past three to four years, which gives us hope to become self-sufficient in food grains. This has encouraged the farmers and the scientists to change their outlook towards the future. But this is only a beginning and concentrated efforts are to be made to meet the bigger challenges of the future. We need to increase production of cereals by over 200 percent during the next three decades to meet with the needs of increasing population. In order to do so we have to carry out intensive and extensive research on many aspects of agriculture including evolving of newer high-yielding crop varieties with better quantity and quality of protein in their grains, which are resistant to pests, diseases and moisture stress and are highly responsive to fertilizer doses and on soil and water management problems, pest and weed controls, labour saving implements and tools, storage, transport and marketing and many other related problems. Agricultural scientists should play an increasingly important role in all these various aspects. so as to make the "Green Revolution" an everlasting one to bring prosperity to the Nation.

CEREALS IN MAHARASHTRA

"RICE"

Rice Specialist Mahatma Phule Krishi Vidyapeeth, Rahuri

Rice occupies a unique position in the World crops and nearly one-third of the area is contributed by the Indian Union. In the state of Maharashtra, rice covers an area of about 13.28 lakhs of hectares giving annual rice production of 13.18 lakh tonnes and is the third important staple food crop-after jowar and bajra. It is cultivated under wide range of soil and conditions, resulting in the variation in the methods of cultivation and varieties. The crop is mainly dependent on south-west Monsoon rain which varies from about 750 to 3,500 MM. About 75% of the crop is transplanted while the rest is drilled or sown broadcast. On account of diverse ecological conditions under which rice is grown in the State, there are hundreds of varieties grown, out of which a large percentage is of fine quality rice.

The regionwise area and production of rice in the state is as follaws :

TABLE I

Area and production of rice in M. S. (1968–69) *

Division	Acreage ('00' hectares)	Outturn of rice ('00' M. tons)
Konkan	4,156	5,376
Nasik	600	415
Poona	1,964	1,798
Aurangabad	844	422
Nagpur	5,717	5,172
Maharashtra State	13,281	13,183

The rice area in the State can be divided in to the following agroclimatic regions :

Region	Soils	Climate and rainfall
(1) North Konkan	Sandyloam on upland and cleyloam in valleys, derived from trap, pH 5·7 to 8·8. Poor in nitrogen, rich in Phosphorous and Potash	Rainfall 2,175 to 2,500 mm. and high temperatures.
(2) South Konkan	Laterite soils, red in colour, acidic in reaction pH 3·6 to 5·9, fairly rich in nitrogen but poor in phosphate and Potash.	Rainfall about 2,500 mm. and high temperatures.
(3) Maval	Calcarious soils, pH 7·5 to 8·5, poor in nitrogen but rich in phosphate and Potash.	Rainfall about 1,500 to 1,750mm. temperatures lower than Konkan.

*Based on fully revised figures reported in S & C Report-1968-69.

Region	Soils	Climate and rainfall
(4) Coastal saline soils	Salt content of the soils ranges from 0·8 to 1·0% in May but gets diluted to 0·3% in rainy (growing) season.	Rainfall about 2,250 to 2,500 mm. and high temperatures and humidity.
(5) Vainganga basin of Vidarbha	Clayloam soils, pH 5·6 to 8·4	Rainfall 1,500 to 1,700 mm.
(6) Dry region of Marathwada	Clayloam soils, pH 7·0 to 8·5, low in humus and nitrogen content and poor in available phosphate.	Rainfall about 750 mm.

Rice Breeding stations and crop improvement work

The diverse ecological conditions and consequent growing of large number of varieties with different package of practices have given rice to most of problems, vigorous effects have been made during the last fifty years to tackle them through breeding and agronomic research. The research on rice at present being conducted at twelve research stations situated in the various rice regions of the State. The various improved strains evolved by these research stations and their special features are given below.

TABLE II

Improved strains of Paddy in Maharastra State

Name of the strain	Name of Rice Res. Stn. evolving strain	Year of release	Duration in days	Yield / hec.	Special features etc.
I. North Konkan (Thana and Kolaba districts)					
Kolamba 42	A. R. S. Karjat (Kolaba)	1924	145–150	2,948	Heavy yielder
Kolamba 540	do	1934	130-135	2,473	Fine grained
Zinia 149	do	1934	145–150	2,920	Very fine grain. Translucent, table rice.
Kada 68-1	do	1946	115–120	2,477	Bold grained, useful for bread making and beaten rice (Poha)
E-K. 70	do	1950	110–115	1,460	Early, fine, longer grain. Suitable for H. W. cultivation.

Name of the strain.	Name of Rice Res. Stn. evolving strain	Year of release	Duration in days	Yield /hec.	Special features etc.
Mahadi 4-4	A. R. S. Karjat (Koloba)	1954	115–120	2,472	Red Kernelled, suitable for bread purpose.
Bhadas 1303	do	1954	135–140	3,751	Heavy yielder, useful for bread making, respond well to manuring.
Garwel 1-8	do	1954	150–152	2,388	Midfine grain, Strong strawed, fairly non-lodging.
Zinia 14	do	1958	145–150	3,311	Fine and lustrous grain. High yielding.
Zinia 63	do	1959	125–130	2,509	Fine and lustrous grain.
Zinia 31	do	—	125–130	2,400	Fine and lustrous grain.
Kada 176-12	A.R.S. Palghar (Thana)	1951	110-115	2,900	Coarse grained.
II. South Konkan (Ratnagiri District)					
Patani 6	A.R,S. Shivgaon (Ratnagiri)	1932	100–105	2,643	Coarse grained, early, suitable for hot weather cultivation - resistance to store moth.
Panvel 61	do	1932	122–125	2,870	Least affected by store pest. Coarse grained.
Waksal 207	do	1932	120–125	2,550	Coarse graied.
Varangal 487	do	1942	145–148	2,960	Fine grained, low land type.
Bhadas 79	do	1932	136–138	3,220	Strong strawed, lowland type.
III. Maval (Western parts of Poona, Nasik, Satara, Kolhapur districts)					
Ambemohar 102	A.R.S. Vadgaon (Poona)	1954	135–140	1,622	Long grained, very slightly scented.
Ambemohar 157	do	1946	150–155	2,300	Highly scented, non-shedding.
Ambemohar 159	do	1946	150–155	2,394	do
Chimansal 39	do	1954	140–145	1,831	Long grained, midfine, nonlodging.

Name of the strain.	Name of Rice Res. Stn. evolving strain	Year of release	Duration in days	Yield /hec.	Special features etc.
Varangal 9	A.R.S.Vadgaon (Poona)	1961	125–130	3,058	Coarse, high yielding.
Dodak 35	do	1962	140–145	3,110	do
Kamod 253	A.R.S. Igatpuri (Nasik)	1962	145–150	1,346	Scented.
Krishnasal	Introduced	1932	125–130	1,448	Suitable for Deccan canal tract.
Basumati 370	do	1949	120–130	1,707	do
Varangal 1,078	do	1963	135–140	1,590	High yielding than local.
Latekolapi 248	do	1954	150–155	1,791	High tillering than local.
H. S. 17	A.R.S. Radhanagari (Kolhapur)	—	115–120	2,018	High yielder than local.
J. S. 180	do	—	120–130	1,975	do
IV. Coastal Saline soils (Thana, Kolaba, Ratnagiri districts)					
Bhurarata 4-10	A.R.S. Panvel (Kolaba)	1953	110–115	1,418	Salt resistant, red kernelled.
Kalarata 1-24	do	1953	120–125	1,420	do
M. K. 47-22	do	1962	120–125	1,565	White kernelled.
S. R. 3-9	do	—	140–145	2,320	do
V. Vainganga basin of Vidarbha (Chandrapur & Bhandara dists.)					
E. B, 17	A.R.S. Sindhewai (Chandrapur)	—	115–120	2,400	Early
R. 2	Introduced from old M.P.	—	125	1,720	Early
R. 8 luchai	do	—	155–160	2,838	High yielding.
R. 12	do	—	150	2,919	Scented
R. 15 Chinow	do	—	170	1,716	Scented, fined grained.
W. L. 112	A. R. S. Sindhewai (Chandrapur)	—	145–150	3,200	High yielding
VI. Low rainfall, Dry region (Drilled paddy region of Dhulia, Osmanabad and Nanded districts)					
Jalgaon 5	do	—	110–115	2,000	Drought resistant
H. R. 19	Introduced from A. P.	—	120–125	2,810	Medium grain
Lalsal 140-31	A. R. S. Tuljapur (Osmanabad)	—	110–115	1,931	High yielding than local
Pandharisal 281–42	do	—	125	1,457	do

The yielding potential of above mentioned improved varieties is on an average 20 to 30 quintals per hectare, which is only about 10 to 15% higher than the local varieties. Most of the varieties are not capable of utilizing the nitrogen efficiently with the result that they produce more of vegetative growth under high fertility and eventually lodge. The annual rice production is not sufficient to meet the total requirement of the state and every year about 5 lakh tonnes of rice has to be imported. With the advent of the high yielding paddy varieties like T.N. 1 from Taiwan in 1964, IR-8 from Phillipines in 1966, Jaya from Hyderabad in 1968, there has been a break through in rice cultivation in India. These varieties have substantially boosted up the rice yield per hectare by virtue of their high yielding potential, which is almost double that of our existing improved varieties. The salient features of these high yielding varieties are as under :-

1. Short statured, stiff strawed, resistant to lodging.

2. Highly responsive to nitrogen fertilizers i. e. utilisation of nitrogen efficiently for more grain production rather than straw.

3. Photo-insensitive but moderately thermosensitive.

4. IR 8 moderately resistant to blast and having moderate seed dormancy.

5. Susceptible to stem borer, leaf hoppers, gall-midge and leaf blight.

6. Resistant to grain shattering,

7. Ideal plant type-erect, dark green thick leaves having high photosynthetic rate.

8. Better nutritive and milling qualities.

9. Cooking quality preferable to the consumers.

10. Long bold white grain, heavier in weight.

Though these varieties have high yielding potential by virtue of high rates of assimilation of absorbed nitrogen, they are all bold grained and hence are not readily preferable to the rice farmers as well as to the consumers. With a view to improving grain quality, intensive hybridization programme has been launched since last 4-5 years at various rice research stations wherein crosses of high yielding varieties of TN-1 and IR-8 have been made with fine grained local improved ones like Kolam and Zinia. Out of these crosses, some promising fine grain cultures viz., K-184, R-60 etc. possessing all the above desirable qualities of high yielding varieties have been evolved and some are presently undergoing extensive trails on cultivators' farms. On assessment of their merits, they would be released for general adoption.

SOME ASPECTS OF THE PRODUCTION OF IMPORTANT CEREALS IN INDIA

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India has a total land area of 781 million acres of which about 49% or 380 million acres are cultivable. The net area cultivated is 340 million acres and due to multiple cropping the total area cultivated is estimated to be 373 million acres Of this area 290.5 million acres are used for raising foodgrain crops. Food grains constitute the bulk of agricultural production in India and out of this cereals (Rice, Jowar, Bajra, Wheat, Ragi, Maize and Small Millets) from a sizeable share. Table-I shows the production as well as imports of Rice, Wheat and other cereal crops in India during the last five years.

TABLE - I

Production and Import of Cereals : All India 1965 to 1969

Year	Production				Net imports			
	Rice	Wheat	Other cereals	Total cereals	Rice	Wheat	Other cereals	Total cereals
1965	39.3	12.3	25.4	77.0	0.78	6.57	0.10	7.45
1966	30.7	10 4	21.1	62.2	0.78	7.83	1 73	10.34
1967	30.4	11.4	24 1	65.9	0.45	6.40	1.82	8.67
1968	37.6	16.5	28 9	83.0	0.44	4.77	0 48	5.69
1969	39.8	18.7	25.1	83.6	0.48	3.09	0.28	3.85

Source: Sarma J S., Feeding India's Population in 1980 (A quantitative assessment) National Food Congress 1970.

Cereals are the main stay of the diet of the average Indian and hence a great deal of the energy and resources of the country are devoted to increasing cereal production particularly Wheat and Rice. Till very recently, the averge yield from Cereal crops was rather low in India compared to that obtained in some other cereal producing countries in the world. This was markedly so prior to the introduction of high yielding varieties of cereal crops Table-II shows the yield obtained from Rice and Wheat in India in 1965 compared to other countries in which these crops are important.

TABLE - II

Yield of Rice & Wheat (Quintals per Ha.) in India compared to other countries

Country	Rice	Wheat
India	13.1	9.1
Pakistan	16.8	8.6
Thailand	16.1	—
Japan	49.5	27.0
U. A. R.	41.8	27.7
U. S. A.	47.7	17.9

Source : F. A. O. Year Book 1965.

The aim of planned devlopment in the Agricultural sector has been to achieve self-sufficiency in food production. As cereals constitute the staple food of the people in this country this practically means meeting the full requirements of cereals of the growing population. Since there is not much cultivable area left for extending cultivation, this has to be done by raising the per acre yields.

Stagnation in Agricultural Productivity :

During the first half of the present century, more and more of food was produced from less and less land in several countries of the world while in contrast the productivity remained stagnant in many of our important food grains during this period, although there was a rise in total production due to increase in the area cultivated and the area brought under irrigation. Though organanised attempts in agricultural research commenced at the beginning of this century, research for increasing production was oriented towards commercial crops like Cotton, Sugarcane and Oilseeds which had export value. The setting up of large irrigation projects and fertilizer factories, and the introduction of development programmes after the attainment of Independence such as the Community Development Programme and the Intensive Cultivation Programmes (Intensive Agricultural District, Programme, Intensive Agricultural Area Programme) pointed up the need for intensive research for increasing production from food grain crops The direct result of this was the introduction of exotic high yielding varieties and the development and spread of these High Yielding varieties Programme.

The High Yielding Varieties Programme :

Since 1966, the entire dynamics of Indian Agriculture began to change. The principal force behind this change was the introduction of high yielding varieties of several food grain crops and the related changes in the use of inputs. The exploitation of hybrid vigour as in Maize and Sorghum and the introduction of a plant type possessing a dwarf non-lodging habit and photo-insensitivity as in Wheat and Rice were the genetic instruments utilised in developing varieties of food grain crops which respond well to high doses of fertilisers and good soil and water management. New vistas in crop yields have been opened up during the past few years through the development of varieties of crop plants genetically designed to utilise sunlight, water and fertiliser more efficiently to produce high yields. The following is a brief account of the development of some of the important varieties of cereal crops.

Rice:

Rice occupies nearly 35 million hectares in our country, but the average yield was only 1.3 tonnes per hectare in 1965 as against over 4 tonnes per hectare in Japan. The low yield of our rice varieties is due to many factors. These include warm dry and night temperatures, high humidity, short days, low light intensity and the very nature of the varieties grown as we shall see.

The varieties grown in India prior to the introduction of the High Yielding Varieties Programme belong to the subspecies "indica" of Oryza sativa. The tall, vigorous growing, profuse tillering, late-maturing, photo-sensitive "indica" types have persisted for centuries in South-East Asia because of their ability to survive deep water and to compete with weeds at low soil fertility level. Because of their tall weak stems they are highly susceptible to lodging and are not therefore able to take up Nitrogen and give higher yields. For example, for every pound of Nitrogen applied, these varieties give only 10 pounds of rice while the high fertilizer responsive dwarf varieties give about twenty pounds of rice per pound of Nitrogen. Again, because of the weak stem and tall growing habit of the plants the rice crop usually lodges long before maturity and frequently before flowering. This is another important cause of poor yields. The other causes for the poor Rice yields obtained in our country are:-

a) Poor photo-synthesis due to extensive cultivation of rice during the mosoon when the sky is cloudy during most parts of the day;

b) poor utilisation of sunlight due to mutual shading of leaves, i.e., shading of the lower leaves by the upper ones;

c) poor soil and water managment and

d) lack of attention to details in cultural practices such as spacing and depth of transplantings. Some years ago as Dr. M. Swaminathan, Indian Agricultural Research Institute, New Delhi, reports some Chinese Scientists discovered a spontaneous mutant in the Rice variety "Dee-Geo-Woo-Gen" having the following characteristics:-

i) A dwarf plant habit enabling the plant to absorb more nitrogen without lodging and giving higher yields;

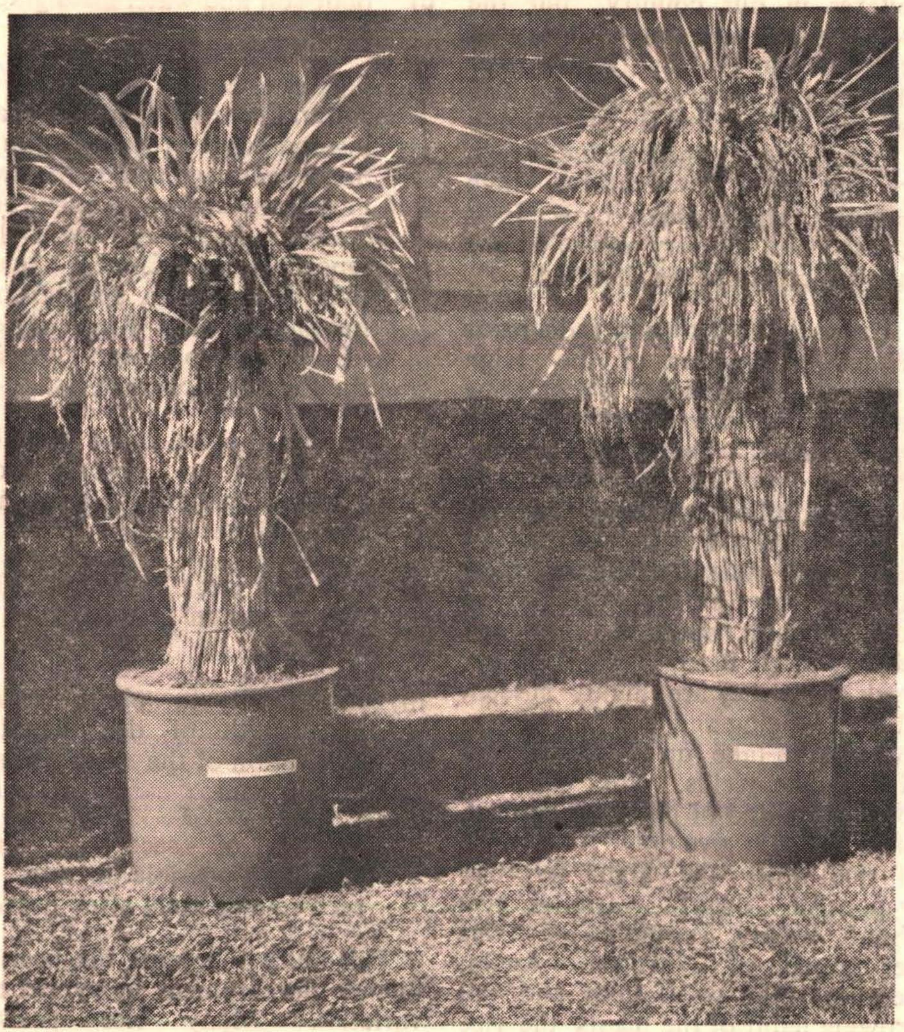
ii) stiff and erect leaves enabling the maximum interception of sunlight;

iii) intensitivity to photo period, i.e., length of day enabling cultivation of the crop in any season; and

iv) absence of seed dormancy making it possible to sow the seed smmediately after harvest.

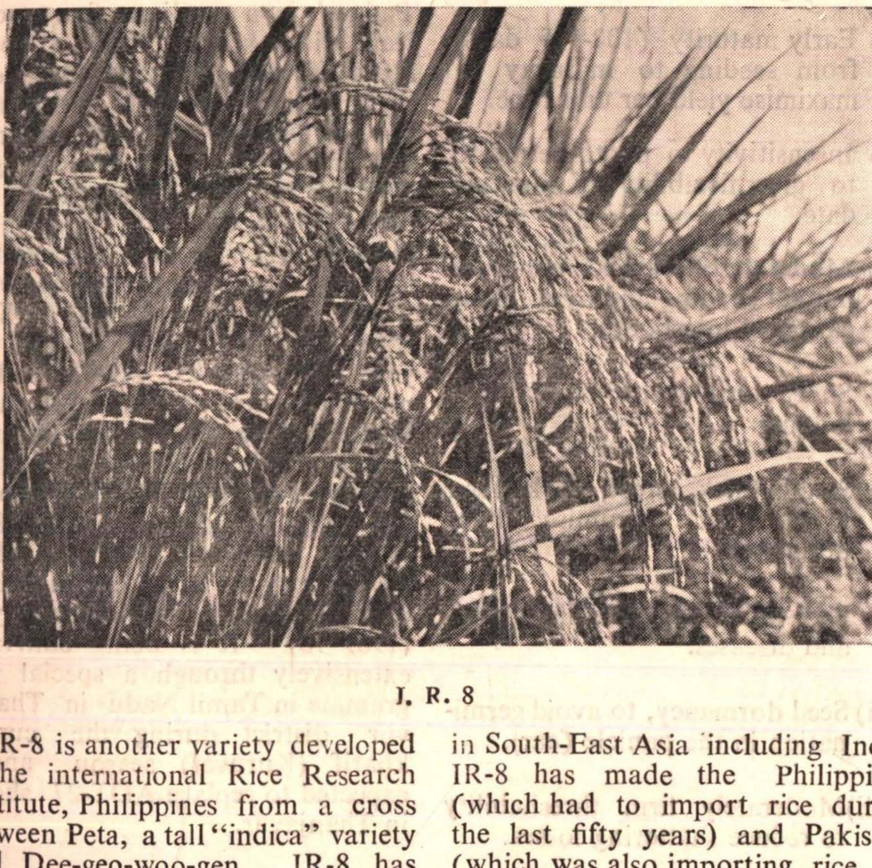
This mutant became the basis of further development in hybrid rice varieties. Many rice growing countries including our own have now developed fertiliser responsive and photo-insensitive varieties which have revealed large possibilities for increasing yields of "indica" rice. Taichung Native-I developed in Taiwan was the first of such high yielding varieties and its development became a major advance in rice breeding. The theory that only "japonica" varieties of rice are capable of responding highly to the application of fertilisers was exploded by Taichung Native-I. Taichung Native-I was developed by crossing a tall "indica" variety Tsai-yuen-Chung with Dee-geo-woo-gen. It has done quite well from the point of yield in the States in which it was introduced, notably Andhra Pradesh and Mysore in South India. However, being a variety which produces coarse grains it does not fetch a good price in our markets and hence its cultivation did not spread much.

A number of tropical "japonica" varieties developed in Taiwan such as Taiwan-3 and Taichung-65 have also done well in India giving yields of 5 to 7 tonnes per hectare. They are very resistant to the



Taichung Native I I. R 8

bacterial blight diseases, but have sticky grains (due to a low amylose content) and their acceptanee in the Indian market was low. Hence attempts have been made to cross "japonica" and "indica" varieties to combine the good characteristics i.e., high yield and good grain quality of both the sub-species during the last two decades. But due to the difficulties in getting the desired combination of characters, it was not possible to develop many varieties. Of the few varieties developed from the "japonica" x "indica" hybridisation programme, A.D.T-27 developed in Madras State by crossing Norin-8 ("japonica") with GEB-24("indica") is the most outstanding. It gives an average yield of about 5 tonnes per hectare as against about 3 tonnes per hectare from comparable local varieties This variety has the additional advantage of a short duration of 105 days with grains which are medium fine with a white rice of good cooking quality. In the course of two or three years from its introduction in 1966 it has replaced almost entirely the short duration varieties grown previously in Thanjavur district. More important, it made possible the expansion of the double cropping programme in this district from the normal of about 3 lakhs acres to 5 lakhs acres.



I. R. 8

IR-8 is another variety developed at the international Rice Research Institute, Philippines from a cross between Peta, a tall "indica" variety and Dee-geo-woo-gen. IR-8 has shown wide adaptability in addition to giving yields as high as 8 to 10 tonnes per hectare in many countires in South-East Asia including India. IR-8 has made the Philippines (which had to import rice during the last fifty years) and Pakistan (which was also importing rice till a few years ago) into exporters of this commodity. Because of its spectacular performance IR-8 has come to be know the MIRACLE Rice and is becoming popular in almost all Rice growing areas in the country. In Kerala it is the major rice variety in ihe High Yielding Varieties Programme. In Tamil Nadu, a "Crash" programme was successfully carried out in 1969-70 to spread it over 7-8 lakhs acres in the State.

The Plant-type concept:

The plant type concept has now become the basis of the hybridisation programme for evolving new varieties of Rice as well as other grain crops. According to this concept, the plant should have the following genetic architecture:

(i) Early maturity (100-125 days) from seeding to maturity to maximise yield per unit time.

(ii) Insensitivity to photo-period to to give flexibility of planting date.

(iii) Moderate tillering to minimize mutual shading and over elongation of internodes.

(iv) Short sturdy stems to minimize lodging.

(v) Small, thick, erect, dark-green leaves to maximise light utilisation.

(vi) Resistance to prevailing pests and diseases.

(vii) Seed dormancy, to avoid germination in the panicle (ear).

(viii) Moderately firm threshability to reduce shattering losses.

(ix) Glaborous leaves and husks to facilitate mechanical harvesting and processing.

It should have in addition high milling yield and acceptable shape, size and cooking qualily of grain with a high protein content.

A great deal of work is now under way for breeding new varieties with the plant type for high yields combined with good cooking quality and nutritive value for ready marketability and consumer acceptance. Under the All India Co-ordinated Crop Improvement Research Programme operated by the Indian Council of Agricultural Research, two new varieties of Rice 'Jaya' and 'Padma' were released in 1968. 'Jaya' matures earlier than IR-8 and gives a higher yield. 'Padma' is a medium fine type of grain with a short duration of about 110 days. It is suitable for growing as rabi and summer crops and also for multiple cropping in areas like Orissa, Bihar and West Bengal. (Padma is not recommended for cultivation in the main seassion in these States). A new rice variety has been developed in the State of Tamil Nadu by crossing ADT-27 with IR-8. It has been realised this year (1970–71) as CO-33 and is popularly known as 'Karuna'. While having the short duration (about 105 days) and the fine grain quality of ADT-27 'Karuna' posses the high yielding character of IR–8. It out - yielded ADT-27 by about 20 percent in trials conducted all over Thanjavur district last year (1969-70). It is being cultivated extensively through a special programme in Tamil Nadu in Thanjavur district during the current kharif (Kuruvai) season and is expected to replace ADT-27 shortly in Thanjavur.

As many of the new dwarf high yielding varieties have been found to be rather susceptible to certain diseases and pests-intensive-research is now being undertaken to develop resistant varieties and also to develop better *plant protection* schedules for controlling pests and diseases.

Some other important high yielding varieties of Rice which have been developed or introduced recently are described briefly in the following paragraphs:

IR-5:

This is a strain developed at the International Rice Research Institute, Philippine. Its parents are Peta, a tall "indica" from Indonesia and Thankai Rotan, a variety from Malaysia. It is weakly photo-sensitive but not seasonal, i.e., the strain can be grown successfully in all seasons. Depending on the photo period it comes to maturity within a period of 130 to 150 days. Trials carried out at the International Rice Research Institute, Philippines have shown that the response of IR-5 to added doses of Nitrogen is rated below that of IR-8; but in areas where the soil fertility is medium or low, IR-5 out-yielded IR-8. The highest grain yield of 6,919 kg/ha. was obtained when a total of 60 kg. N/Ha. was applied during *the panicle initiation* and booting stages. In Tamil Nadu and Southern States (where CO-25 is now grown) CO-25 can be replaced by IR-5 as (1) it out-yields CO-25; (2) does not lodge; (3) responds to high doese of N upto 140 kg/ha, (4) has a lesser duration of about 150 days and (5) the grain has a higher protein content (8·4% against 6 9% in CO-25)

Pankaj (IR-5-114-3-1):

It is an introduction from the International Rice Research Institute, (Philippines) where a longer duration variety (over 140 days) is required to tide over specific seasonal requirements such as damage due to rains at harvest during kharif seasons. From the trials conducted by the All India Co-ordinated Rice Improvement Project, it was found that Pankaj is significantly superior to IR-5 for water logged low lands of rice where long duration varieties are cultivated. Its parentage is similar to IR-5 (Peta x Tangai Rotan) and grows to a height of 90 to 120 cms. Its maturity period is 140 to 160 days It has broad leaves but less erect than IR-8. It is fairly resistant to lodging. The grain is long, bold has less abdominal white with acceptable cooking quality. This variety is reported to yield upto 44 q/ha.

Hamsa:

This is a fine variety among the high yielding varieties of Rice with translucent grains. It fetches a high price in the market like H. R-35 or GEB-24. Hamsa is a derivative from a cross between HR-12 (a cold tolerant and fine grain variety) and Taichung (Native)-I evolved at Rajendranagar (Andhra Pradesh). It is particularly suited to colder regions where due to the lower temperature during the vegetative stage in December and January the thermo sensitive varieties like IR-8 or Taichung (Native)-I do not come up well. It can be raised as a second crop but it is susceptible to pests and diseases including blast and needs all care that is needed for IR-8 or Taichung (Native)-I by way of plant protection.

The variety is gaining popularity in the States of Andhra Pradesh and Mysore.

Jagganath (B.B.S. 873):

This is an irrediated mutant of T-141 (which is one of the parents of Jaya and Padma). It is sensitive to photo period and its maturity period varies from 140 to .70 days. It is slightly susceptible to lodging, but fairly resistant to bacterial blight. It grows to a height of 150 cms. It has medium slender grain without abdominal white and is reported to be of a good quality Like Pankaj, this may also be suited for specific seasonal requirements of some low land rice areas. This variety is reported to yield upto 42 quintal per hectare.

IR-20.

It was selected from a cross made at the International Rice Research Institute (Philippines) between IR-262-24-3 and TKM-6 (a stem-borer resistant variety evolved by the Agriculture Department, Tamil Nadu). It was selected for its resistance to this pest. Its maturity period is 120 days in dry season (December sowings) and 135 days in wet sowings (June sowings) under conditions prevailing in the Philippines. It has medium grain, rice, hard and translucent, free from white belly with a good cooking quality. It has a tendency to lodge when high rates of Nitrogen (70 to 100 kg/ha) are used. It is more resistant to bacterial leaf blight than IR-8. It is reported to have yielded upto 63.9 q/ha in the wet season when IR-8 yielded 61 q/ha. in the Philippines.

IR-22.

This variety was selected from a cross made at the International Rice Research Institute (Philippines) between IR-8 and Tadukan (a Philippine veriety with disease resistance and good grain quality). Its duration is 115 days in dry season (December sowings) and 130 days in wet season (June sowings) in the Philippines. It has long, slender, hard, translucent grains free from white belly. It is more resistant to bacterial leaf blight than IR-8. It may however be more susceptible to Tungro virus disease than IR-20 or IR 8 as it is not resistant to green leaf hopper which is a vector of the virus. It is reported to have yielded 61 q/ha in the Philippines. Purification of seeds of IR-22 is in progress at the International Rice Research Institute along with its evaluation in tropical countries. Seeds are likely to be available to farmers in India during 1971.

IR-20 and IR-22 are not only shorter in duration than IR-8 with a higher yield potential, they have the much needed quality grain with a higher recovery of head rice (unbroken rice) when milled. Therefore, these two new rice varieties may fetch a better price in the market than IR-8 or IR-5.

Basumati Cultures :

Scented rice varieties with fine grain like Basumati have a special preference in the market. Research work done by the University of Agricultural Sciences, Bangalore has yielded a new variety from a cross between Taichung (Native)-I and Basumati which has been named 'Kusuma'. It produces a fine scented rice and yields 5,600 kg. per hectare. It is nonlodging and responds to a high level of fertiliser application. It has 9.4% protein as against 8.7% in Taichung (Native)-I. It can be raised under irrigation during the main seasons. This variety is suited for the Tungabhadra Project area and tank—fed areas round about

Bangalore and rain-fed drill sown areas in Dharwar district.

A new fine rice variety named Sabarmati has been developed by the Indian Council of Agricultural Research recently. Sabarmati is a selection derived from the progenies obtained by crossing TN-I and Basumati-370 and Basumati-370-4. This variety is reported to have yielded over 4 tonnes per hectare [even 5 tonnes per hectare in Delhi and Karnal (Haryana)]. Its grain is medium sized and slender and has a pleasant aroma. It has excellent cooking and nutritive qualities.

WHEAT :

India, till a few years ago, produced only 10 million tonnes of wheat from about 13 million hectares, the average yield being only 1·3 metric tonnes per hectare even under *irrigation*. The chief reasons for the low yield were.

(i) Tall plant habit which results in lodging in fertile soils.

(ii) The rapid rise in termperature in February - March which limits grain development and creates problems of soil and atmospheric drought.

Utilising the dwarf Norin Wheat varieties of Japan, which have a non-lodging plant habit, a number of dwarf wheat varieties were developed in the U. S. A. and Mexico. The Indian Agricultural Research Institute introduced in 1963 seed materials from the Norin Wheat types developed in Mexico, in collaboration with the Rockfeller Foundation and the Mexican Ministry of Agriculture for breeding varieties suitable for cultivation in India. They also imported a number of commercial wheat varieties for testing at the Indian Agricultural Research Institute and also in the field, simultaneously. Two of these varieties i.e., Lerma Rojo and Sonora-64 were introduced for large scale *cultivation in irrigated areas in* 1965. Sonora-64 was recommended for cultivation in Tamil Nadu also. The dwarf wheat varieties 'Lerma Rojo' and 'Sonora-64, introduced in 1965 have become obsolete as these two red grain wheat varieties have now been replaced by other dwarf varieties, which have a better yielding potential and which have amber coloured grains preferred by consumers of wheat in India. They are 'Sharbathi Sonora' released in 1966 and 'Kalyansona', 'Sonalika' 'Safed Lerma' and Choti Lerma' released in 1967. Sharbathi Sonora is rich in protein and Lysine and was developed by atomic radiation. Sharbathi Sonora resembles Sonora-64 in all other respects except quality and colour of the grain. In addition it also has an average of 16.5% protein as against 14.0% in Sonora-64, i. e., 20% more protein. It has a 30% more lysine also. In feeding trials, rats fed with Sharbathi Sonora gained by 10% more weight than those fed with Sonora-64. A great deal of research has been done for developing dwarf types known as "3-gene dwarf" wheat or "triple dwarf" wheat varieties with higher yield potentials. They are being tested.

The wheat varieties Sharbathi Sonora, Sonora-64 and Sonalika can be sown as late as January and have made possible new crop rotations such as Cotton-Wheat and Sugarcane wheat. With the development of these new wheat strains which are not so sensitive to temperature, the cultivation of wheat is now possible in areas like

Tamil Nadu where traditional wheat varieties could not be successfully cultivated due to the relatively warm weather conditions prevailing even in the winter months. Sharbathi Sonora gave a yield of 3.4 tonnes per hectare at Coimbatore (Tamil Nadu) during the 1968–69 season in 85 days. The total wheat production in the country reached 17 million tonnes in 1968 against the previous best of 12 million tonnes in 1964-65. A special stamp entitled "Wheat Revolution" was released by the Prime Minister during July 1968, to commemorate this signal achievement.

Due to the introduction of the high yielding varieties and improved agronomic practices, Ludhiana district in the Punjab (where the Intensive Agricultural District Programme is being implemented since 1961) has recorded the world's highest yield for the last three years in succession. It recorded a yield of 3,044kg. per ha. in 1968–69 while the average yield in the district in 1960-61 was only 1,316 kg. ha. Ludhiana has created a world record in average wheat yield being ahead of top wheat producing countries like Japan, Mexico, U S.A., Canada, Australia, Pakistan and the U.S.S.R.

A number of new wheat varieties are being tested all over the country including EA-222-1 (popularly known as Lal Bahadur) and UP-301 which have both good grain quality and disease-resistance though they have not given yields higher than 'Kalyansona'.

Millets :

With the development of hybrids in jowar and bajra and the perfection of techniques for commercial production of hybrid seed, large scale cultivation of hybrid millet varieties became possible. The jowar hybrid CSH-I and bajra hybrid HB-I and also more recently HB-4, have been found to be suitable for cultivation in almosts all the districts where the traditional varieties of jowar and bajra have been grown, yielding two to three times the yield of the local varieties. Their dwarf hybrid parentage gives them the ability to withstand high levels of fertilisers without lodging. They

Hybrid Jowar CSH-I

are shorter in duration, highly fertiliser responsive and with good soil and water management, give high yields (5 to 6 tonnes per hectare). The Hybrid Jowar CSH-I which matures in 90 days lends itself admirably to ratooning. The ratoon crop yields as much as (if not more than) the planted crop. The hybrid bajra, HB-I, matures in 80 to 85 days and has a uniform tillering habit in contrast to the protracted tillering habit of local varieties which have to be harvested two or three times. Hybrid bajra HB-4, which was recently introduced gives about 26% higher yield and being taller, also produces more fodder than HB-I.

Hybrid Bajra HB-I

As a result of recent work in Jowar the experimental hybrid Ms. 2219 x I.S. 3691 has been developed at the Indian Agricultural Research Institute, Regional Station, Coimbatore. The parents of this new hybrid are, a new male sterile line M.S. 2219 (developed at Coimbatore) and I.S. 3691 the pollinator for CSH-2. It has recorded an all India average yield of 3,387 kg/ha which is 24 percent more than that obtained with CSH-I, 29 percent more than CSH-2 and 59 percent more than the local check in 31 locations spread over nine sorghum-growing States in the country. It is intermediate in maturity between CSH-I and CSH-2. with some tolerance to shootfly. It has hard pearly grain and can keep better in storage than CSH-I. It is more drought resistant than CSH-I which is itself a very high drought resistant hybrid compared to local varieties.

This hybrid would be particularly suitable for cultivation in areas where late September or early October rains usually spoil the grain quality of CSH-I. The assured rainfall areas of Maharashtra, most kharif jowar areas of the Telegana region of Andhra Pradesh, the monsoon areas of Tamil Nadu, the better rainfall areas of the Malwa plateau of Madhya Pradesh and the Bundelkhand area of Uttar Pradesh may be considered as areas of adaption for this hybrid.

An early maturing variety called "Swarna" has also been released in 1968, Swarna gives as high yields as the hybrid CSH-I but is equally susceptible to pests also. But the advantage is that as it is not a hybrid, the farmer can keep his own seeds from "Swarna" for growing successive crops.

Maize :

The area grown under Maize is about 5.5 million hectares in India. The normal yield is less than 1 tonne per hectare. This is among the lowest yields in the world as our conventional open pollinated Maize varieties are poor yielders. It has been proved that the use of hybrid maize can increase our maize yields considerably. Under equal conditions hybrid maize has invariably out yielded local maize varieties as has been proved by trials carried out under the All India Coordinated Maize Improvement Scheme. In all the centres hybrid maize gave yields of atleast 6 to 18 quintals more than the local maize varieties. Many farmers in India now obtain 6 tonnes of maize per hectare.

Maize is a food grain which provides innumerable products for human consumption. The release of Hybrid maize varieties for cultivation has revolutionised maize production. It is reported that in the U.S.A, Hybrid maize has stepped up the acre yield by about 30% and that in the last two decades Hybrid varieties have replaced almost all the older types. In India with the start of the Co-ordinated Maize Improvement Scheme in 1957, several varieties have been evolved and from 1963 trials with Hybrid maize varieties have been carried out in many parts of the country. Nine hybrid maize varieties and six 'composite' varieties were released upto 1967. The 'Composites' are almost as high yielding as the hybrids and have the added advantage that the farmer can keep his own seeds from them for growing successive crops. Of the 'composites', 'Vijay' and 'Kisan' have become popular with farmers. In 1968 the new Hybrid Ganga-5 was released. It is resistant to the "Downy-mildew" disease to which most hybrids are susceptible and becoming popular in many States.

Deccan Maize which is the main variety of Hybrid maize grown in the Southern States, particularly Madras and Mysore is both a grain and fodder crop. It is about 100 days in duration and yields 3,000 to 4,000 kg. of grain and 25 to 30 tonnes of fodder per acre. It is not season bound and if water is available, three crops can be produced in a year. It also fits in very well as a rotation crop and in garden lands along with other crops like rice, cotton and groundnut.

Unfortunately there is no good market for maize in the Southern States and as a result the farmer does not get a good price for his crops. There is, therefore, a pressing need for opening up out-lets for the marketing of maize by (1) introducing maize based industries like the production of break-fast foods, beverages and also starch and (2) for the promotion of the consumption of maize by the local people as a number of common preparations which are made with grains of other food crops can be made equally well with Maize.

Hybrid Maize

Research work done at the Purdue University, USA., recently has shown that strains of Maize with a high lysine content can be produced. (Lysine is an amino-acid in the protein of the maize which increases its nutritive value). Experiments have shown that young animals, fed with maize containing a high lysine content, grow and develop much faster. It is believed that children are fed with maize containing a high lysine content, would have a better chance to grow into more healthy and vigorous adults. This is of very great importance to our country where there is a problem in the nutrition of young children in a good percentage of the population.

Some problems connected with cereals

The cultivation of high yielding varieties is by no means free from problems. It requires the constant personal attention of the farmer who has to see that there is good water management and drainage at all times and keep a close watch for the pests and diseases to which these luxuriant crops are more vulnerable. As has already been mentioned most of the high yielding varieties of Rice and the Jowar variety, CSH-I do not have as good a grain quality as the local varieties. Furthermore, as these are new varieties many of our people have not yet taken to consuming the grain readily. This causes a problem in marketing the grain from the high yielding varieties in some places and calls for an intensive programme for popularising the consumption of these varieties which are more nutritious than most of the local varieties and lend themselves quite well to the preparation of snacks and other dishes such as uppuma, iddili, dosai, vadai, bonda, pakkoda, mixtures and sweets like laddu, Mysore pak and halva which are now prepared from food grains obtained from the conventional non-high yielding varieties

An average Indian citizen gets barely 1,900 calories of food daily as against the requirement of 2,600 calories. The low income groups in the population get much less of their requirements. This is not only because of inadequate production but also because of the heavy losses which occur at various stages during handling. storage, processing, marketing and distribution of foodgrains right from the field to the consumer.

The tropical climate of India is ideal for the multiplication and survival of pests. Among such pests the rodent population has been the cause of high losses in food production. Studies on rodent ecology and habitat and development of effective baiting and fumigation techniques of the burrows have shown encouraging results and have had successful field trials. Rodents are not only a menace in the field but damage food grains in storage and transit. Jute bags treated with rodent repellent are now being used for storing and transporting foodgrains. Organised efforts have to be made to control rodents all over country to cut out these losses.

Insect damage, both in the field and during storage, is heavy. It is estimated that India spent less than 5 million dollars for insecticides during 1965 as compared to the 3,000 million dollars spent in the United States. The growth of the pesticides industry has not taken place fast enough, but the urgency for its development has been realised and it is expected to recieve due prioity under the Fourth Five Year plan

Losses both qualitative and quantitaive, are heavy in stored foodgrains. However, greater attention is being given to the methods for infestation control through the use of scientific techniques, and the use of insect-proof jute bags. The largest problem, however, is that of storing 70% of the foodgrain which is kept in the rural areas where it is produced and consumed. Parpia reports that research work to develop improved storage structures for villages and the use of safe insecticides; namely, the use of the clay containing meta-hydrogen halloysite and the incorporation of tricalcium phosphate in foodgrains have given very promising results.

Recent studies have clearly indicated that improvement in the milling technology of rice by use of rubber roller shellers and improved polishers can increase the milling out turn by 4 to 5 per cent. Improved parboiling techniques developed in the country can supply better quality rice free from toxins and unpleasant odours. It is estimated that extensive utilisation of the new milling techiques can add about 3 million tonnes to food grain supplies in the country.

Douglas Jay, an Economist, observes that a few years ago, it was the fashion for visiting econmists to this country to express a gloomy view of its economic progress pointing to the mounting national debt, soaring population and the food shortages. The growing gap between population and food supply made them to wonder what was the good of constructing steel plants, hydro-electric projects and dams if the people were half-starving. But, Jay observes, with the introduction of the new agricultural strategy the food supply prospect in India has altered remarkably during the last few years. The new strains of wheat and rice introduced recently have transformed the picture throughout the country. Yields have been doubled or even tripled. The cultivation of the new varieties has been extended to very large areas in the course of the last few years through a remarkably wide acceptance of these new varieties which require the application of inputs in quantities to which the farmer was totally unaccustomed. The total area covered under the High Yielding Varieties Programme during 1969-70 and the area proposed for coverage during 1970-71 and at the end of the IVth Plan are given in Table-III.

TABLE - III

CROP		1969—70		1970—71	1973—74
		Target	Coverage	Target	Target
Paddy	...	8.00	7.57	11.00	25.00
Hybrid Maize	...	2.00	0.92	1.50	3.00
Hybrid Jowar	...	4.00	0.25	3.00	8.00
Hybrid Bajra	...	3.00	2.59	3.50	7.00
Wheat	...	10.00	12.60	15.00	19.00
Total	...	27.00	24.93*	34.00	62.00

**Notes :* Information only upto Kharif 1970 and for Wheat 1969–70. In case of Paddy, Maize, Jowar and Bajra, the coverage during Rabi/Summer 1969–70 has yet to become available.

Sceptics believed that our "illiterate" and conservative" farmers will not apply enough fertilisers and plant protection measures to make these new varieties succeed. Here and there this may be true but the sum total result to-date has surprised, if not silenced these pessimists. In a special report on food production in India the Rockfeller Foundation states that the speed with which India's farmers — and Scientists (with the help of materials and counsel from other countries) developed an approach to an abundant food supply has never been duplicated on an equal scale anywhere else in the world.

As Jay states, Japan has demonstrated to the world the simple secret of future agricultural success. Its formula was, leave farming to private enterprise, guarantee a price to the producers and subsidise the consumer. By exploiting the new technical knowledge, providing an incentive price for the produce and subsidising the consumer from taxation, Japan has achieved a large rice surplus from its small farms. Its store-houses are overflowing now with a 5½ million tonnes rice surplus to which 1½ million tonnes is likely to be added this year. The food grain output in India during 1968-69 was 8 million tonnes larger than the previous record output of 89 million tonnes of 1964-65. The output during 1969-70 is estimated to be around 100 million tonnes which will be the highest on record. Applying the same principles and adopting an almost similar policy as it is doing now, India could well become an exporter of food grains in the 1970s.

REFERENCES :

1. Beachell H.ve and Jennings P. R. *"Need for modification of Plant Type"* - **Symposium on the Mineral Nutrition of the Rice Plant.** Research Institute, Philippines (1964)

2. Cochrane W. W. *" The World Food Problem"* Thomas Y. Cromwell (1969).

3. Gurupadaswamy M. S. *"Role of Agriculture in the Indian Economy"* **Bharat Krishak Samaj Year Book** (1968)

4 Jay Douglas *"Green Revolution boosts the case for aid"* **Economic Times** (3rd February, 1970)

5. Johnson A. A *"The present position and future prospects for rapid increases in Rice Yields"* - **ORYZA** (Extension Number), 1969.

6. Lewis, John P. *"Wanted in India: A relevant Radicalism"* **The American Review** (USIS) April 1970.

7. Parpia H. A. B. *"Research in Food Technology"* **Participant Journal** Vol **V**, No. 1 (July, 1970)

8. Sarma J. S. *"Feeding India's Population in 1980"* (A quantitative Assessment) **Paper presented at the National Food Congress,** 1970.

9. Swaminathan M. S. *"The age of Algeny. Genetic destruction of Yield Barriers and Agricultural Transformation"* **Presidental address at the Fifth Indian Science Congress.**

10. Wheller - McMillen *"The grain with a thousand uses" Useful Arts of Man-the Green Frontier"* **Stories of** chemurgy. G. P. Pukuams Sons, New York (1969).

ROLE OF PUNJAB AGRICULTURAL UNIVERSITY IN "GREEN REVOLUTION"

BY

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For the last two years we have witnessed what is popularly known as 'Green Revolution' in Punjab and Haryana. The spearhead of this change is the Punjab Agricultural University which has played a pivotal role in bringing about a change in the attitudes and understanding of the farmers and in convincing them to adopt modern technology.

The acceptance of this technology has been reflected in the phenomenal increase in wheat production. Since 1967 the wheat yield is touching a new height. Last year when Punjab produced forty two and a half lakh tonnes of wheat, it was an all time record, but this year the wheat yield is expected to be about fifty lakh tonnes. If this rate of progress is maintained, the day is not far off when we can cut off import of food-grains from abroad.

If we take a close look at the increased agricultural production, we will notice that a number of factors have contributed to it. In Punjab these factors are : a good agricultural base provided by the scheme of consolidation of holdings on a state-wide basis, speedy rehabilitation of refugees from west Pakistan, hard working and intelligent farming population, new varieties of wheat particularly the Mexican wheats, increased use of fertilisers and other inputs, tapping of the ground water by tube wells, powered both by electricity and diesel and credit facilities etc.

The biggest single factor which has sparked the green revolution is the varieties of wheat PV-18, Kalyan-227, and S. 308, developed by the Punjab Agricultural University from material originally received from Mexico. The yield potential of these wheat varieties is as high as 60 quintals per hectare as against 30 quintals of the best indigenous tall varieties. These new varieties give yields which are double to triple the yields of traditional varieties. Being short-stemmed they can absorb large quantites of fertilisers without lodging as compared with the traditional varieties which grow too tall, become top heavy and fall down. They are much more responsive to fertilisers at all levels of application. A given amount of fertiliser produces a much greater increase in yield in the new varieties than in the old varieties. Apart from this, they are adaptable to a broad range of latitudes.

Tube Wells

These high yielding varieties of wheat require copious irrigation which the canals cannot provide. As such sinking of tube wells becomes necessary even in the canal irrigated areas where irrigation intensity is low. Apart from supplementing irrigation the tube wells would *maintain ground water level* at an optimum depth, thus saving the land from water-logging and salinity.

Chemical Fertilisers

Because of the new strains of wheat and other researches in this University on improved farm practices, the consumption of various inputs has also increased tremendously over this period. The figures of fertiliser cosumption in India indicate a rise from 2.94 lakh metric tonnes in the year 1961-62 to 8.97 lakh metric tonnes of nitrogenous fertiliser (N) in 1968-69. Phosphatic fertiliser (P) consumption increased from 72 to 549 thousand metric tonnes. Potassic fertilisers (K) consumption increased from 32 to 279 thousand metric tonnes.

In Punjab, the chemical fertiliser consumption increased from 49 to 545 thousand metric tonnes in this period.

Farm Machinery

The phenomenal increase in the production of foodgrains has not only saved the country from a great political crisis but has also provided a stimulus to the economy. There is now less talk of recession in the industrial sector. A large demand for consumer goods has arisen. Industries which manufacture bicycles, sewing machines, transitors and textiles have benfited a great deal from the agricultural revolution. The requirement of new agriculture, in the terms of fertilisers, plant protection chemicals, pump-sets, electric motors, pipes, sprayers and dusters is endless. In fact a projected demand for all these agricultural inputs has to be recalculated.

With the ready availability of water all the year round from tube wells, double or even triple cropping has become a common practice. Farmers no longer want to waste their time on harvesting and thrashing wheat with traditional bullock power. Moreover, the increase in the quantity of wheat crop is about three hundred per cent and this vast increase can only be tackled by machinery and not by animal or man-power. The number of power-driven thrashers in the year 1962 was negligible and has suddenly increased to 80,000 in the year 1968-69.

Demand For Tractors

Small thrashers powered by electricity or diesel are now a familiar sight in the Punjab countryside. The need to prepare the seed-bed quickly and to plant the next crop has generated a great demand for tractors. In 1961, Punjab had only 4,997 tractors and in 1969 there were 13,000. The total demand envisaged is about eighty thousand. The farmers use the tractors not only for ploughing their land and thrashing their grain but also for custom hire. There is a strong case for setting up a tractor factory in Punjab which is the foremost State in using this multipurpose machine.

Intensive farming with the new technology has generated the demand for more farm labour. As a result. acute labour shortage has arisen. Another contributory factor is that after receiving education, the sons of Harijans, who are landless labourers, are going into professions and skilled jobs and are no longer interested in working on farms as unskilled labourers.

Storage

Another innovation which merits mention here is the metal storage bin developed by the College of Agricultural Engineering of the University. The air-tight metal storage bin saves the foodgrains from damage by pests. During the year 1969 about 10,000 storage bins have been distributed to the farmers at concessional rates. Its use is likely to grow and would result in saving of large quantities of food-grains from insect-pests.

Agricultural Engineers

Here it would be relevant to refer to the excellent work done by the College of Agricultural Engineering of the Punjab Agricultultural University. Besides training agricultural engineers and providing technical guidance to industry, this college has done excellent research in the field of agricultural machinery. The pieces of equipment developed by the College, such as fertilisers-cum-seed-drill, bullock and tractor operated reapers, potato havesting machines, groundnut digger and storage bins have already been taken up by private industries for manufacture.

Pau's Link With Farmers

Established in 1962 on the pattern of the Land Grant Colleges in the United States of America, the Punjab Agricultural University has a very effective extension programme for promoting agricultural development. The Directorate of Extension Education of the University, functions as a link between the farmers and the research scientists of the University. The Farm Advisory Service has in each district, specialists in agronomy, plant protection, soil, horticulture etc. The Direcorate has selected 200 private farms all over the Punjab State as demonstration farms which provide education to the surrounding farmers.

Kisan Mela

An Annual Farmers' Fair (Kisan Mela) is organised at the Univeresity in the month of March during which the latest techniques and improved implements are demonstrated to the farmers. Dummy demonstrations are laid in respect of crops which are not sown in that month and all processes from seed treatment to harvesting and storage of grains are explained. A face-to-face discussion between the farmers and the experts of the University is arranged in which questions are answered. The diseases of plants are diagnosed and sample of soil and water tested on spot. Beside's improved seeds of various crops are sold to the farmers. In fact, this is the biggest attraction of the Kisan Mela.

Twice a year a Workshop for Agricutural Officers is arranged at which the latest research findings are explained to the extension staff of the State Department of Agriculture. Training camps for farmers are also held at the district and block levels.

Short courses on poultry farming, horticulture, vegetable growing, fruit preservation, tractor driving and mangement of pumping sets are arranged for the benefit of farmers. Training is also provided to school teachers, bankers and officials of the Co-operative Department. Thus, the University brings under its programmes, people from different professions and fields and imparts them orientation so that they understand the problems of agriculture better. In all, about 115 training and refresher courses are held in a year.

Now the main problem is how to sustain the green revolution. The crucial factor is an incentive price for wheat. This must be maintained. Unfortunately, there is a tendency on the part of the Government of India to increase the price of imputs such as prices of diesel oil and fertilisers while no allowance is made for such increase in finding the price of wheat. Thus, a process of erosion of farmers' profit has started which will ultimately have an adverse effect. Another bottleneck which has arisen is the shortage of power. Tapping of ground water and thrashing of wheat are dependent on electric power. Recently, there has been a great shortage of electricity which has given a set-back to the thrashing of wheat and has thus affected the market arrivals. This shortage in electricity must be made up even at the expense of industry. Moreover, no taxation policy should be adopted which may result in the waste of time of the farmers. For the first time in the history of India, time has acquired value for the farmers. A good farmer spends his energy and intelligence on organising his agriculture and if any fiscal measures are adopted which may divert their energy to litigation, it would not be in the interest of the country.

DEVELOPMENT OF WATER RESOURCES & ITS IMPACT ON CEREAL PRODUCTION

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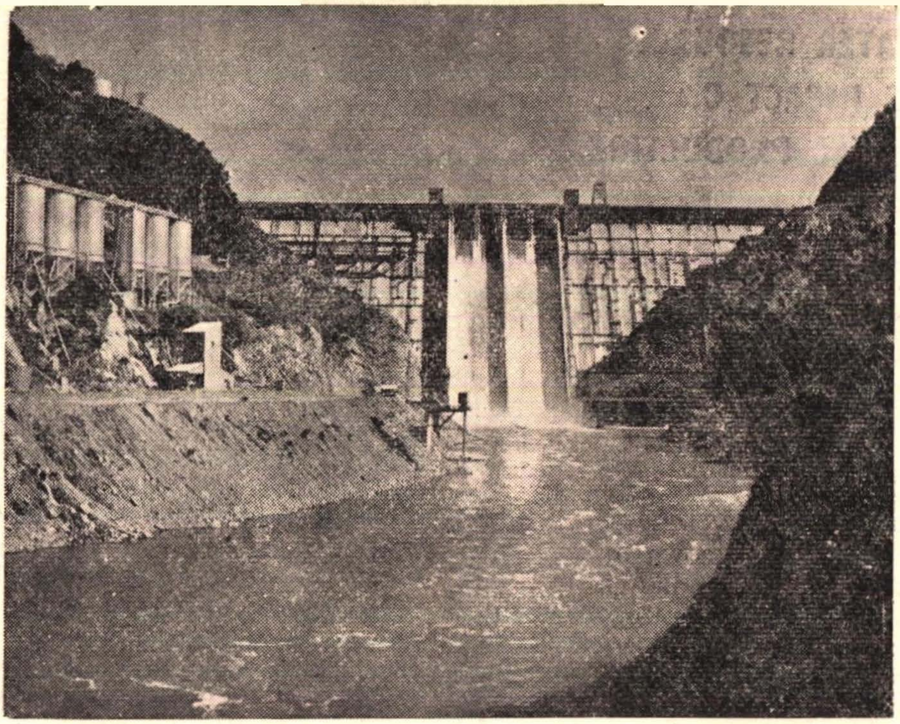
Irrigation is known to have been practised in India from times immemorial. For a tropical country like ours, which experiences long spells of sunshine, and occasional rains, this was but a natural development for successful cultivation of crops. The early settlers learnt the need for irrigation and the rudiments of water conservation from their everyday experience. No wonder, therefore, that a large number of tanks and wells were in use in India, even before the dawn of recorded history, when this practice was totally unknown over large parts of the world.

Appreciating the crucial importance of irrigation to agriculture, ancient rulers of India had accorded great priority to these works; and references to them abound in old literature. The country had acquired sufficient knowledge and expertise in hydrology and irrigation matters that the Cholas could build a surplussing structure across river Cauvery in the early 2nd century to provide irrigation for Thanjavur delta in Tamil Nadu - a unique achievement by all existing standards. Centuries later, the Mughal rulers, probably drawing their inspiration from the numerous inundation canals on river Indus took out canals from the Ravi and the Jamuna. A large number of other works like wells and tanks, big and small, also came into existence in different parts of the country.

Development of Irrigation under the British Rule.

Development of irrigation received a much greater emphasis during the British rule. Beginning with renovation and remodelling of existing works, they undertook new works like the Ganga Canal and the Godavari and Krishna delta canals. The expansion works, in the early stage, were mainly confined to the level plains of Indus and Ganga in the north and the deltas of Cauvery, Krishna and Godavari in the south and the main motivation was revenue. Strict financial norms for investment on irrigation works were adopted by the Government to secure attractive dividends. Later under pressure

*The views expressed are purely the personal views of the author.



Bhakra Project

of severe famines during the latter part of the nineteenth century, protective type of irrigation, mainly in the form of tanks, diversion canals and canals with storages were constructed after making considerable relexation to the rigid financial rules. Areas which benefited mostly from such type of works were the scarcity prone tracts in Uttar Pradesh, Madhya Pradesh, Maharashtra, Bihar and Orissa.

The frequent occurrence of famine in different parts of the country prompted the Govt. of India to appoint the first Irrigation Commission in 1901. It was assigned the specific task of reporting on irrigation as a protection against famine. Besides making a comprehensive study of irrigation development till that date, future prospects of devlopment and specific recommendations regarding financing and maintenance of irrigation works, the Commission had examined the working of all existing irrigation works and details of practically every new scheme under consideration at that time. The report of the Commission was submitted in 1903 and most of the recommendations were accepted by the Govt. This gave considerable impetus to construction of new works particularly in areas prone to frequent occurrence of famine. Godavari canals and the Nira right-bank canal in Maharashtra, Weinganga and Mahanadi canals in Madhya Pradesh and Triveni canals in Bihar were some of the important works completed in such areas as a result of the recommendations of that Commission.

In spite of the compelling pressures of famine, the Government of India did not desist from taking up new, more paying works. Bigger schemes, bold in concept, design, execution and irrigation potential, requiring greater investment like the Triple Canals, the Sutlej Valley Project and the Sukkur Barrage, all now in Pakistan and the Sarda system of canals in Uttar Pradesh were constructed during the present century. The Irrigation Commission too had recommended these works in their Report. The Central Government also assisted native states like Mysore and Hyderabrd to undertake new works. Besides, farmers were encouraged to dig their own wells. The sum total of all the efforts made under the British Rule resulted in a total net irrigated area of 28.33 million hectares in the whole of Indian sub-continent of which about 55% was irrigated by canals, 11% by tanks, 23% by wells and the remaining by other miscellaneous sources.

Independence and the

Five Year Plans

The precarious balance between population and resources that was gradually built up over decades was upset by partition and India was left with 81% of the population, 77% of the geographical area and 68% of the irrigated area. Undaunted by the enormity of the problem, the country launched a bold programme of economic development in 1951-52 aimed at self-sufficiency in food production and modernisation of the economy. Agriculture received priority in allocation of funds in the Plans and within agriculture, irrigation development received greater consideration. The following table which gives the expenditure on irrigation including flood control and the aggregate plan outlay is indicative of the magnitude of efforts undertaken during the period covered by the Five Year Plans.

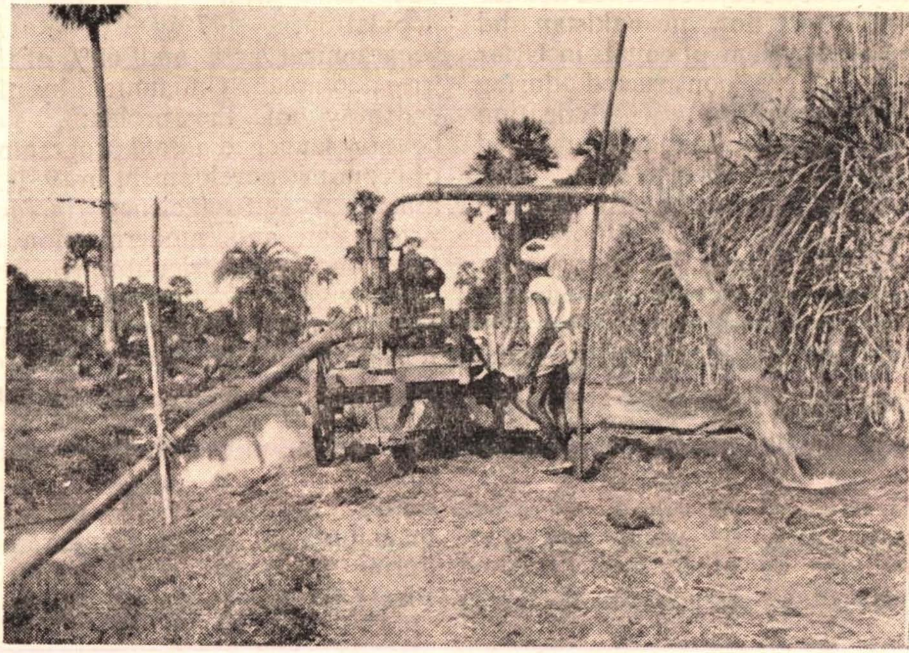
(Rupees in crores)

	Total Plan outlay	Expenditure on irrigation	Percentage share of irrigation in the Plan
1st Plan	1960	478	24.4
2nd Plan	4672	523	11.2
3rd Plan	8577	937	10.9
1966-67 to 1968-69	6676	771	11.5

As compared to Rs. 2709 crores expended on irrigation during tne 18 years from 1951-52, the aggregate amount spent during 150 years preceding, was hardly Rs. 156 crores.

Physical increases in irrigation during the Plan periods.

In terms of area irrigated, the achievement, though substantial, was not that spectacular. Net area irrigated increased from 20.2 million hectares in 1949-50 to 24.7 million hectares at the end of the Second Plan and 27.5 million hectares at the end of 1966-67. This meant an increase of 36% over 17 years or roughly two per cent per annum. It may be noted that while a part of the new irrigation facilities created under new major and medium schemes went to stabilise or replace the already existing irrigation, in case of minor works, a number of them were falling into disuse due to neglect etc. which had an inhibiting influence on expansion of irrigation. Increase in the proportional share of irrigated area in the total net sown area in the country was from 17% to 20% during this period. The apparent slow pace, however, was due to constant additions to cultivated area through conversion of marginal lands.



A Trolley Pump-set in operation

Major means of irriyation in the country are canals, wells, tanks and other sources in the proportion of 41%, 34%, 17% and 8% respectively. Compared to the bench mark levels of 1950-51, the maximum expansion in irrigation has been achieved through wells followed by canals. There has been a big increase in the number of lift pumps and tubewells in use during this period. Number of diesel pumps increased from 0.68 lakh to 6.84 lakhs; electric pumps from 0.18 lakh to 10.62 lakhs; private tubewells from 0.04 lakh to 2.90 lakhs and State tubewells from 0.03 lakh to 0.15 lakh. This development was quite significant in the sense that it imparted greater stability to agriculture and facilitated its intensification in the command areas of these works. The success of the new dwarf wheat varieties in the Indo-Gangetic plains has been, to a large extent, due to assured and controlled irrigation provided by such minor irrigation works.

Impact on agricultural production

Agricultural production, particularly production of cereal crops, showed a definite uptrend since the launching of the Plans. Between 1949-50 and 1968-69 production of rice increased from 25.1 million tonnes to 39.8 million tonnes, wheat from 6.8 million tonnes to 18.7 million tonnes, cereal crops as a group from 50.7 to 83 6 million tonnes and foodgrains as a whole from 60.7 to 94-0 million tonnes. In 1969-70, foodgrains production has been reported to have touched the 100 million tonnes mark for the first time. The linear growth rates of Economics and Statistics (Ministry of Food, Agriculture, Community Development and Cooperation) indicate an increase of 3.61 per cent per annum during the period 1949-50 to 1968-69. This was in significant contrast to the sluggish performance of foodgrains production during the pre-Plan period. According to some studies*, foodgrains production was virtually stagnating during the first quarter of this century and in the following quarter it, in fact, registered a decline Thus, it was only after the inception of the Five-Year Plans that definite signs of a break with the past in agriculture emerged and these signs have been more perceptible in receptible in recent years.

Yields contribute more to increase in production than area.

An important qualitative aspect of the new change has been the increase in average yeild of almost all the important cereal crop grown. It is observed that in recent years a large proportion of the increase in crop production has been due to productivity factors i. e. increase in yield per acre rather than addition to crop acreage.

It is, however, unrealistic to assume that the entire increase in crop productivity was solely due to extension of irrigation. A number of agricultural programmes were initiated during the last 20 years or more, which included the 'Grow More Food Campaign', the Community Development and National Extension Programmes, popularisation of Japanese method of paddy cultivation, the Intensive Agricultural Development Programme, the High-yielding Varieties and multiple Cropping Programmes and a number of supplementary schemes for promotion of fertilisers, green manure, pesticides, improved seeds, minor irrigation etc.. and all of them should have had some impact on agricultural production. Nevertheless, availability of irrigation facilities including assured rainfall has been the basis everywhere on which progressive agriculture was built up and complementary increases in crop productivty achieved. Most of the States which registered high rates of growth in crop yields like Punjab, Tamil Nadu, Haryana, Andhra Pradesh, Kerala etc. had either a good proportion of cropped area under irrigation or assured rainfall as in the case of Kerala.

Trends in yield of rice and wheat under irrigation

The significant differences in performance observed in yields of rice and wheat between groups of States when combined according to level, of irrigation, further substantiates the point made above. For this analysis States have been grouped into three categories, based on date for 1966-67 namely, those with:

a) less than 20% irrigated area under rice/wheat,

b) between 20% to 50% irrigation under these crops, and

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* S. R. Sen—Growth and Instability in Indian Agriculture-Journal of the Indian Society of Agricultural Statistics, June, 1971.

c) more than 50% irrigation:

The States falling into the three categories are as follows :—

Rice

a) Less than 20% irrigation: Gujarat, Madhya Pradesh, Maharashtra and Uttar Pradesh.

b) Between 20% to 50% irrigation: Assam, Bihar, Orissa, Rajasthan and west Bengal.

c) More than 50% irrigation: Andhra Pradesh, Haryana, Kerala, Mysore, Jammu & Kashmir, Delhi, Himachal Pradesh, Punjab and Tamil Nadu.

Wheat

a) Less than 20% irrigation: Madhya Pradesh and Jammu & Kashmir.

b) Between 20% to 50% irrigation: Andhra Pradesh, Bihar and Maharashtra.

c) More than 50% irrigation: Delhi, Gujarat, Haryana, Orissa, Punjab, Rajasthan, Uttar Pradesh and West Bengal.

Average annual yields of rice and wheat were worked out for these three groups for 19 years from 1950-51. Linear regressions were fitted to this date to estimate the rate of growth in productivity, separately for these crops and following table presents the relevant data:—

Average annual rate of growth (per cent) in productivity in respect of group of States with :

Crops	Less than 20% irrigation under the crop.	20% to 50 irrigation under the crop.	Over 50% irrigation under the crop.
Rice	1.3	2.6	2.7
Wheat	1.9	3.0	3.1

It is clear from the above table that with increase in the proportion of area under irrigation, whether in respect of paddy or wheat,significant increases in productivity were also observed. The rate of growth in yields in respect of rice was 2.7% per annum in the group of States with 50% irrigation and above as compared to 1.3% observed in the case of the first group with less than 20% irrigation. Similar was the case in respect of wheat. This was quite natural to expect because once water is assured to fields, farmers are generally more than willing to adopt yield-raising technology and apply costly inputs like new varities of seeds, fertilisers, pesticides etc. The resulting increase in crop production and crop productivity are, therefore, due to a number of factors and their interaction. It is, however, relevant to observe that there is hardly any significant difference in the rate of growth of productivity recorded by the medium group of irrigated areas (between 20% to 50%

irrigation), and the highly irrigated areas (more than 50% irrigation), in respect of both rice and wheat crops. It appears plausible that the traditional methods of irrigation management in vogue have been giving rise to excessive or in opportune watering of crop, water logging, salinity etc. increasingly inhibiting yields particularly in the highly irrigated areas. This point, however, needs further investigation.

Increase in yields due to irrigation

It may be worthwhile posing the question at this stage as to how much is the contribution of irrigation to the overall increase in yields? Unfortunately, there are no reliable data available on a national scale to give any definite indication in this regard. Some fragmentary data, however, exists in the Intensive Agricultural Development Programme (I.A.D.P.) districts, thanks to the statistical efforts made under that programme to increase the number of crop-cutting experiments in the districts to obtain reliable estimates of crop production at that level.

High Yielding Dwarf Wheat Crop

The Institute of Agricultural Research Statistics has tabulated the available data cropwise for each district for the following input combinations: —

OOO : No irrigation; no fertilzer; no manures..

OOF : No irrigation; no manures; fertilizer is used.

OMO : No irrigation; manure is used; no fertilizers.

OMF : No irrigation; manures and fertilizers are used.

IOO : Irrigation with no feritilizer and manures.

IOF : Irrigation with fertilizer use; no manures.

IMO : Irrigation with manures-no fertilizers.

IMF : Irrigation with fertilizers and manures.

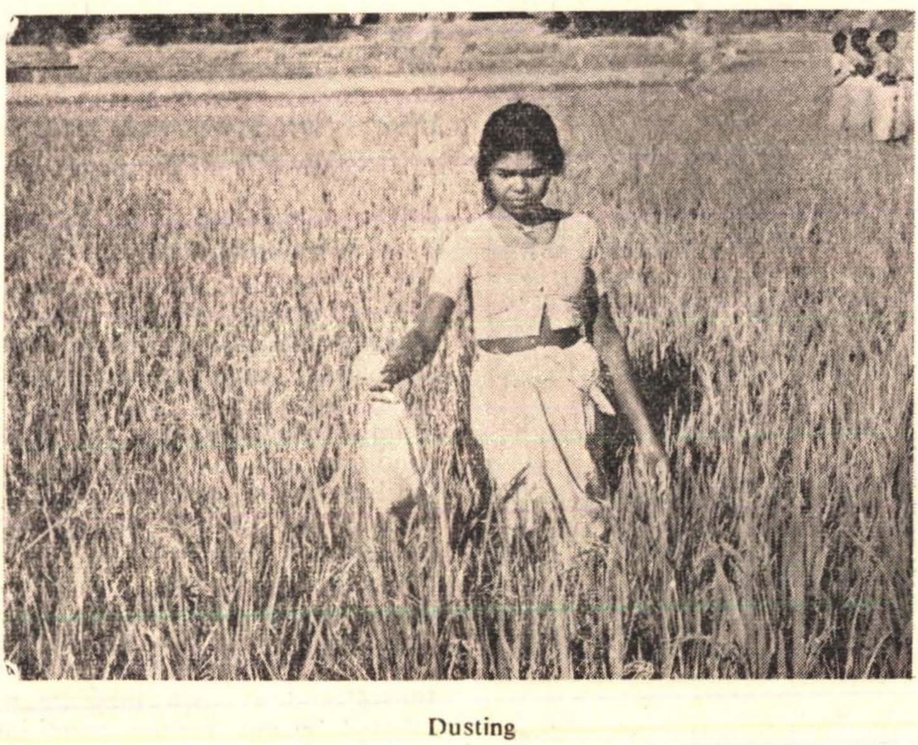
Data in respect of such crops for which details as above were nearly complete, have been included for aggregation and analysis. The average yield under the basic condition of no irrigation, no fertilizer and no manures; i.e. 000 is assumed as hundred and relative indices have been worked out for other input-categories. These are then averaged for different crops. Data made use of for the purpose relate to the period 1961-62 to 1964-65 and as such they are not affected by any serious conditions of wide-spread drought. They do not also reflect the impact of the new dwarf high yielding varieties of crops on yields. The relevant details are presented in the following table :

Comparative level of yields obtained in IADP district for different input combinations :

	OOO	OOF	OMO	OMF	IOO	IOF	IMO	IMF
Rice	100	127	120	152	144	177	143	177
Wheat	100	116	111	125	147	172	162	197
Maize	100	145	129	131	121	160	135	173

The data are broadly indicative of the relative contributions of irrigation, fertilizers and manures and their combinations to yields. Compared to a basic non-irrigated situation, rice and wheat, on an average, yielded 45% more, when irrigation was available and 75% more when fertilizers were also applied. Generally, maximum increases in yields were observed when all the three inputs, namely, irrigation, fertilizers and manures were applied. It is, however, important to note that the maximum level to which complementary inputs, namely, fertilizers and manures, were capable of raising yields when applied without irrigation was about 30% - the levels indicated by wheat and maize rather than rice, the cultivation of which pre-supposes a minimum availability of water.

The varietal changes taking place in Indian agriculture from the mid-



Dusting

sixties has made possible realisation of much higher increases in yields than indicated by the input combination of I.M.F. in the above table. Adequate irrigation facilities and improved agricultural practices are assumed, if the new varieties of rice, wheat and hybrid millets are to give the expected yields. The rated average potential per hectare of these crops are in the range of 5 to 6 tonnes in the case of rice, about 5 tonnes for wheat, 4 to 4.5 tonnes for hybrid maize and jowar and 3.5 tonnes for hybrid bajra. The average yields and maximum yields obtained under National Demonstration trials on cultivators, fields during 1965-66 to 1968-69, by making use of high-yielding varieties and package of practices, presented in the following table, indicate that the former levels could be achieved with some effort and even then there would be enough scope for further improvement.

Production potential obtained under National Demonstration during 1965-69

Crop	Average yield in the country	Average yield under National Demonstration	Highest yield obtained	Remarks
Paddy	9.60	50.68	152.89	In Rajasthan in 1968-69.
Wheat	9.96	39.51	102.00	In Madhya Predesh in 1968-69.
Maize	10.21	42.32	97.50	In Punjab in 1968-69.
Jowar	5.02	35.28	99.44	In Mysore in 1968-69.
Bajra	3.50	30.96	67.00	In Haryana in 1966-66.

Source : J. S. Kanwar, Land Resources in India to Meet Food Challenge-paper presented to the National Food Congress 1970.

The experiment of Intensive Agricultural District Programme in some of the districts in the country has given ample proof that significant increase in production and yield are possible even within a short period. Instance to the point is Ludhiana in the Punjab which has a net cultivated area of 3.13 lakh hectares of which 34% is double cropped. Over 70% of the total cropped area in the district receives irrigation, mainly from minor irrigation works like tubewells, wells, etc. While the total cultivated area in the district had remained steady, there had been a considerable increase in the area under foodgrains, particularly wheat. Yield per hectare of food-grains which include wheat, maize and gram) increased from 1.28 tonnes in 1960-61 to 2.08 tonnes in 1966-67 and to 2.81 tonnes in 1967-68. In the case of wheat which accounts for 40% of the total cropped area, the average yield per hectare rose from 1 56 tonnes in 1960-61 to 2.65 tonnes in 1966-67 and further to 3.35 tonnes in 1967-68. The order of increase in yields achieved during the course of 8 years from 1960-61 was over 115%. This clearly indicates that an average yield of 2½-3 tonnes per hectare is within the reach of the Indian farmer provided he is given the necessary wherewithal including extension support

Future Prospects :

The gross irrigated area in the country at the end of 1968-69 was 35.9 million hectares, of which 25 million hectares were irrigated by surface sources and 10.9 million hectares by ground water sources. The efforts made under the Plans since 1951-52 up to the end of 1968-69, created an irrigation potential of about 9 million hectares, 82% of which has been pressed into service. Efforts are also being made to ensure the utilisation of the remaining unutilised potential. As a proportion of the total cropped area of 160 million hectares, the gross area irrigated in 1968-69 works out to 22%.

Nearly 80% of this area was under foodgrains, mainly rice and wheat. The average potential yield of the high-yielding varieties of food crops like rice, wheat and hybrid millets being in the range of 3.5 to 6 tonnes per hectare, and as their cultivation is largely confined to irrigated areas, it is technically possible to realise from this limited area alone, what the entire country has been producing in recent years. This would mean that the country can comfortably tide over the carbohydrate deficiency in the diet of her people in the near future itself. However, the question of balancing the diet with adequate protein and fat contents will still remain.

The average level of water resources that can be harnessed for agriculture is 630 million acre ft, 450 million acre ft. from surface sources and 180 million acre ft. from groundwater sources and the total irrigation potential which these water resources are capable of creating is estimated at 82 million hectares, 60 million hectares from the former and 22 million hectares from the latter. Of this what has been realised to date has already been indicated — 25 million hectares or 42% of surface water potential and 10.9 million hectares or 50% of groundwater potential. This leaves a wide gap, particularly in respect of surface water resources. It is generally hoped that during the course of the next two or three decades the country would make steady progress towards realisation of this ultimate potential of 82 million hectares of irrigation.

Even after realising the entire irrigation potential, nearly half of the cultivated area in the country is likely to remain exposed to vagaries of weather. The problems of these areas, which have not received adequate attention in the past, should claim greater attention in future. It is important to note that these are the areas which produce most of the pulses and oilseeds crops which provide most of the protein and fat in the Indian diet. Bulk of the fibre crops in the country also come from these. Hence, development of these areas has a special significance to the overall well-being of the country. These areas are poorly endowed; rain fall is particularly scarce and highly variable. Development efforts in these areas should therefore concentrate on evolving appropriate dry farming techniques including moisture conservation measures. Introduction of high yielding varieties of crops which are drought avoiding/resisting, suitable cropping patterns evolved through 'area-based' research, and a new scientific approach towards conjunctive use of rainfall, surface and ground water on the part of farmers would be crucial to the success of any agricultural programme in these areas.

The present utilisation of both land and water in irrigated areas leaves much to be desired. There is, as yet no significant difference in intensity of cropping as between irrigated and unirrigated areas. In fact, the latter areas had a higher proportion of double cropped lands compared to irrigated areas during the fifties. If 1964-65 intensity of cropping was 1.15 in both the areas. There is, however, some evidence of an increase in double cropping in irrigated areas in the following two years when there had been a big spurt in minor irrigation works but the figures in respect of unirrigated areas for these years are not comparable due to the widespread drought conditions prevailing. The High-yielding Varieties Programme mounted since 1966-67, with short-duration, photo-insensitive varieties of rice, wheat etc. and the Multiple cropping Programme launched thereafter, are aimed at intensification of agriculture in irrigated areas. But the success of this programme would depend on the removal of certain constraints holding up intensification of agriculture like irrational preferences for particular crops, rigid adherence to unsuitable cropping patterns etc. and also adoption of promotional measures like a minimum level of mechanisation of essential agricultural operations, conjunctive use of water resources, marketing assistance etc. In the command areas of canal irrigation works, whose limits have been drawn rather wide to accommodate as many cultivators as possible to afford a greater measure of protection in drought years, there should be greater stress on supplemental irrigation from ground water sources, wherever feasible, if double cropping has to be supported. A more judicious use of available water, particularly from government canals, is also an essential pre-condition. If a minimum of two crops can be uniformly raised on all irrigated lands, not only the gap between the present level of irrigation and the ultimate potential will be narrowed down but our progress towards the long cherished goal of self-sufficiency in food will also be much quicker. Besides, since scarce land resources in the country have been provided with irrigation at considerable cost to the community, it is very important that these areas are utilised fully to the best advantage of all.

Nearly 200 million acre feet of water is utilised for irrigaion today and the gross output of foodgrains is about 100 million tonnes. Since only one-fifth of the area which produced this output is irrigated, it is obvious that bulk of the water resources are expended on a limited area to produce a limited crop, from the all India point of view. The wastage of water on farmers, fields through flooding and 'field to field' irrigation is now well known. Progress in the field of intensive cropping, discussed earlier would depend, to a considerable extent, on how efficiently and quickly the problem of management of irrigation water is solved. The situation can improve only when fields are properly shaped, water channels carefully planned, and supply of water at the approprate time assured to farmers. Proper drainage of fields also has to be ensured. The farmers need to be educated on requirements of their growth when irrigation is crucial etc. and the most efficient and economical ways of irrigating fields. All the government agencies, including Departments of Irrigation, Agriculture, Revenue, Cooperation etc. have to coordinate their activities in irrigated areas, to facilitate a smooth change over to a new system of irrigation practice, on which mainly depends the future prosperity of Indian agriculture.

NEW TRENDS IN BULGARIAN GRAIN PRODUCTION

BY

T. TAUMBOV

Bulgarian agriculture holds a place of major importance in the nation's economy. It meets the nation's needs for foodstuffs, the requirement for raw material in a series of industrial branches and still sets aside a considerable portion of its output for export, thus contributing for the international division of labour. Stagnation in farm production may cause a lag in the production of whole industrial branches and, therefore, its all-round development, further concentration and specialization and the introduction of industrial technologies and methods of management are an object of serious and ceaseless solicitude on the part of the State and personally of Todor Zhivkov, the Prime Minister of the People's Republic of Bulgaria.

It may be said that the main problems in farming have been resolved more than two decades ago. It was at that time that the decision was made which road to take in order to do away with the existing extreme backwardness in agriculture, hard labour and poverty among the great majority of the peasant population. Bulgaria proceeded to setting up co-operative farms and to a voluntary merging of the small, fragmented plots into large tracts of arable land as well as to mechanizing all farm work. The co-operative farms formed in all villages proved a success. Their first achievements attracted the vacillating farmers to them and somewhat later, even the most sceptic unbelievers. The introduction of machinery into all branches of farming brought before long to the fore the problem of a further extension of the farm tracts of making their cultivation easier. At that stage, several villages merged their land and formed a single co-operative farm. Thus, the arable land in the country was divided up among a total of 866 co-operative and 209 state farms. Each farm cultivates an average of 4,000 hectares of land. But the potentials and advantages of this merger have nearly been exhausted and a third concentration of the land, and the adoption of farming on a qualitatively new basis is under way at the present stage. The key factor in the technical progress of agriculture at this stage is the introduction of industrial technologies and methods of management. As a result of the new voluntary merger of farms, the newly established agro-industrial complexes have now at their disposal from 25,000 to 50,000 ha. of arable land. They are major economic organizations, involving a high degree of concentration of production and thorough-going branch specialization. According to the new organization of production, the individual co-operative farms joining the complexes retain their autonomy, the hitherto practised methods of management and distribution of incomes. These farms have their representatives on the board of the newly formed agro-industrial complexes, which decide by common consent all matters concerning the pooled funds and their appropriate allocation, coordination of the individual farms' plans, with a view to promoting specialization and consistently implementing industrial methods and technologies, the setting of agro-chemical centres supplied with up-to-date machinery, unified systems of transport, supplies, storehouses and repair workshops, with due consideration being given to all farms merged in the complex.

On the basis of the achievements of socialist agriculture so far, and in line with the latest trends in this field, we propose to concentrate our efforts on grain-production, so as to catch up with the most advanced countries in the world. The main grain crops in Bulgaria are wheat, maize, barley, rye, sunflower and beans. There is also a substantial output of oats, vetch, soyabean, rice and millet, but their share in the total grain output is comparatively small. These basic crops are cultivated on an area of 2,300,000 ha, i. e. half of the arable land in the country. The other half is taken up by vineyards, orchards and market - gardens, tobacco, sugar beet, cotton, strawberry, potato and other agricultural crops.

The three following tables show the extent of the areas over which the main grain crops have been cultivated in the last ten years, their absolute annual outputs and average yields.

Areas sown with cereals

(in a thousand hectares)

Crop	1960	1965	1966	1967	1968	1969
Wheat	1248.9	1144.9	1142.2	1064.2	1060.1	1035.3
Barley	296.1	371.6	415.9	386.9	402.2	414.2
Rye	78.3	46.2	41.5	31.4	24	24.3
Maize grown for corn	643.2	554.7	574.1	567.3	557.2	578.2
Sunflower	235.8	267.0	254.5	267.7	280.3	287.5

Total output

(in a thousand tons)

Crop	1960	1965	1966	1967	1968	1969
Wheat	2379	2921	3193	3254	2549	2540
Barley	622	876	1064	985	807	918
Rye	82	52	56	38	24	28
Maize grown for corn	1505	1238	2207	1971	1768	2371
Sunflower	344	357	423	478	459	541

Average yields

(per hectare in kilograms)

Corp	1960	1965	1966	1967	1968	1969
Wheat	1900	2548	2794	3055	2404	2453
Barley	2087	2347	2552	2541	2004	2215
Rye	1042	1103	1146	1210	996	1134
Maize grown for corn	2359	2207	3810	3433	3132	4062
Sunflower	1452	1336	1660	1780	1633	1875

Bulgaria is known the world over as a traditional wheat-grower. Its output accounts on the average for 1 per cent of the world production of wheat Since 1966, it has for the first time succeeded in producing an amount over and above this one per cent. Today, as well as in the past, wheat continues to be the predominant grain crop both with respect to the area it occupies and with respect to its output and its general economic and political importance. In 1939. marking the summit of economic development of pre-war capitalist Bulgaria, 2.003,000 tons of wheat were obtained from an area of 1,527,100 ha. The latest statistical data have shown that Bulgaria today obtains 2,540,000 tons of grain from only two thirds of this area, while in 1967, the most favourable year for this crop, the output of grain came up to 3,254,000 tons. This figure is in itself convincing evidence of the great changes which have taken place along the lines of intensification of wheat-growing in the country.

While in other countries there is a discernible trend of inereasing the areas sown with wheat along with its output, the trend in this country is to vacate areas for vine- and fruit-growing, and still keep up to the level attained in gross annual wheat production, sufficient to meet the country's home needs and those of the markets secured abroad. To achieve this, the accent is placed on yields per unit area. The yields obtained so far show certain variations through the years, but the main trend is one of a steady rise in the yields per unit area. The objective is to attain a total annual output of four million tons of wheat,

Maize planting at the co-operative farm in Beloslatina

through a steady improvement of production technologies, increasing the overall quantity of fetilizers and machinery and broader application of new wheat varieties from the very first years of the new five year period.

The main variety, which has been grown in the country in the last few years, is the Soviet Bezostaya-1 wheat variety. Other widespread varietes are San Pastore, Mironovskaya 808, Jubilee 12 and III, Okerman 17, etc. In some regions up to 95 per cent of the areas under cereals are sown with Bexostaya-1, distinguished for its valuable economic and biological properties and yielding the expected quantities of grain under the climatic conditions prevailing in the country. The Bulgarian scientists and the Research Institute of wheat-Growing continue their work in the field of selection along the line of developing new winter wheat varieties suited to cultivation according to advanced agricultural engineering methods and mechanized harvesting, which will ensure high and stable yields under the various soil and climatic conditions in the country.

Second in importance among the grain crops in Bulgaria is the maize crop. It is solely grown to meet the country's needs of forage and has long ceased to be a crop on which the Bulgarians count for their daily bread. The areas allotted to it are steadily increasing, it being the main source for the further development of stockbreeding. It has, indeed, exceptional prospects for development under the conditions prevailing in Bulgaria. This was amply proved by its Bulgarian growers who obtained 4,062 kg of grain per ha. in 1969, thanks to which our country ranked among the foremost maize-producers in the world. Maize-growing methods have considerably been improved, which made it possible to obtain such quantitites of maize and fresh forage as can fully meet the home needs. Nearly one third of the areas sown with maize are irrigated and the yields from these areas are far greater than the average yields in the country. Maize-growers have set themselves the task to ensure no less than 2,800,000 tons of maize grain for the national economy this year.

What makes it necessary to set such targets, and what are conditions for their attainment at hand in Bulgaria? Bulgarian agriculture has long ceased to be a self-contained sector. It is, bound to the nation's economic system by numerous complex ties. It is, therefore, of crucial importance steadily to expand and improve its material and technical base and step up its mechanization. Early this year, our agriculture had at its disposal over 90,000 tractors (in terms of 15 h.p.), about 17,000 combine-harvesters, over 46,000 ploughs, over 30,000 cultivators, over 23,000 seed-drills, over 7,000 mowing machines, more than 19,000 lorries and 38,000 taactor trailers. Early in 1969, the overall capacity of the machines in agriculture per 100 ha. of arable land reached 133 h.p. against 30 h.p. in 1952. A high degree of mechanization was attained in a series of farm processes, in the cultivation of individual crops and productions The whole cycle of growing cereals, beginning with sowing and ending with the storage of the grain from the new crop in the silos, has now been fiully mechanized. This trend is followed in maize-growing, too, in which the gathering in of the crop has not yet been fully mechanized.

Substantial changes in the technical basis and in the technology of production are also introduced by the ever-growing degree of chemicization applied in agriculture. Whereas in 1947 only 6,000 tons of fertilizers (active substance) were used. in 1957 their quantity rose to 60,000, and in 1967-to about 607,000 tons, which shows that the rates of their application have increased in a geometrical progression. In addition to the large plants for the production of mineral fertilzers, another big plant is soon to be built. With its commissioning and the imports planned during the sixth five year plan period (1971-75), farming will be supplied with

Harvesting scene in a field of a co-operative farm in Tolbuhin district

1,500,000 tons of mineral fertilizers, which will fully meet its requirements.

The rapid pace of technical progress in agriculture and the structural changes that have taken place in it over the past years have provided conditions for the setting up of the so-called complex mechanization teams. The areas cultivated by these teams involve thorough mechanization of all farm processes to the complete gathering in of the crops. By the end of last year, 1,780 teams and 230 groups of complex mechanization were formed and put in charge of 1,900,000 ha. of land. About 80 per cent of the areas sown with wheat and maize were cultivated by these teams. In 1969, every farmer from the complex mechanization teams and groups turned out produce to the value of 16,563 leva, and every machine operator - to the value of 24,530 leva*. For an average of 100 kg of produce, 0.45 man-days were expended in wheat production, 0.40-in burley, one man-day—in maize, and 0.98 man-days—in sunflower production. These figures for the complex mechanization teams amount for wheat to 0.35, barley-0.32, maize-0.63, and sunflower - 0.81 man-days. In the complex mechaniation teams, the cost per I00 kg. of produce is considerably lower. The average work performed by a tractor (in terms of 15 h p.) in these teams was 603 ha. of soft ploughing, while the average figure for the country was 477 ha.

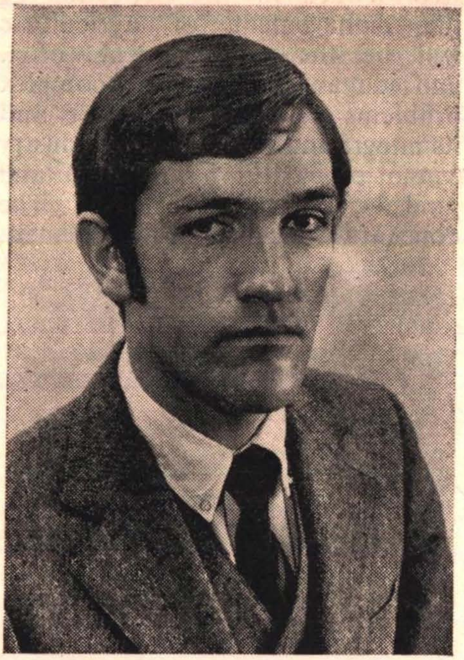
The most appropriate agricultural engineering methods, varieties and systems of mechanization have been developed and implemented in the growing of cereals, and the application of the achievements of science, concentration and specialization in farming have ensured considerable successes in grain production. The new merger thorough-going specialization in the cultivation of crops in the farms have opened up new prospects for raising output and lowering costs in gain production. This year, 4 to 5 kilometre-long tracts of maize have been laid out, which will make the use of the machines very effective.

A new feature of grain-production in the current year is the purchase of the grain on the spot from the combine-harvesters and its direct transport to the State reception storehouses, supplied with highly productive grain-cleaning and drying machines. This new type of organization of purchases eliminates a series of operations so far performed at the farms, such as cleaning drying, storage, loading and unloading the grain at the individual farms, and bring about a considerable economy of labour and reduction of production costs.

As the problem of still further concentration and specialization of grain-production in the country has come to a head, new tasks will be set to the food and tobaccc industry, which s exclusively supplied with raw materials by agriculture. Conditions are at hand for a gradual integration between agriculture and the food industry. This involves further concentration of this industry. The integration of the two sectors will set the stage for the gradual amalgamation of individual enterprises into integral regions, and, in the long run, into an integral national system. A great

*2 leva=1 US dollar, according to the official exchange rate step forward in the perfection of the management of agriculture will be the establishment of a unified management. The complex problems arising in agriculture and its integration with the food industry cannot efficiently be resolved and guided by two centres. The concentration of their management in the hands of the Ministry of Agriculture and Food Industry, the integration of agricultural science with farming, is a timely measure which will contribute to the successful implementation of concentration and the development of agriculture along industrial lines.

THE AUSTRALIAN WHEAT INDUSTRY



ROWLAND HILL

Wheat is Australia's largest agricultural crop and second biggest export item.

The record 1968—69 production of 1,07,12,000 metric tons has an estimated value of $A 74,80,00,000. About half the crop is exported.

Australia is the seventh biggest wheat producer, but accounts for only 3 percent of the total world crop.

However, it is the fourth biggest wheat exporter, shipping 53,32,000 metric tons of its 1968-69 crop to some 27 countries.

This represented 14 per cent of the world's wheat shipments.

Mainland China has been the largest single market for Australian wheat since 1960-61, having taken an average of 32 percent of total Australian exports of wheat and flour in the financial years from 1960-61 to 1968-69.

Production and export figures of major wheat growing countries are given below :—

World Production of Wheat, 1969
(Provisional totals)

COUNTRY	'000 metric tons
U. S. S. R.	75,000
United States	39,652
Mainland China	22,500
Canada	18,455
India	18,000
France	14,270
Australia	10,712
Turkey	9,800
Italy	9,550
World Total	3,04,477

World Exports, 1968-69
(Preliminary estimates only)

COUNTRY	'000 metric tons
Unite States	14,693
Canada	8,701
E. E. C.	7,788
Australia	5,332
U. S. S. R.	5,316
Argentina	2,666
World Total	47,078

Marketing Control

The Australian Wheat Board is the sole authority for the marketing of wheat within Australia, and for the marketing of wheat and flour for export from Australia.

It was founded under national security regulations in 1939 and maintained by the Australian Government to achieve orderly marketing of wheat through a single authority.

The Australian Government supports a stabilisation scheme at avoiding year-to-year differences in profits to growers.

It operates under the Wheat Industry Stabilsation Act, first enforced in 1954, and reinstituted for the fifth time with the start of the 1968-69 season.

The scheme guarantees the growers a price for their wheat, based on world trading conditions and prospects, and adjusts both guaranteed and home consumption prices annually by index methods.

Loading bagged wheat on a small property in the Pine Island area, near Canberra, Australia's national capital. On larger properties wheat is loaded as it is harvested into hoppers and carted direct to silos but on smaller places, it is bagged and carted away later.

The Situation in Australia

Production :

The Australian Wheat Industry expanded rapidly during the 1960s with production reaching a record 54,40,00,000 bushels in 1968-69.

The crop in 1969-70 is provisionally estimated at 39,36,00,000 bushels, some 28 per cent smaller than the previous year but still the third largest wheat harvest in Australia's history.

The lower output expected in 1969-70 is partly the result of a fall in the planted area to 2,33,00,000 acres from the 1968-69 record of 2,68,00,C00 acres but a more important cause is the reduced average yield due to some droughts and frosts.

The average yield per acre in 1969-70 is estimated at 16.9 bushels, compared with 20.3 bushels in 1968-69 and the record 22.4 bushels of 1966-67.

Receivals :

The Austrailan Wheat Board has estimated for 1969-70 a 31 per cent fall from the 1968-69 record deliveries to its depots. They expect to receive 35,10,00,000 bushels compared with the record 51,45,50,000 bushels.

Drastic falls in the Western Australia and Queensland crops will create problems in maintaining continuity of supplies of prime hard wheat to overseas markets.

Exports :

(1968-69 crop) Exports of wheat and flour from Australia declined in 1968-69 to 19,55,00,000 bushels from 25,64,00,000 bushels in 1967-68.

Shipments of wheat dropped by 5,91,00,000 bushels to 17,97,00,000 bushels, and flour exports to 1.62,00,000 bushels (wheat equivalent). This was 14,00,000 bushels less than in 1967-68.

Mainland China was again Australia's most important wheat market in 1968-69, although shipments at 4,34,00,000 bushels were less than half those of the previous year.

Large sales were also made to Japan (4,21,49,000 bushels) and Britain (2,84,12.000 bushels).

Relative to 1967-68, increased exports of wheat were made. to western Europe, Africa, Japan, North Korea and Thailand, but shipments to mainland China, India, Middle East countries and South America fell.

Ceylon continued as the largest customer for Australian flour, but exports to this destination and to nearly all other declined from the previous year's levels.

Current Crop :

Wheat and flour exports are expected to recover in 1969-70 to around 25,00,00,000 bushels.

Shipments to mainland China will increase. In January and December of 1969 two contracts, each for the sale of 8,21,00,000 bushels of wheat to mainland China, were announced by the Australian Wheat Board.

In August a sale of 7,50,000 tons to Egypt was announced and contracts for the supply of 10,00,000 tons in each of the next three years signed.

The following charts show Australian Wheat and Flour exports :-

Wheat exports : Australia : by destination

(Year ended 30 June)

Destination	1956-66 '000 bushels	1966-67 '000 bushels	1967-68 '000 bushels	1968-69 '000 bushels
China, mainland	74,130	79,523	88,781	43,340
Japan	13,357	15,851	22,484	42,149
United Kingdom	23,293	14,233	23,622	28,412
Malaysia	3,758	9,244	9,374	9,299
Netherlands	—	4,406	4,479	5,935
Singapore	4,479	7,403	9,297	3,924

Flour exports (grain equivalent) : Australia : by destination

(Year ended 30 June)

Destination	1956-66 '000 bushels	1966-67 '000 bushels	1967-68 '000 bushels	1968-69 '000 bushels
Ceylon	7,874	6,712	7,436	6,621
Indonesia	138	1,110	3,035	2,713
Mauritius	469	561	802	785
Papua and New Guinea	604	591	688	703

Crop Value :

The Wheat Industry Stabilisation Fund, enforced since 1954, guarantees growers a price for their wheat, based on world trading conditions.

In 1969-70, the gross value of wheat prodction—in line with the smaller harvest—is expected to decline to an estimated EA 53,60,00,000, some $A 20,80,00,000 below the 1968-69 peak, but still the third highest gross value on record.

The guaranteed price and the home consumption price have been raised slightly from the 1968-69 levels.

A break down of prices and returns since 1965-66 is shown below:-

Wheat : Guaranteed Price, Home Consumption Price average export return and average return to grower : Australia (Per Bushel)

Crop Year	Guaranteed Price	Home Consumption Price	Average Export Return	Average Return to Grower
1965-66	1.517	1.530	1.409	1.412
1966-67	1.550	1.565	1.447	1.414
1967-68	1.640	1.655	1.352	1.473
1968-69	1.450	1.710	1.254	1.237
1969-70	1.459	1.725	n a.	n a.

Quotas:

A quota system, to control Australia's wheat production was introduced for the 1969-70 crop, limiting Australian Wheat Board deliveries to 35,70,00,000 bushels.

Delivery quotas for 1970-71 have reduced intake by a further 11 percent to 31,80,00,000 bushels.

The reduction was made necessary by the continued build-up of stocks and the limited opportunities for increasing sales.

The carry-over at November 30, 1970 is forecast to rise to more than 30,00,00,000 bushels—the largest carry-over in Australia's history.

The sharp rise in carry-over stocks since 1965 is shown in the chart below:-

End-of-Season Wheat stocks : Australia

Year	Quantity (million bushels)
1965	24.4
1966	16.5
1967	80.5
1968	51.9
1969	266.7

The International Grains Arrangement

Some measure of price stability was achieved by the International Grains Arrangement (IGA) inaugurated on July 1, 1968.

Due to expire on June 3, 1971, it established minimum and maximum prices for most wheats. It consists of two separate coventions the Wheat Trade Convention and the Food Aid Convention.

Most of the world's most important wheat exporting and importing nations—notable exceptions being Russia, mainland China and the countries of Eastern Europe-formally indicated their acceptance of the Wheat Trade Convention.

The 12 signatories to the arrangement were Argentina, Australia, Canada, Denmark, the EEC, Finland, Japan, Norway, Sweden, Switzerland, Britain, and the United States.

From the outset the IGA was subject to considerable strain as a result of the increasingly intense competition among exporters in declining world markets.

The arrangement had been formulated at a time of relative stability in world wheat economy, but surplus supply and price-cutting by non-IGA members made it apparent, its provisions could not be sustained.

In July 1969, it was agreed at a meeting of exporting member countries that wheat could be sold below the IGA minima at prices calculated to be competitive with those of non-member exporters.

A return to the fixed minimum was to be achieved as soon as possible.

Overproduction :

Quotas and an aggressive selling stance by the Australian Wheat Board are the main measures adopted to beat Australia's overproduction of wheat.

The Austalian Wheat Industry

The quotas were introduced by the industry and, according to Government officials, will be the greatest single factor towards reducing wheat supply to a position more in accord with demand

The board's high-pressure salesmanship was demonstrated in August when it gained re-entry to the Egyptian market after an absence of sales totalling 37,50,000 tons.

Suggestions that further markets could be obtained for Australian growers if they turned to production of wheat for fodder have been strongly opposed by the Australian Wheat Board.

Advocates of the move point to the rapidly developing agricultural areas of South-East Asia and its limited availability of cropping lands. They claim Australia-grown fodder wheat would find a ready and large market, even though at lower prices than wheat grown for human consumption.

The board doubts that fodder wheat would prove a viable proposition, although they sold quantities of low quality wheat to Britain on the understanding that it is not for human consumption. This wheat has been denatured in Europe after shipping from Australia.

Australia and the EEC

It is difficult to obtain a clear picture of implications for Australia should Britain join the EEC because of the number of variable factors involved. As well, the Australian Wheat Board is reluctant to discuss its attitude in case it effects its position after the EEC decision has been made.

However, observers make that although Britain is endeavouring to increase wheat production, it is unlikely to reach self-sufficiency for many years. One London survey predicted that by 1975 Britain would still be importing from 39,00,000 to 45,00,000 tons of wheat.

Observers here maintain that France will be the key to the Australian situation should Britain enter the EEC.

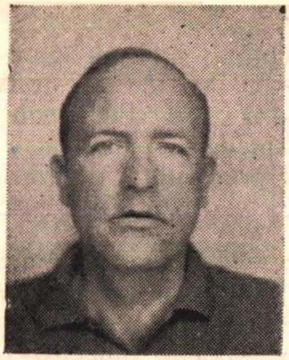
France is a net exporter of wheat and consequently will be Britain's main supplier within the economic community. However, European strains of wheat are of the soft variety.

Australia, observers say, will be able to fill Britain's demands for hard varieties. Quotas for prime hard wheat from both Queensland and New South Wales have been stepped up in the 1970-71 season.

Australia's foresight in diversifying its markets will show to advantage. Britain, in 1959-60, took almost one-fifth of Austrailia's total wheat exports, whereas in 1968-69 it took only one seventh.

In the same period, Australia's total wheat exports have increased from 9,12,52,000 bushel to 17,97,00,500 bushels, while Britain's purchases from Australia have increased from 2,09,85, 000 bushels to 2,84,12,000 bushels.

TREND IN CEREAL PRODUCTION IN FRANCE



P. AURIAU

Maitre de recherches de l'I. N. R. A.
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Versailles

Generalitics

The trend of these productions in France is dominated by a strong increase of volume in the twenty years. It is more a consequence of the yield increase than of an extension of the surfaces (see extra-text table). Two species have the most important development, Barley and Corn. Now French farmers export one third of their production (see below). This tendency will be enhanced by the achievement of the Common Market.

French Cereals Exportations (millions of quintals)

	Common wheat	Durum wheat	Barley	Oat	Corn
Total production ...	140	4,0	90	25	60
Internal disponibilities...	95	5,6	55	25	44
Net exportation	+45	-1,6	+35	0	+16

Another fact of significant importance is the repartition of the internal disponibilities (see below, in millions of quintals) :

	Wheat	Barley	Oat	Corn	Total
Human consumption	55	2	1	2	60
Feeds	30	45	22	35	132
Seeds and losses ...	10	8	2	7	27
Total ...	95	55	25	44	219

In the 1930-1939 period two third of the cereal disponibilities were affected to human consumption; now less than one third is used for this purpose. More and more the exportation and the feeding use, are the destinations of French production of cereals.

Wheat

All regions in France are concerned with this culture. But the most impotant areas for this crop are great plains of the Basin of Paris and of the Aquitania.

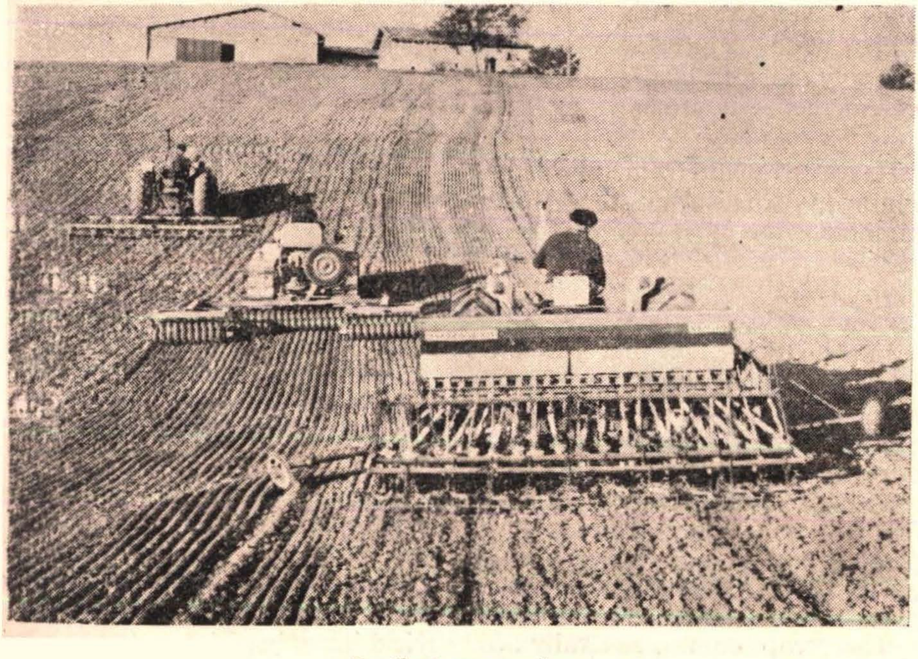
In all areas red soft winter types are the most cultivated but hard red spring and durum types cover some areas in the Beauce (South of Paris) and in the Garonne River valley.

The increasing yields of French wheats result from cultivars improvement and from a better managment. One of the first high yielding varieties was CAPPELLE DESPREZ registred in 1946, that had covered the wheat areas between 1950 and 1960. ETOILLE DE CHOISY, an earlier variety registred in 1950, had given a significant change in the trend of agriculture in the South.

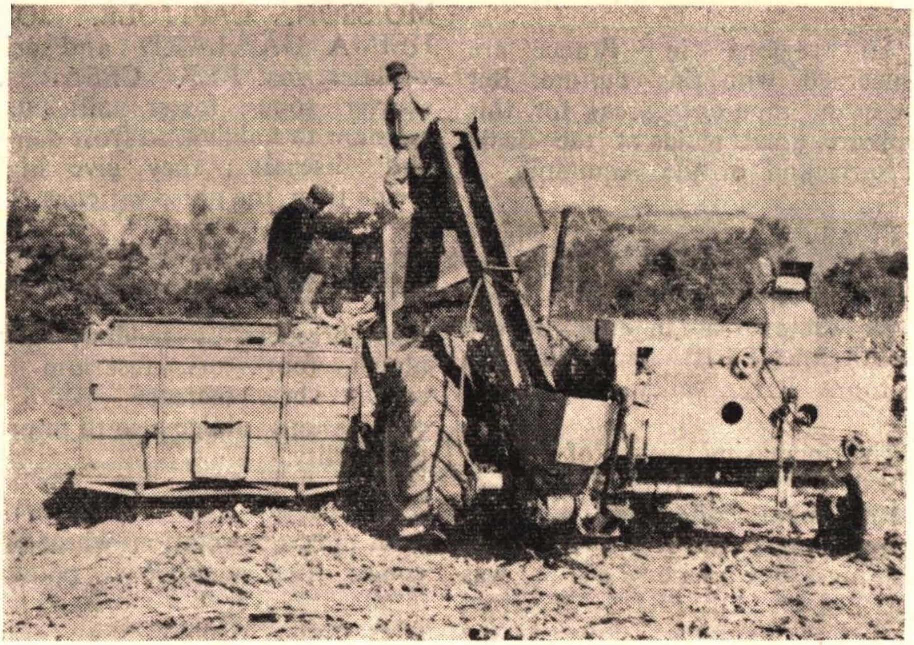
The new winter varieties as MOISSON, CAPITOLE, JOSS, HEIMA, GAILLARD and spring varieties as REX CESAR are shorter (one meter tall) more resistant to lodging, to frost damage and diseases ; they give higher yields than the older varieties.

But with these improvements, new diseases set a problem to plant breeders as mildew, glume blotch, foot—rots, fusarium and ergot. The increase of the exportations oblige also to improve the quality.

In the crops rotations wheat often comes after sugarbeets, potatoes, alfalfa or clover, but more and more after corn. Mechanization of the cultural pratices is now complete and the seed bed preparation is generally a good one. The seeding period lies from late October to late November. Seeding rate is 100 to 120 kg. an hectare.



Seedbed preparation



Corn harvest

The following rates of fertilizers are applied per hectare :

Nitrogen	100-150 kg
Phosphorus	80-100 ,,
Potassium	80-100 ,,

For weed control 2-4 D is generally replaced by pre-sowing or pre-emergency treatment.

Harvest is made from June in the South to August in the North; combine is the most used device.

Barley

In spite of the fact that this crop is used in major part for feeding purpose the most important breeding work had been achieved for brewing purpose (by SECOBRA for example). But this work had been useful also to the production of feeding barley and many brewery barley varieties are used for feeding.

This crop comes, generally after wheat and the spring types are the most cultivated (90%). The variety RIKA covers, one half of the total surfaces, but new cultivars as AGER, MAMIE, TRAIT D'UNION are replacing it. Management and fertilization are not quite different as for wheat.

The principal disease is mildew.

Oat

This declining crop yields less than wheat or barley. Among the cultivars used NOIRE DU PRIEURE, PENIARTH and NOIRE DE MOYENCOURT can be mentioned. One varietiy NUPRIME,with naked kernels, had been bred to improve feeding value but its yield is not good enough.

Rye

It is a crop for poor sandy soils particulary in the mountains of Massif Central. Foreign populations, as PETKUS, are the most used. As for other cereals yield have been improved by using fertilizers.

Corn

Just after the Second World War this crop covered only small areas in Aquitania with poor yields. After the introduction in 1946 of the first American hybrids a gain of yield of 20-30% had been obtained ; but these hybrids were generally too late for French conditions. The breeding of French hybrids earlier and more tolerant to cold than the American ones offered better possibilities.

Now corn is successfully used in all regions in France. The most important cultivar is an early French hybrid INRA 258 (45% of the total areas). The second in importance is a medium early American hybrid IOWA 4417 (10,3% of the total areas).

The sowing time lies in April and the harvest time in October.

Soil preparation is generally good, manure is used if possible and the rates of fertilizers are high (see below) :

Nitrogen	100-150 kg/ha
Phosphorus	120-180 ,,
Potassium	80-180 ,,

Good control of the weeds is obtained with triazine.

Mechanization is complete in the North but not in the South.

Irrigation is used on some areas with added yield.

Hybrid Sorghum harvest

Hybrid Sorghum

This crop is fairly new in France and its extension is restricted to the dry, hot countries of the South. Management and fertilization are quite similar as for corn. Birds are most important parasites.

Rice

It is also a new crop in France and its extension is limited to the delta of the Rhone River. Mechanization is complete and managment is a good one.

The Italian cultivar BALLILA is the most cultivated but new varieties with improved quality are also used.

Direct sowing is always prefered with a chemical control of weeds.

The production covers approximatively the internal consumption.

Cereals Breeding And Improvment of Cereals Production

The National Institute of Agronomical Research (I.N.R.A.) [1] is the leader in all investigations *on cereals production.* The investigations are carried out in five centers (Versailles, Rennes, Dijon, Germont-Ferrand, Montpellier). But the contribution to cereal breeding of many French Plant breeding firms is very important too. Beside profssional associations as C.E.T.A.'s or "Chambres d'Agriculture" and the "Technical Institute for Cereals and Forage" (I.T.C.F)[2] extends the results of the investigations on the farmers level.

Conclusion

The recent development of the cereals production in France result from a big increase of their average yield. Cereals are now industrial crops that give good return with a minimum work.

More and more feeding cereals are produced for cattle because they give the best response to an increasing task for meat in the Common Market.

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(1) 149, rue de Grenelle—71—Paris 7-ème

(2) 8, Avenue du President Wilson—75—Paris 8-ème

TREND IN THE EVOLUTION OF SURFACES, YIELD AND PRODUCTION FOR CEREALS IN FRANCE

Period	Common Wheat			Durum Wheat			Barley			Oat		
	Surface (1)	Yield (2)	Production (3)	Surface	Yield	Production	Surface	Yield	Production	Surface	Yield	Production
1930—1939	5.000	15,4	77,0	0	—	—	710	15,0	10,7	2,500	14,2	
1951—1955	4.300	20,8	89,4	—	—	—	850	18,4	15,7	1,600	18,2	
1967—1970	4.000	34,5	138,0	0,15	27,4	4,3	2,800	32,5	90,0	900	—	

Period	Rye			Corn			Hybrid Sorghum			Rice		
	Surface	Yield	Production	Surface	Yield	Production	Surface	Yield	Production	Surface	Yield	Production
1930—1939	680	11,5	7,8	300	15,8	5,3	3	33,8	0,1	—	—	—
1951—1955	418	11,5	4,8	400	22,8	4,0	20	27,1	0,6	20	35,0	0,7
1967—1970	60	33,3	2,0	2,000	30,0	60,0	55	36,3	2,0	24	36,0	0,9

(1) thousand of hectares (2) quintals by hectare (3) millions of quintals

PRODUCTION AND CONSUMPTION OF CEREALS IN THE NETHERLANDS (1964/65—1968/69)

BY

M. E. VIERVANT TUKKER

Asst. Agrl, Attache., Royal Netherlands Embassy.

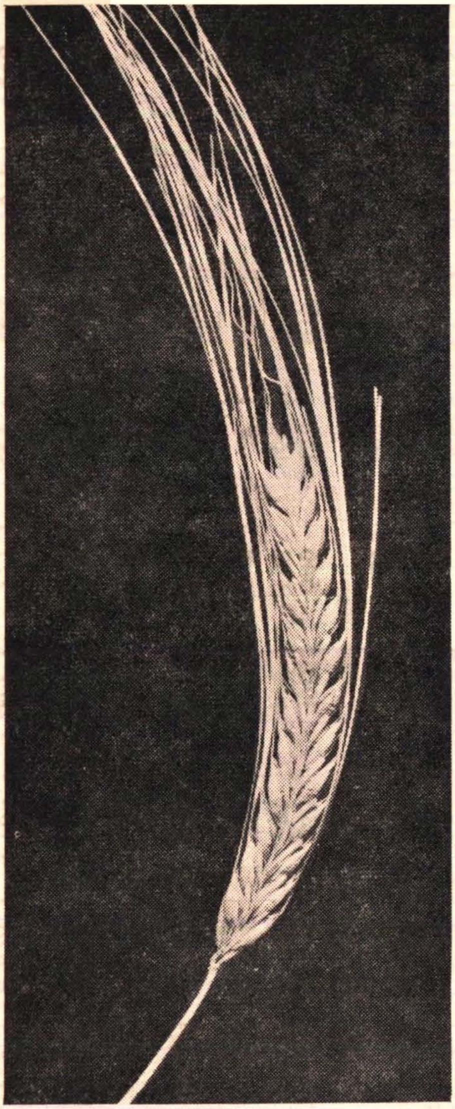
Production

Because of a reduced production of oats and rye, the total production of cereals in the Netherlands during the past five years decreased by more than 16%.

Haverplium (oats)

Consumption

The total consumption of cereals in the past fell with 15%. This was mainly due to a rise in the price of cereals, which made their use as cattle-feed too expensive (decrease 23%). This was, however, offset by an important increase in the consumption of cereals in the



Barley

industrial sector (50%). The lion's share for this increase went to maize; in the beer production, the consumption doubled; in the production of starch, it amounted to 90% and the production of glucose took care of 50%. The consumption of barley in the breweries increascd between 1964 and 1969 with 32.000m. tons (35%). Human consumption of foodgrains remained more or less constant in the said period.

Production and Consumption of Cereals in the Netherlands(1,000 m.tons)

	WHEAT					RYE				
	1964/65	1965/66	1966/67	1967/68	1968/69	1964/65	1965/66	1966/67	1967/68	1968/69
Production	737	704	603	757	709	356	250	190	239	239
Consumption	1.143	1.089	1.122	1.046	1.307	495	362	250	247	232
of which: human	1.007	1 000	994	954	967	49	60	57	66	67
industry	7	8	11	12	21	2	2	2	2	1
fodder	97	56	91	54	302	429	289	180	168	155
	BARLEY					OATS				
Production	376	373	416	447	390	546	452	419	416	346
Consumption	433	448	450	473	494	547	468	348	344	250
of which: human	5	4	4	3	4	9	9	8	8	7
industry	90	99	108	120	124	—	—	—	—	—
fodder	324	328	324	336	353	523	445	328	325	232
	MAIZE					SORGHUM AND MILLETS				
Production	—	—	—	—	—	—	—	—	—	—
Consumption	1.796	1.845	2.223	2.392	1.919	727	590	474	326	164
of which: human	29	32	28	30	26	3	3	3	2	2
industry	126	135	155	175	206	2	4	2	3	4
fodder	1.641	1.665	2.040	2.187	1.687	722	583	469	321	159
Total cereals										
Production	2.015	1.779	1.628	1.859	1.684					
Consumption	5.141	4.802	4.867	4.828	4.366					
of which: human	1.102	1.108	1.094	1.062	1.073					
industry	227	248	278	313	355 (x)					
fodder	3.744	3.379	3 432	3.391	2.878					

(x) beer, starch, glucose, dextrose, dextrine, maltwine yeast, spirits and malt extract.

PRODUCTION AND USE OF CEREALS IN SWEDEN

EWERT ABERG

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As a background to a discussion of the production and use of cereals in Sweden, some data on location and size of the country are needed. Sweden forms the eastern part of the Scandinavian Peninsula. In the west it borders Norway and the waters of Skagerack, Kattegatt and Öresund, in the south and the east it borders the Baltic, the Gulf of Bothnia and Finland. Sweden has an approximately rectangular shape with a maximum length of 1,600 km from south to north and stretches between 55°20' and 69°3' N. It has a maximum width of approximately 500 km, between 10°58' and 24°10'E. The location of the country in relation to other countries can be illustrated by the facts that the sixtieth degree of latitude which crosses Sweden immediately north of the city of Uppsala in Central Sweden also passes through the southern tip of Greenland and the south coast of Alaska. The land area of Sweden is approximately 4,50.000 square kilometres. Of this area approximately 6.5 per cent or 29.920 square kilometres were in 1970 used as agricultural lands.

Acreage and growing conditions for cereals

More than half of the agricultural lands in Sweden or approximately 15.750 square kilometres were in 1970 used for cereals. This acreage - equal to about 15,76,000 hectares - was used for the folowing crops:

Wheat		
Winter wheat	2,25,600	hectares
Spring wheat	39,200	"
Rye		
Winter rye	76,300	"
Spring rye	900	"
Barley	632,000	"
Oats	524,000	"
Mixed cereals		
(=barley and oats)	75,900	"

It is quite natural that in a country located as far north as Sweden and with such a length from the south to the north end there are considerable variations in temperature. As a result of this there are also considerable variations in the length of the vegetation periods in different parts of the country. It is usually delimited by the temperature 3° C. With such a delimitation, the vegetation period is in south Sweden 240 days. Further north it becomes shorter and it is only 130 days in the extreme northern parts of the country.

For the growing of cereals the length of the vegetation period is essential as is the length of the period when the maximum temperature is above 15° C. If the need for both a vegetation period, delimited as above, and a certain period with more than 15° C are considered the following data can be given as the minimum data for a successful growing of cereals.

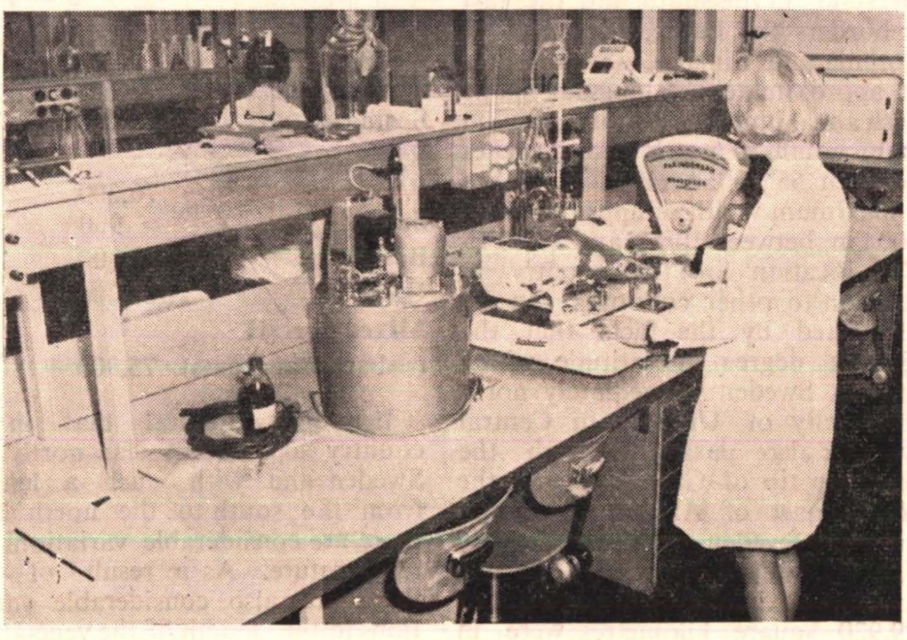
Number of days for :

	Winter wheat	Spring wheat	Winter rye	Barley	Oats
Length of vegetation period, more than 3°C	180	160	150	140	150
Period with more than 15°C	110	75	75	60	75

The requirements in regard to number of days, as presented above, indicate that the acreages of cereal on a percentage basis is higher in the southern and central parts of Sweden than in the northern ones. Actually on the plains in South and Central Sweden cereals occupy 50-60 percent of the cultivated lands while in North Sweden they do not occupy more than 15-20 percent.

Aims of cereal production

Cereals are in Sweden grown for food and feed. The main production is for feed as barley and oats are grown almost entirely for that purpose. It is estimated that about 5 percent of the barley production



Cereal Laboratory

is used for malting while, as much as, 95 percent is for feeding purposes. Of oats, the amount used for rolled oats is nearly 2 percent of the total production while the rest, *i.e.* 98 percent, is used for feed.

Both wheat and rye are mainly bread cereals although a certain percentage of the wheat is at present used for feeding. There are indications that in the future a higher percentage of the wheat yield will be used for feed. Investigations aiming at finding out the possibilities of using rye as a feed are under way.

Cereals and planning of crop rotations

Above it was mentioned that in South and Central Sweden 50-60 percent of the cultivated lands is used for cereals. Compared to the situation during the first half of the 20th century,this means a marked increase in the percentage of agricultural lands that is used for cereal growing. Up to, and including the period of the second world war, the crop production systems were characterized by the principles of alternate husbandry. This meant growing of cereals in more or less regular alternation with leys of clovers and grasses, root crops, pulses etc. But the developments towards a better efficiency and an increased mechanization have after the second world war led to a more and more specialized production in the Swedish agriculture. Amongst others this has meant a steadily increasing acreage of cereals as a specialization on cereals has been favoured by economic developments as well as by technical measures of the type mentioned above. The mechanization, the labour situation and the marketing conditions during the years after the second world war gave rise to an eagerness in specialization and an increasing skill in carrying through the specialization.

The skilfulness in regard to the specialization on cereals—as it is characterized today—is equal to the ability of the farmer to use artificial fertilizers in an efficient way, to apply chemicals for the control of weeds, diseases and insects, to adapt machineries to a high extent, and to carry through combine harvesting and drying of the harvested products in an efficient way etc.

All this efficiency may, however, lead to complications. These may be undesirable soil structure, uneven stands and increase in weeds, diseases and insects that damage the cereals. The weeds appearing are species that are resistant or tolerant to the most commonly used chemicals which are compounds based on phenoxyacetic acids. Examples on such weeds are wild oats and quackgrass. The diseases that increase as a result of onesided or continuous cereal production are eye spot and foot rot Nematodes are becoming more common and this is especially true for the oat nematode, which attacks not only the oats but also wheat, rye and barley.

Situations of the above discussed type brings up the question whether a new system for the use of crops in alternation with cereals should be introduced or if a growing technique that allows onesided or continuous cereal growing could be developed. These are at present problems of great concern in the Swedish agriculture. They cannot be neglected as the problems now being faced are of interest not only from a biological and technical point of view but also from an economical one. This should be seen against the background that a cereal production in Sweden has reached such a level that a certain part of the cereals produced must be exported. The prices paid for the part that has to be exported is considerably lower than the prices obtained inside the country. This situation indicates that marketing conditions in the future may call for still more intensified growing techniques.

Varieties, seeds and cultivation techniques

A number of problems concerning varieties, seeds and growing techniques are common for the four cereals grown in Sweden. They will, therefore, be treated together.

Varieties

Plant breeding is a well established science in Sweden and has, during this century, given results of an enormous importance for the crop production in the country. In cereals the results of plant breeding are very obvious, There are striking examples on achievements by the plant breeders for improving the cereals. Such achievements have meant improvements in yield, strength of straw, disease resistance and quality for various purposes as well as adaptation to the length of the vegetation period. For adaptation earliness is an important factor.

Further improvements in factors as the mentioned ones are needed. Thus, breeding for these factors are still important tasks in the cereal breeding in Sweden. But the aim with breeding for these factors has changed. Breeding for disease resistance in cereals is, for example, since many years observing resistance to different types of rust. Besides this, there is now a very great activity in developing varieties of wheat and barley resistant to mildew and varieties of wheat barley and oats resistant to nematodes but also in finding resistance to take-all in wheat and barley.

Improvement of quality by breeding has for a long time been directed towards improvement of the technological quality. Breeding for a better baking quality in wheat and rye is a good example on this. During the last ten years the nutritional aspects have received increased attention and at present great emphasis is put on protein content and protein quality in cereals. In connection with protein quality special attention is given to the presence of essential amino acids.

Variety testing

New breeding products are tested in experiments where they can be compared with older varieties with regards to quantity and quality production, resitance to attacks by diseases and insects, stiffness of straw, etc. The breeders carry out earliest testing in experiments aimed at producing results on which the breeders can base their submission of a new product for acceptance in the official variety testing. This testing at the breeding stations has the character of a **pretesting.** It is actually, the last step in the breeding procedure. The **official variety testing** has the charter of a government testing and is carried out by the Department of Plant Husbandry at the Agricultural College of Sweden in Uppsala. For the cereals the testing period is normally 3-4 years but could be longer if the experiments should fail in certain districts or certain years or if the results do not clearly show the value of the new variety. The variety trials are often combined with different cultivation factors. Sometimes the reaction of the varieties is studied at different nitrogen levels, at different seeding and harvesting times etc. Thus, the aim of the variety trials is not only to give information about the value of different varieties but also to show the reaction of the varieties under different growing conditions.

The costs of official variety testing is shared by the government and the plant breeders. Basic costs as buildings and laboratory equipments are taken care of by the government while running costs, for example, costs for field experiments and laboratory analyses, are divided equally between the government and the plant breeders. Special fees for *the running costs have been fixed.* Example on this is 10.000 Swedish Kronor for a winter wheat variety. The breeder pays 50 per cent of that sum.

Seeds and Seed Certification

If improved varieties, made available through continuous plant breeding, shall be efficiently used it is necessary with an effective system for seed production and seed control. Activities for the developing of new varieties and for the testing of them have been discussed above. They are of such a nature that they should inspire the farmers to efficient use of the new material. To achieve this the farmers must use good seed. They must be able to appreciate the value of a good seed. And they are This means that they want a seed, the properties of which are good, independent of whether they are the results of genetic constitution or environmental influence. Quality seeds of cereal varieties as well as of old ones are consequently common in Swedish agriculture.

But even if intensified growing technique in cereals has already brought with it use of better seed this does not mean that the seed in the future cannot be even better. Specialized agriculture calls for improved technical methods, which amongst others, means use of a seed that is controlled in regard to both genetic and environmental factors. It means certified seed bought from outside or produced on the farm itself. Independent of whether the seed is brought or produced on the farm the demand for a certification label means that the value of the seed is always determined and declared. At first sight this may seem a hard claim-even in a country like Sweden with a well developed seed production. But it is very likely to be accepted. Amongst *others introduction* of hybrid barley and hybrid wheat on the market will stress a development in this direction. No doubt, seed produced with skill by farmers specialized on seed production, is a future development worth observing. Such a production can be expected to lead to seed lots that fulfil those requirements concerning characters and purity of variety and seed quality that by the National Board of Agriculture are presented for certification. Seed quality is based on mechanical purity, number of weed seeds, germination, moisture content, freedom from disease etc. The main responsibility for carrying out the seed certification rests on the State Central Seed Testing Station.

Establishment and development of stands

The economic background to cereal production in Sweden calls for high yields per hectare. Examples on the meaning of this are that for winter wheat yields around 5,000 kg. per hectare are desirable. Corresponding figures are for spring wheat 4,000, for barley 4,500-5,000 and for oats 4,000-4,500. Such yields must be based on even and well developed stands. Also in regard to quality there is a need for even, well developed stands. This needs to be especially emphasized as combine harvesting is practically the only cereal haversting method in the country and often has to be carried out during weather conditions when the moisture content in the kernel is high and artificial drying a necessity. Quality under such conditions is more easily obtained if the kernels are in the same stage of development. Late shoots and poorly developed or green kernels may cause troubles and lower the quality considerably.

A cultivation technique that prevents delayed development and uneven shooting is, therefore, a necessity There are many problems encountered in such a situation and there are quite different reasons for such problems. Very important is the water factor. Precipitation varies from one area of the country to another one It means that germination and early plant development vary considerably. Certain parts of the country, especially the eastern plains, have a dry period during late spring and early summer. This gives rise to uneven and sometimes thin stands in which new shoots develop after summer rains, coming at a later period. The kernels on these shoots will be poorly developed and are some times green at the time of harvest. On the plains in south Sweden, unevenness caused by water deficiency, is not as common as in other parts of the country and quantity and quality problems, due to this factor therefore not so serious.

Harvesting

The development of a technique for combine harvesting under Swedish conditions has meant basic studies of the ripening process under existing environmental conditions. These studies have had to be made with consideration of the moisture content of the kernels during different ripening stages. They started in very early ripening stages. Of special interest for the discussions here are the studies that began in the yellow ripening stage i.e. the stage when all of the green colour has disappeared from the ventral furrow of the kernels. The moisture content at that stage is 25-30 per cent and the development towards the full ripening stage is mainly a question of decreasing water content. Under Swedish conditions one aims at combine harvesting when the moisture content of the kernels is 20 per cent. It may, naturally, be carried out at a lower moisture content but also at a higher. Artificial drying before the storage and use of the cereals is, thus, a necessity in Sweden as the desirable moisture content for storage in silos is 14 percent. As a result of this artificial dryers on the farms and at the central storage houses are common. From the above it is clear that the weather situation during the ripening and harvesting periods and its influence on the crops is of great importance for the quality obtained. The methods for determining the quality have been developed with this in mind. They will be examplified below.

Crops

Above was mentioned that the four cereals grown in Sweden are wheat, rye, barley and oats. Besides, mixed cereals are found.

Wheat

Acreages of winter wheat and spring were given above and general problems in connection with the growing of these two cereals as well as other cereals were discussed. Which are then the special problems for winter and spring wheat that have been observed during recent years ?

For winter wheat the over-wintering problems are naturally of utmost interest in a country located as far north as Sweden. The over-wintering depends on resistance to low temperatures which is a genetic factor that has for a long time been observed in the Swedish plant breeding work. But the overwintering depends also on the severity of attacks by diseases which in turn are the results of varietal resistance and environmental conditions. During the last 20 years special attention has been given both to stages of development of the seedling between the seeding time in the fall and the time of the outbreak of the winter and to attacks of diseases due to seedling development and weather conditions. It has been proved that it is very important to choose seeding times and seeding rates that give well established stands of medium-sized plants at the time of the outbreak of the winter. Such plants are more likely to resist attacks by fungi, for example **Fusarium** and **Septoria**, than large plants. They are also more likely to develop a satisfactory stand in the spring than small plants, even if the latter ones should be completely healthy. For good overwintering there is, there fore. a need for use of varieties with resistance to low temperatures and to diseases attacking during the fall and winter. But there is also a need for a cultivation technique that leads to stands able to resist diseases and strenuous weather conditions during the fall and winter periods.

Harvesting problems for cereals in general were discussed above. It was then mentioned that combine harvesting is the main harvesting method and that it requires artificial drying. The weather conditions at the time of harvest as well as the conditions for combine harvesting and drying to a low moisture content are of great importance for the storage, use and quality of the wheat and should be stressed especially. So far, wheat has been used almost entirely for flour. It is likely that also in the future, most of the wheat will be used for flour even though there is now a tendency to use more wheat for feed. Independent of the way wheat is used, the characters of protein and starch are decisive for its value. Protein content must be high and protein quality is important as protein composition influences the strength of the flour at the time of baking. Both content and quality of proteins are varietal characteristics but can be influenced by cultivation technique. Starch quality is largely depending on the influence of environmental characters and this is, under Swedish conditions, very important. The reason for this is that weather conditions during the harvest period often cause germination of the kernels in the heads. This changes the enzyme conditions in the kernels and part of the starch is broken down to sugar. The amylase activity is of special interest. As a result of the breaking down of starch to sugar, the baking quality of the wheat is lowered.

Methods for determining the starch quality and amylase activity are, thus, important. The most common one among these is the method for determining the **falling number**. By this method one determines the number of seconds it takes for a measuring device to fall through a suspension of distilled water and coarsely ground flour of the whole kernel. Special conditions in regard to temperature are to be observed. To the number of seconds obtained in the test, there are added 60 seconds, which correspond to the time needed for preparing the suspension. The normal value for falling number for winter wheat is 190. Lower values than 190 indicate decreasing baking quality.

For **spring wheat** the main problem is to increase the acreage and to do this in areas where there are good possibilies for obtaining good baking quality in the wheat produced. Spring wheat in Sweden is more and more becoming a special crop, grown with the intention of producing quality wheat that can be used for mixing with winter wheat in the processing industry. Therefore, there is a special price for wheat lots coming from certain varieties of spring wheat. The general accepted term for such wheats is **quality wheat** as compared to **normal wheat,** being mainly winter wheats.

To produce quality wheat it is essential to use existing varieties with an earliness and a stiffness of straw that allow harvesting under acceptable conditions. Essential is also to breed new varieties with characters that make possible a high quality production of spring wheat. An essential character on top of earliness and stiffness of straw is resistance to mildew. The cultivation technique calls for selection of growing districts in the country where soils, precipitation and length of the growing period make possible even stands with a good and even development of the kernels. This means the plains in the southern parts of the country.

Rye

As the figures above show, practically all rye grown in Sweden is winter rye. During earlier periods rye was the most commonly used bread cereal. Now, wheat has become more important. But even if this is the case rye plays an important role and the special problems in rye production are attached to the possibilities of producing rye with a good baking quality. Just as for winter wheat one of the most important factors for obtaining good stands is good over-wintering. In general the same problems as for wheat, are then to be considered. It should, however, be emphasized that the relation cultivation technique and danger for disease attacks during fall and winter is even more important for rye than for wheat.

For the development during the vegetation period the characters that influence ripening and harvesting are of special interest. Among these stiffness of straw and resistance to germination in the heads during the ripening period should be especially emphasized. A shorter straw and a better stiffness of straw has been the aim of the breeders for a long time Good results have also been achieved. Use of the straw-shortening substance CCC (chloro-choline--chloride) has been tested and it has been proved that use of 2-4 kg CCC per hectare when the plants are 15-30 cm tall, shortens the straw and reduces the lodging.

Resistance to germination of the kernels during the ripening in the field has long been a factor under consideration. It has been possible to obtain genetic differences in such a resistance and these have been used for the breeding of varieties in which the amylase activity is lower when the varieties are subjected to poor weather conditions in the field than is the case in the commonly used varieties. This is a valuable achievement as the starch quality of rye is very important for the future use of rye is a bread cereal. The starch quality is determined by the method of falling number which was described in the presentation of wheat above. The normal value of falling number in rye is 160.

Barley

The barleys grown in Sweden are mainly two-rowed barleys. Six-rowed barleys are used in areas where early ripening types are desirable. Recent developments have, however, led to breeding of early two-rowed types. These are now used in many areas and under many conditions where six-rowed barleys were earlier predominant. Barley is grown from the extreme south to the extreme north in the country. Six-rowed barleys are more common in northern Sweden than in southern. Practically all barleys in Sweden are spring barleys and these are also the only ones treated below.

Many of the problems in barley production are similar to the ones treated in connection with the discussion of cereals in general. Great attention must be given to seeding with the aim of obtaining even stands of barley, which is very important in regard to the quality for feeding or malting. Poorly developed kernels as well as green ones must be avoided. Great attention must be given also to fertilizer application. This is valid especially for nitrogen, which has a marked influence not only on kernel development but also on protein content and protein production per hectare. Evenly and well developed stands, that are obtained through good cultivation technique, for example, by using effecient methods for seeding and fertilizing, can be further improved through effective methods for controlling weeds, diseases and insects and by using the best varieties among the ones available.

Barley breeding in Sweden has given a number of good varieties, which in regard to yield, stiffness of straw and a series of quality factors have meant great progress. Today the breeding is aiming particularly at improving protein quantity and quality with special reference to barley for feed and at establishing better resistance to diseases and insects. Breeding for improving the proteins deals with higher protein content but also with a higher percentage of essential amino acids in the protein Of special interest in this case is the increase of the lysine content, which from a nutritional point of view, is of great importance.

Oats

There are two types of oats grown in Sweden, namely oats with white kernels and with black kernels. The types with white kernels are the commonly grown ones; the types with black kernels are found only in certain districts in northern Sweden. Oats are grown all over the country and often in alternation with the other cereals. As stated above oats are almost entirely used for feed. The important factors are then to obtain even stands with well developed kernels. High-yielding, stiff-strawed varieties are available. With regard to quality efforts to breed varieties with thin hulls have long been an important factor. Improvements in this respect have also been registered.

Mixed cereals

As stated above mixed cereals in Sweden are generally mixtures of barley and oats. In recent years peas have also been included in order to help raising the protein production. Mixed cereals are used with the intention of having less variation in yields from one year to another. If the year should be poor for barleys it may be good for oats and the opposite. With more specialized cropping systems in Sweden the use of mixed cereals has decreased. Barley may appear too often in the cropping system if mixed cereals are allowed to alternate with other crops in a system when barley is a frequent crop. This development has led to a decrease in the acreage of mixed cereals. At the end of the 1950s there were 2,60,000 hectares of mixed cereals while in 1970 there were only 76,000 hectares.

REFERENCE

Aberg, E.: *Proteingrodor i vaxtfoljden.* (Protein crops in the crop rotation). -Kungl. Skogs-och Lantbruksakad. Tidskr. 108, 1969.

Aberg, E. : *Allsidigare vaxtodling-alternativgrodor.* (A more varied crop husbandry -alternative crops). Manuscript for: Kungl. Skogs- och Lantbruksakad. Tidskr. 110, 1971.

Aberg, E , Bengtsson, A. and Steen, E. : Cultivar Testing.- Manuscript for: Swedish Seed Production, Orebro 1971.

Akerberg, E. : *Vad kan vi forvanta oss fran vaxtforadlingen under 1970-talet?* (What can be expected from the plant breeding work at the Swedish Seed Association during the 1970's)?-Sveriges Utsadesf. Tidskr. 80, 1970

Bengtsson, A. : *Fodersadens grundkvalitet och vaxtodlingsatgarderna.* - Aktuellt fran Lantbrukshogskolan, Nr 132, 1969.

Bengtsson, A. and Eggum, B : *Virkningen af stigende N-gdskning pa havre- og bygproteinets kval itet.* (The effect of increasing nitrogen fertilization on the protein quality in grain of oats and barley). -Tidskr. for Planteavl, 73, 1969.

Gesslein, S. : *Strasadens mognadsforlopp och skordemetoderna.* (Ripening process of cereals and harvesting methods), -Vaxtodling. Plant Husbandry 13, 1959.

Hagberg, A., Karlsson, K. E and Munck, L. : *Use of Hiproly in barley breeding.* -Improving Plant Protein by Nuclear Techniques, Proc. of a Symposium, Vienna 8-12 June, 1970. Vienna 1970.

Larsson, R. : *Hostsadens overvintring och avkastning.* (Winter survival and yield of fall sown cereal). -Vaxtodling. Plant Husbandry 16, Uppsala 1961.

Munck, L. : *Increasing the nutritional Value in cereal protein: basic research on the hilly character.* -Improving Plant Protein by Nuclear Techniques, Proc. of a Symposium, Vienna 8-12 June, 1970 Vienna 1970.

National Board of Agriculture : *Certification of seed* (except seed potatoes) for use in Sweden and for international trade. — National Board of Agriculture, Announcement No 5, 1968.

Olered, R.: *Falltalsmetoden.* (The falling-number method).-Sveriges Utsadesf. Tidskr., 74, 1964.

Olered, R.: *Development of α–amylase and falling number in wheat and rye during ripening.* -Vaxtodling. Plant Husbandry 23, Uppsala 1967.

Osvald, H.: *Swedish agriculture.* -Stockholm 1952.

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CEREAL PRODUCTION AND PROCESSING IN AUSTRIA

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In order to understand the present state of wheat production and the production programme of this industry in Austria, it is necessary to consider, first of all, its historical development.

The Republic of Austria in its present form emerged from the former Austro-Hungarian Monarchy after World War I in 1918. This territory, also known as Habsburg Monarchy or Danubian Monarchy, covered an area of 673.000 km² and included the large cereal producing areas of the Hungarian Low Plains and the Bohemian Basin. That not only meant that the Danubian Monarchy could meet the requirements of its 50 million population but could also export cereals abroad.

The Republic of Austria to-day merely covers an area of 83.849 km² and, as successor to the Habsburg Monarchy, has only taken over the mountainous area of the Eastern Alps which is suitable for cattle breeding but not for wheat production. Before the end of World War I, the territory of the present Austrian Republic was supplied with wheat by those areas that constitute today the States of Hungary and Czechoslovakia, The only cereal growing areas that remained with the Austrian Republic were small regions in the plains along the Danube, north of the Alps, and those situated along the Eastern fringes of the Alps facing the Hungarian Low Plains. The difficulties confronting the Republic of Austria since 1918 with regard to wheat supplies are characterised by the fact that two fifth of the country are covered by an area of more than 1,000m above sea-level while the remaining three fifth are situated partly between 500 and 1,000m and partly below 500m above sea level and 1,2 million hectare (14% of the total) are entirely unproductive. Only 4 million hectare (48% of the total) can be used for agricultural purposes. Of these the greater part is used for grassland farming and mixed farming-arable as well as grassland farming (3·1 million hectare) -while only 1·1 million hectare are available for arable farming. It can, thus, be seen that in Austria neither climate, soil nor area available provide favourable conditions for the cultivation of cereal.

The disastrous shortage of supplies during World War I and the acute scarcity of food after World War I and II, together with the structural difficulties have combined to further cereal production, the object being to achieve self-sufficiency to the greatest possible extent. The Austrian Republic was also compelled to take measures promoting self-sufficiency for yet another reason: After 1918 there were not enough industries able to produce articles for barter transactions, resp. goods for exports bringing foreign currency as a means to ensure the importation of cereal, providing food for the population.

Assisted by technological and scientific progress, the measures for safeguarding the national food supply have proved a complete success for the last 50 years. Here are some figures to illustrate, this development with respect to motorisation: Whereas in 1930 the number of tractors used in Austria foragricultural purposes was 753, after World War II the figures rose steeply to 14,500 in 1950; 31,000 in 1953; 1,21,000 in 1960 and 2,49,000 in 1970.The number of combine harvesters rose from 919 in 1953 to 26,500 in 1969. Draught oxen decreased from 1,32,000 in 1950 to 42,200 in 1960 and to some 2,000 in 1969. By means of motorisation on the one hand and the reduction of draught animals on the other, two tasks were achieved simultaneously. It was possible to increase the cultivation of cereal while lowering the demand for feed grain. The progress of technology, motorization and mechanization was complemented by the cultivation of high yield cereal, appropriate fertilisation and scientific protection of the crops by pest control.

As a result of these measures, the production of bread grain has risen substantially. In Austria, wheat and rye are termed as bread grains as they are almost entirely used for human consumption, whereas other kinds of cereal are being used for feeding and industrial purposes. There is practically no cultivation of millet. Thus, the cultivated area of bread grain has decreased from an average of 6,19,000 ha in 1934/37 to 4,67,000 in 1950 and, further, to 4,12,000 ha in 1970. The crop yield, however, increased from 9,28,000 t in 1934/37 to 1,4 million t, the latter being the average for the last three years (1967-1970). The increase in crop yield per hectare was specially pronounced in the case of wheat. As a result of World War II it decreased from 16 dz/ha (= 100 kg pro hectare) to 10,3 dz/ha in 1947, but then steadily increased as follows: 17, 6 dz/ha 1950, 25,3 dz/ha 1960, 29,o dz/ha 1970. The same tendency can be noted in the case of rye: 14,3 dz/ha 1934/37, 10,8 dz/ha 1947, 15,5 dz/ha 1950, 20,7 dz/ha 1960 and 25,3 dz/ha 1970. Comparing these figures with the crop yield of wheat per hectare of 100 years ago (1869), i. e. 12,3 dz/ha, and that of rye 13,1 dz/ha, it will be observed that the substantial increase in production ook place only during the last 20 years.

In order to understand cereal marketing, it is important to realise the interesting fact that during the last 120 years a complete reversal in the food habits regarding wheat has taken place. Whereas in 1847 the crop yield of wheat was 2,65,000 t, the comparative figure for 1966 was 8,97,000 t. On the other hand, in 1847 the crop yield of rye was 7.10,000 t as compared with only 3,63,000 t in 1966. In Austria, wheat has, thus, taken the place of rye and, for this reason, food containing cereal has largely changed in appearance. Since in Austria climate and soil are partly more suitable for the cultivation of rye than wheat, this change in the national taste has caused some difficulties in Austrian wheat production. In fact, the consumers' preference of wheat and their reluctance to eat foods containing rye may force many farmers to give up the cultivation of cereal altogether.

A similar tendency could be noted with regard to feeding stuffs for livestock. In 1847 the crop yield of rye was only 1,87,000 t but by 1966 it had risen to 7,06,000t. On the other hand, the decrease in the horse population caused a reduced production of oats, since the latter is mainly used as horse feed. Whereas in 1847 the crop yield of oats amounted to 871,000 t, the figure for 1966 was 3,25,000 t (and for 1970 2,71,000 t).

These far-reaching changes in Austrian cereal production brought about the following situation in the years after 1960 :

On the one hand, production of the Austrian standard wheat (soft wheat) rapidly increased far above the requirements of the population, partly on account of technical and scientific progress and partly due to some government assistance. On the other hand, there was a shortage of certain types of cereal (quality wheat and durum wheat wnich are largely used for industrially produced food). While production of wheat was increasing, rye production decreased to such an extent that the livelihood of the rye producing farmers was threatened, and the still existing requirements of rye had to be met by importation, The great changes that have taken place with respect to Austrian feed grain (i.e. rye, oats and maize) have not been able to warrant sufficient supplies to cover the demand caused by the increase in livestock. In the years after 1960, there arose the unsatisfactory situation that wheat destined for human consumption had to be increasingly denatured in order to be used for feeding purposes. As this denaturisation had to be subsidised by the government, it involved a doubling of government expenditure. The requirements of the population with regard to bread and flour had been met, but now the reverse problem arose, i.e, the problem of surplus production, since supplies exceeded the requirements of the home market.

Wheat marketing in Austria, like in many other countries, is not carried out on the lines of a free market economy. The prices of wheat are officially fixed and indirectly subsidised by the government. The farmers, however, do not receive direct government subsidies, the payment being carried out through approximalely 700 commercial mills. Administration and settling of accounts are, thereby, greatly simplified since the government has to settle accounts only with the aforementioned 700 mills instead of several hundred thousand farmers.

In order to ensure equitable marketing of supplies, a special board, the so-called Grain Compensation Board, has been founded. It is responsible for an equitable distribution of supplies by means of appropriate storage, regulation of imports, etc.

The surplus production of bread grain together with the shortage of feed grain, respectively import requirements of feed grain, have caused the government to take decisive measures in the middle of the sixties, the object being the reorganization of wheat production in order to adjust it to the requirements of the market and, thereby, enabling the government to reduce agricultural subsidies as much as possible.

The aims of this policy were formulated as follows :

1. a decrease in bread grain production and an increase in feed grain production in the areas available,

2. a decrease in the production of standard wheat and an increase in the cultivation of quality wheat, since the latter is not only needed for the home market but could also be exported,

3. an increased cultivation of rye to replace wheat as there is still a certain demand for rye.

The Austrian legislation does not authorize the Government to achieve these aims by direct control of production. It is, therefore, obliged to take indirect measures, for example to issue price regulations or to provide technical equipment, thus achieving its aims by providing economical and psychological incentives without excercising direct economic control. The measures for the reorganization of wheat production can be divided into the following three groups:

By gradually increasing the price of feed grain, f. e. in the case of fodder barley the last increase took place in 1970, that means by adjusting its price to the price level of bread grain the production of feed grain has become profitable to farmers. Thus, the transition from the cultivation of bread grain to that of feed grain was greatly furthered;

The officially fixed prices of wheat for each month were altered in such a way that farmers are no longer so keen on marketing their wheat but either use them largely for feeding purposes or, alternatively on their own accord, switch over to the cultivation of feed grain;

In order to further the cultivation of maize instead of wheat, it was necessary to take special measures since neither soil nor climate in Austria are suitable for the growing of grain-maize. Numerous drying plants have, therefore, been built for the purpose of producing grain-maize (coarse grain).

These measures have so far met with considerable success. The cultivated area of wheat, which was 2,77,000 ha in 1960 and reached the record figure of 3,16,000 ha in 1967, was reduced to 2,75,000 ha in 1970. The crop yield of wheat which amounted to 7,02,000 t in 1960 and reached a peak of 10,45,000 t in

1967, was reduced to 7,94,000 t in 1970. Even the crop yield pro hectar now shows a downward trend (1960-25,3 dz/ha, 1968-34,2 dz/ha, 1970-29 dz/ha). The measures have proved particularly successful with regard to the marketed output of wheat (production by farmers for general use) which had increased considerably till recently, i.e. from 3,58,000 t in the farm year 1959/60 (1/7/1959-30/6/1960) to 7,54,000 t in 1967/68. As a result of the measures of reorganization, the marketed output of wheat was reduced to 6,36,000 as early as 1969 and is estimated at only 5,00,000 t for 1970/71.

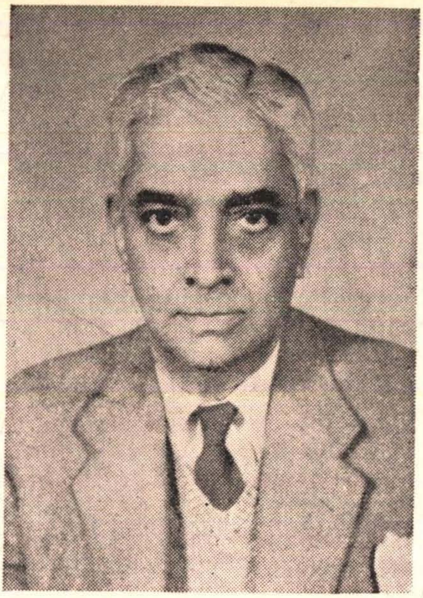
For feeding purposes 50,000 t of wheat were denaturised in 1960/61, rising to the record quantity of 2,30,000t in 1967/68. In 1969/70 the figure was reduced to 2,03,000 t.

The development of feed grain production (with the exception of barley) follows an even more favourable trend. The cultivated area of barley increased from 2,09,000 ha in 1960 to 2,20,000 ha in 1965 and, 2,09,000 ha in 1970. The crop yield of barley increased from 5,89,000 t in 1960 to 9,08,000t in 1970, the crop yield pro hectare during the same period rising from 28,1 dz/ha in 1960 to 31,3 dz/ha in 1970. The most pronounced changes could be observed in respect to grain maize. These are the figures: Cultivated area 1960 : 58,000 ha, 1965 : 50,000 ha, 1970 : 1,24,000 ha, crop yield 1960 : 2,13, 000 t, 1965 : 1,87,000 t, 1969 6,98,000 t; crop yield pro hec tare : 36,5 dz/ha, 1969 : 59,6 dz/ha As a result of the extremely great increase of home production in feed grain, the Austrian import requirements of feed grain (oats, barley, maize) were rapidly reduced: 1965 : 7,51,000 t; 1966 : 6,22,000 t; 1967 : 3,87,000 t; 1968 : 3,08,000 t and 1969 : 1,93,000 t; for 1970 the estimated feed grain imports (despite the bad harvest) will only amount to 70,000-1,20,000 t.

The incentives for the production of quality wheat include the granting of Government premiums for quality, reduced prices for registered seeds and fertilizers, confining production to varieties that provide best quality as well as high crop yield and, finally, a system of contracts regulating cultivation and supply. In this way, it was possible to increase the marketed output of quality wheat from 11,200 t in the farm year 1959/60 to 1,40,100 t in 1969/70. A further promotion of rye production was achieved by increasing the official rye prices received by the farmers. These measures resulted in an increase of the marketed output of rye which had been 1,47,000 t in the farm year 1965/66 and 2,99,000 t. in 1969/70.

By means of these changes in wheat production and wheat imports, the Government subsidies were reduced by 25% after 1965. In the years to follow the Government will, therefore, continue and possibly intensify their measures aiming at an adjustment of wheat production to the requirements of the market.

FERTILISERS FOR INCREASING GENERAL PRODUCTION IN THE SEVENTIES



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The decade of the seventies has begun on a promising note so far as food production in India is concerned. For the first time we have succeeded in scoring a century ln foodgrains' production (100 million tonnes) with record harvests of about 42 million tonnes of rice and 20 million tonnes of wheat. This achievement appears all the more impressive when viewed against the substantial production of foodgrains around 95 million tonnes in the two previous sessions, i.e., 1967-68 and 1968-69. These three successive good seasons have had a salutary effect in easing the food situation in the country. Not only have we wiped off the unpleasant memories of 1965-66 and 1966-67, when food production was as low as 72 and 75 million tonnes respectively, but we have also succeeded in building up buffer stocks for use against possible future crop failures. Indeed, the idea of exporting sizeable quantities of fine quality rice, hitherto only a remote aspiration, now seems possible of achievement in the near future. Equally satisfying is the fact that we may, after all these years, be able to discontinue imports of food grains by 1971.

TABLE–1

Production of Foodgrains in India
(million tonnes)

Year	Total Food-grains	Rice	Wheat	Jowar	Bajra	Maize	Others
1951	54.9	22.1	6.8	6.2	2.7	2.0	15.1
1959	74.3	30.2	9.9	8.8	3.6	3.0	28.8
	(35.3)	(36.6)	(45.6)	(41.9)	(33.3)	(50.0)	(91.4)
1969	94.0	39.8	18.7	9.8	3.8	5.7	16.2
	(26.5)	(31.8)	(88.9)	(11.4)	(5.6)	(90.0)	(–43.7)
	*(71.2)	(80.1)	(175.0)	(58.1)	(40.7)	(185.0)	(7.3)

Note : Figures in brackets indicate the percentage increase or decrease over the previous year.

* Percentage increase over 1951 figures

Data given in table 1 show that we have made substantial progress in the last two decades. The total production of foodgrains has gone by as much as 71 percent, showing roughly an increase of 20 million tonnes in each of the two decades. Curiously enough, all the major cereals showed a more or less uniform rise in output in the fifties, when the higher production was obtained largely by extension of the area under these crops. However, in the sixties. when the accent was on realising bigger harvests from a unit area-extension of area under crops being no longer possible-wheat, rice and maize showed a greater increase in output than other crops.

Several factors have contributed to the progress achieved on the food front. Sustained, intensive and planned efforts made by the Government and other related agencies in popularising the improved agricultural practices have now begun to bear fruit. Availability of essential inputs of the right tvpe has increased over the years, though fertilisers were in short supply for a brief period in mid sixties. Favourable weather conditions obtained in 1964-65 and the last three seasons have paved the way to successful adoption of modern crop technology. Remunerative prices of foodgrains fixed by the Government in the past few years have provided the much needed incentive to farmers. Above all, the farming community has risen to the occasion by showing willingness and enthusiasm of an unparallel nature in adopting the intensive method of cultivation evolved and advocated by our scientists, extension workers and private agencies. Both our research effort and the extension agency now seem adequately geared to meet the challenge of ever increasing food requirements.

The idea of exploiting our abundant natural resources, such as plenty of sunshine available throughout the year, to good advantage by obtaining higher output per unit area of land has now struck firm root. No one disputes the role of fertiliser as a key input in maximising our agricultural output in a short time. Equally well understood is the important role of seeds, plant protection chemicals, improved implements and water as associated inputs in getting the best out of each unit of fertiliser used in the country.

We have thus entered the new decade with high hopes and seem poised for a real breakthrough on the agricultural front.

However, a look at the figures of what we have achieved so far and what needs to be achieved in the next ten years will make it clear that we need to struggle hard if we are to maintain the tempo of progress.

In terms of foodgrains, we will have to aim at harvesting around 167 million tonnes by 1980-81 to meet all our food requirements. This means an increase of 67 million tonnes in 11 years or 6 mlllion tonnes per year. Cereals are expected to contribute as much as 148.5 million tonnes of the total food requirement. Much of the increased yield must come from higher output per unit area as extension of cropped area is not possible. The net cultivated area, which stood at 138 million hectares in 1966-67 will go up only to 151 million hectares by 1980-81.

Amongst the cereals, wheat, which has shown by far the greatest increase in production in recent years, is likely to rise to higher levels of production. As compared to rice, wheat cultivation in India is undertaken on relatively limited, definite areas. It is the pivot of multiple or relay cropping, and will continue to be so. Wheat varieties and wheat agronomy including use of water are much better developed than in the case of rice and other crops. Wheat will also continue to command a greater share of available irrigation resources.

Rice, which is our most important crop in respect of both area and production and, therefore, represents immense possibilities, has so far not given us much reason for satisfaction in terms of total output. The wide range of conditions under which it is grown in India makes its successful cultivation a difficult problem. Agronomic practices for rice can not be easily perfected in view of the water-logged conditions under which it is grown. Fertiliser efficiency is below par and some of the high yielding varieties are not in a position to withstand long durations of standing water. However, the intesive research that has now been undertaken to overcome these problems has already yielded some promising results in the shape of good varieties and improved fertiliser efficiency by adjusting its placement and time of application. What we could not achieve in the sixties in the case of rice seems to be a distinct possibility in the seventies.

Jowar and bajra, our two major millets, have so far proved poor yielders though they command a large acreage. Both of them are traditional crops of restricted rainfall or dry areas and do not receive much irrigation. Though some success has been achieved in evolving high yielding varieties of these crops, they do not seem to have become as popular as in the case of rice and wheat. Jowar and bajra will need great attention in terms of research effort and extension of research results to farmers because experience has shown that it is difficult to motivate farmers belonging to dry areas into adoption of improved practices. Whether we shall be able to achieve our target of foodgrain production by 1980 or not, will be largely determined by the increase we are able to bring about in the yields of these two crops. Maize crop presents a story which is not very different from that of jowar or bajra and will also need great attention.

The crop-wise situation has been briefly surveyed because it will greatly influence the pattern of fertiliser consumption in cereals in the coming ten years

The total fertiliser consumption, which began to pick up in early fifties and reached a modest level of 0.15 million tonnes of nutrients ($N+P^2O^5+K^2O$) by 1956-57, increased substantially to 1.69 million tonnes by 1969-70. But in order to achieve self-sufficiency in food and fibre and to meet the needs of other crops, we will have to increase the level of consumption to about 10.0 million tonnes in the next 10 years. Similarly, as against the coverage of 9.2 million hectares in 1968-69 under high yielding varieties, we will have to step up the coverage to 25 million hactares by 1973-74. The targets for areas under high yielding varieties in 1980-81 are not yet available, but it is apparent that we may have to bring upwards of 50 million hectares under the seeds of these varieties by that time. Though it is not possible to quantify the growth in use of other inputs like water, plant protection chemicals and implements, all of them will certainly have to be used in much greater quantities than hitherto.

Out of the 10 million tonnes of fertiliser nutrients likely to be consumed by 1980-81, as much as 6.7 million tonnes will be used for foodgrains and most of it for the five major cereal crops discussed above.

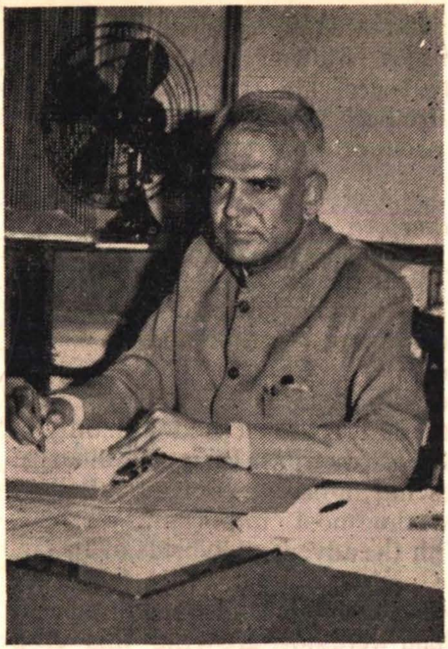
Though cropwise consumption data are not available, it is reasonable, to presume that wheat and rice will receive the bulk of the fertilisers among cereals. In the case of jowar, bajra and maize, the need for increasing fertiliser efficiency will be all the greater because we will have to get the maximum returns from the limited quantities of fertilisers that will be used for these crops. This does not, of course mean, that fertiliser use in rice and wheat need not be highly efficient.

While fertiliser use will greatly influence the production of cereals in the coming decade, as it has done in the previous one, the availability and efficient use of other inputs will also have to be ensured. Much will depend on how best we utilise our irrigation resources to get the maximum output per unit of land. The role of multiple or relay cropping in this connection can not be overemphasized. The areas which can not receive irrigation water and are also less favoured in terms of rainfall will be able to produce best only if they grow drought resistant, quick maturing varieties with adequate fertilisation to utilise to conserved moisture to the best advantage. It is a happy augury that a scheme for development of dry land areas has been stared. It will no doubt contribute a great deal in improving the agriculture of these areas.

Fertiliser use and other improved techniques among cereals as also other crops, has so far been adopted mainly by farmers with medium and large holdings. A greater share of increased farm income has, therefore, gone to them accentuating social inequality and tensions. Small farmers and tenants have so far not enjoyed this benefit largely due to their own shyness, lack of contact with extension agents, lack of resources and inability to take risks. That it is possible effectively to help this section of our farming community in overcoming their difficulties is seen clearly from the highly successful implementation of village development programmea in Raipur district of Madhya Pradesh. The experience gained in this district could be utilised for bringing the small farmers of other areas within the ambit of the green revolution.

The potential of increasing production of cereal crops through judicious use of fertilisers and other inputs is very high. It is for the farmers and those who serve them as advisers or suppliers of inputs to translate the potential into actuality for the benefit of all concerned.

CEREALS IN MYSORE



Dr. H. R. ARAKERI,
Director of Agriculture,
Mysore State, Bangalore.

Cereals occupy an important place in Agriculture of Mysore State. The total cropped area in Mysore State was 10,467 thousand hectares in 1966-67 of which 7,749 thousand hectares constituting about 74% were under food crops. Cereals occupied an area of 6,060 thousand hectares constituting about 58% of the cropped area. The important cereals grown in the State are jowar, rice, ragi, wheat and bajra. Since the introduction of hybrid maize, this crop is gaining ground and the area has gone up considerably in recent years.

The area and production of important cereals is given below: (based on forecast figures of Bureau of Statistics for 1968-69).

	Area (Hectares)	Production (tonnes)
Jowar.	30,59,065	15,29,876
Rice	10,99,425	18,38.952
Ragi	7,32,964	4,18,486
Bajra.	7,86,019	2,26.259
Wheat.	3,09,541	1,23,507
Maize.	55,983	1,19,995
Others.	3,43,800	97,863
Total:	63,86,797	43,54,938

As could be seen from the above table, jowar occupies the first place in area, but second place in production. Rice, on other hand, occupies the second place in the area but first position in production. The reasons are quite obvious. Jowar is mostly grown as a dry crop in the State and as such the yield per acre is low. The other important cereals are ragi, bajra, wheat and maize both in area and production, in order of importance.

Jowar

Jowar is grown in all districts except the coastal districts of South Kanara and North Kanara, Kolar, Bangalore, Coorg. This crop is grownin kharif as well as rabi season. It is grown predominantly in northern districts. Bijapur,Gulbarga, Raichur, Dharwar, Belgaum, Bellary are the most important districts. With the advent of hybrids of Jowar, the cultivation of the crop has spread to Kolar and Bangalore also which were not growing this crop previously. The average yield of the crop is about 5 quintals per hectare. The important varieties of jowar for kharif season are D. 340, Nandyal, Fulgare white and yellow Bailhongal etc. and for rabi M-35-1, Muguthi jola (5-4-1), H. I etc. Hybrid jowar CSH-I is becoming increasingly popular in the state. This is found to be suitable for kharif and also summer seasons. This is found to perform very well even under rainfed conditions in kharif season and, therefore, is becoming more popular. The performance of CSH-2 in transitional belt is good. The area irrigated under jowar is only about 88,000 hectares in the State and as such the average yield per hectare is low.

The trend of production of jowar can be judged from the following table.

	Area	Production
1955-56	26,67,256	9,50,135
1960-61	29,69,351	11,35,591
1965-66	28,77,484	13,09,818
1968-69	30,59,065	15,29,876

The yield per hectare has also been going up gradually which is about 5 quintals during 1968-69.

Rice :

This is the most important crop as for as production is concerned occupying the first place. Rice is the staple food crop in the coastal districts of South Kanara and North Kanara and the heavy rainfall tracts (Malnad). This crop is mostly grown as a wet crop in heavy rainfall tracts, and also in the irrigated areas. Paddy is grown under three different conditions in the State. In the coastal regions and heavy rainfall regions paddy is grown rainfed but under wet conditions. The crop is transplanted. In areas where irrigation facilities are available either under the irrigation projects or under tanks or other minor irrigation works, the crop is transplanted. In the transition belt it is drill sown. The conditions and problems in each of these regions are different. The crop is grown in three seasons viz., kharif, winter and summer. However, kharif is the most important season as major area under this crop is sown during that period. The important rice growing districts are South Kanara, Dharwar, Shimoga, North Kanara, Belgaum, Mysore, Chickmagalur, Mandya and Coorg. The important varieties of paddy grown in the State are S. 705, SR. 26.B, S.701, S.1092, S.317 etc. In recent years, the High Yielding Varieties have also become quite popular. The important high yielding varieties are Taichung Native-1, and IR.8. Of these IR.8 is found to be becoming increasingly popular in the State.

The trend of production of rice in the State can be judged from the following table :

Year	Area (in hectares)	Production (in tonnes)
1955-56	8,78,180	11,83,889
1960-61	10,28,399	13,28,173
1965-66	11,48,869	12,40,106
1968-69	10,99,425	18,38,952

There is an increase both in area and production. The area has increased by about 25% in 1968-69 as compared to 1955-56 while the production has increased by about 55% during the same period. One of the reasons for increase in area is the increased irrigation potential under major, medium and minor irrigation projects. The yield per hectare is one of the highest in the country. The yield per hectare which was 12 quintals in 1956-57 as increased to 16½ quintals in 1968-69. The yield per hectare is bound to go up further with the advent of high yielding varieties. However, there is one lacuna in this respect. A suitable high yielding variety for the kharif season for growing in the high altitude areas of the Malnad tract which is one of the very important regions as for as rice is concerned, is yet to be evolved. Similarly, a variety suitable far southern parts of the State and in drilled paddy areas, is yet to be evolved. At present IR.8 is restricted to warmer regions of the state.

Ragi

Ragi is the next important food crop in the State both in area and production. It is the staple food in the southern districts of the state. The crop is grown mostly as a dry crop in the kharif season and as an irrigated crop in the summer. The important districts growing this crop are Bangalore, Tumkur, Kolar, Mysore, Hassan, Chitradurga and

Mandya. The area under the crop is going down in recent years. The trend of production can be seen from the following table.

Year	Area in hectares	Production in tonnes
1955-56	9,31,396	9,03,382
1960-61	9,95,718	7,53,531
1965-66	12,60,065	3,33,980
1968-69	7,32,964	4,18,486

The area was increasing till about 1965-66, but the production has been going down. In 1965-66, the State faced one of the worst droughts in living memory and Ragi was the crop which suffered most. The production touched a very low level. Since then the area under the crop is found to be going down because the seasonal conditions have not been favourable for the last few years.

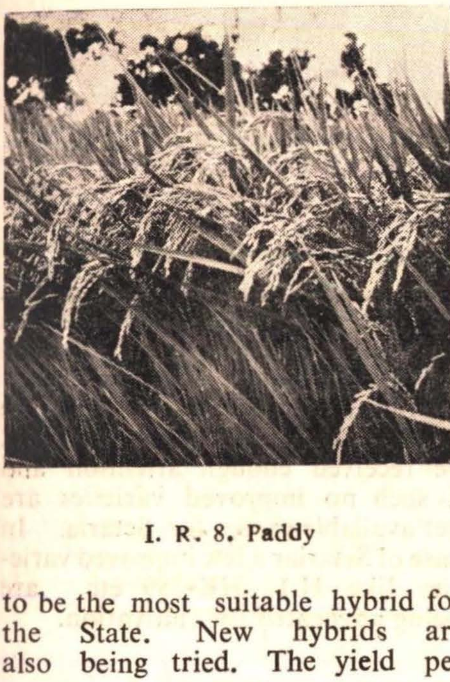
The important varieties under rainfed cultivation are H.22, K.1, Cauveri E.S. 11, Poorna. Poorna is found to be the most important crop being of short duration with higher yields. It is becoming more popular.

Bajra

The next important cereal is Bajra. This is grown mostly in the dry regions of the State particularly in the northern districts. The area and production is as under :

Year	Area in hectares	Production in tonnes
1955-56	5,66,558	1,57,187
1960-61	4,99,907	1,28,643
1965-66	4,99,165	1,21,871
1968-69	7,86,019	2,26,259

The area and production of the crop has increased considerably as compared to 1955-56. The important districts growing this crop are Bijapur, Gulbarga, Belgaum, Raichur, Bellary and Chitradurga. The crop is mostly grown in kharif season. Since a few years hybrid bajra has been introduced in the State. This can be grown both in kharif and summer. HB-1 is found



I. R. 8. Paddy

to be the most suitable hybrid for the State. New hybrids are also being tried. The yield per hectare of the crop in the State is low being less than three quintals. However, there is vast scope to increase the yield per hectare with the introduction of hybrids.

Wheat

Wheat is an important rabi crop in the northern parts of the state occupying an area of about 3 lakh hectares. The important wheat growing districts are Dharwar, Bidar, Belgaum, Gulbarga, Raichur and Bellary. The important varieties are Bijaga yellow, Bijaga red, K. 28 etc. In recent years Mexican varieties of wheat are becoming more popular. Cultivation of this variety is spreading to districts like Bangalore, Tumkur, Kolar and few other districts where wheat was not grown, in previous years. It is quite likely that cultivation of this crop will spread to other districts particularly in the Malnad regions of the State. The yield per hectare is rather low being only about three quintals. The trend of production can be seen in the following table:

Year	Area in hectares	Production in tonnes
1955-56	3,08,022	69,108
1960-61	3,24,091	76,868
1965-66	2,48,638	47,241
1968-69	3,09,541	1,23,507

The production has been going up in recent year.

Maize:

Maize was a minor crop in the State till recently. However, in recent years the area and production has gone up considerably particularly after the introduction of Hybrid Maize. Deccan-1 is the most popular hybrid grown in the State. Now the crop is grown throughout the State in all the three seasons. It is even being successfully grown under rainfed conditions in kharif season in the transitional tracts. The trend of production is as under:

Year.	Area in hectares	Production in tonnes.
1955-56	12,068	5,734
1960-61	11,281	12,178
1965-66	17,636	10,422
1968-69	55,983	1,19,995

Thus it is evident that there is a sudden spurt in production of this crop in recent years. Further, the crop is found to be subject to very few pests and diseases as compared to other crops. The average yield of the crop is quite high in the State being more than two tonnes per hectare. Hybrid maize has practically displaced local maize in almost all maize growing areas of the State.

Other Cereals

A number of other cereals are also grown in the State. Mostly these are minor millets like **navane** (setaria), **save** (panicum miliare) and **Haraka** (Paspalum Sp). Though individually they are of little importance, collectively they are of considerable significance occupying nearly 3½ lakh hectares in area and producing about a lakh tonnes of grains annually. Tumkur and Dharwar are the important districts as far as minor millets are concerned. These crops have not yet received enough attention and as such no improved varieties are yet available except for Setaria. In case of Setariar a few improved varieties like H.1, HK-289 etc. are being advocated for cultivation.

High Yielding Varieties Programme

High yielding varieties programme had a great impact on cereal production in the state in recent years. The programme covers five crops in this state viz. rice, jowar, maize, bajra and wheat. The state has not been fortunate enough in getting suitable high yielding rice varieties. A beginning was made with Taichung-65 and Taichung Native-1 in 1966-67. But they were not very popular. However, IR.8 has been found to perform better in many parts of the state, particularly in coastal areas and warmer regions of the state. Jaya and Padma are now being tried in the state and their suitability or otherwise has to be watched. The main problem as for as rice is concerned is that no high yielding variety is yet available for growing in kharif season in malnad region which is the most important rice growing tract in the state. All the available high yielding rice varieties are found to perform well only in warmer regions that too in summer.

Hybrid jowar is becoming more popular in the state. CSH-1 is found to be the most suitable hybrid for the state for growing in kharif and summer seasons. However, no suitable jowar hybrid for growing in rabi season is yet available. CSH-1 has performed well under rainfed conditions in kharif season. As such the area under hybrid is likely to go up in the years to come.

Hybrid maize is the crop which has made great progress in a short span of 4 years. Deccan-1 is the most popular hybrid in the state. The crop is found to be comparatively free from pest and diseass as compared to other hybrids. The soil and climatic conditions of Mysore State seem to be very well suited for hybrid maize cultivation. The area and production may go up further but for the fact that in recent times marketing difficulties have arisen.

Hybrid bajra is fast catching up in the state. HB-1 is found to be suitable for the state. This hybrid can be grown both in kharif and summer seasons. HB. 3 and HB. 4 are also showing good progress.

Mexican wheat is the other high yielding crop included in the programme. Lerma rojo and Sonora-64 were the first to be introduced. In recent years Safed lerma, Chhoti lerma, Sonalika etc, have been introduced.

The area under high yielding varieties have been going up every year. The following table gives the progress under the programme.

Crops	Area covered in thousand hectares.				
	1966-67	1967-68	1968-69	1969-70	1970-71
High yielding					(Target)
varieties of rice.	25	53	75	121	158
Hybrid Jowar.	22	45	93	147	221
Hybrid Maize.	18	54	87	81	103
Hyprid Bajra.	1	8	18	23	51
Mexican Wheat.	1	11	26	36	70
Total :	67	171	299	408	603

The success of this programme has been responsible to a very great extent for the increased production of cereals. Further, the cultivation practices of cereals have also undergone improvements during the last decade and a half. Farmers are using better seeds and adopt fertiliser applications, plant protection measures etc. Due to these improvements the production of cereals has gone up. The following table gives the trend of production of cereals in State.*

The production of cereals which was about 34.24 lakh tonnes in 1955-56 has reached 43.54 lakh tonnes in 1968-69. With the advent of high yielding varieties, creation of more irrigation potential and the willingness of farmers to adopt improved techniques of farming, the production of cereals will go up further in the years to come.

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* Please see the statement on Page 163.

PRODUCTION OF CEREALS IN THE STATE

CEREALS	1955-56		1960-61		1965-66		1968-69	
	Area Hectares	Production Tonnes	Area Hectares	Prodn. Tonnes	Area Hectares	Prodn. Tonnes	Area Hectares	Prodn. Tonnes
Rice	878180	1183889	1028399	1328173	1148869	1240106	1099425	1838952
Ragi	931396	903382	995718	753531	1260065	333980	732964	418486
Jowar	2667256	950135	2969351	1153591	2877484	1309818	3059065	1529876
Bajra	566558	157187	499907	128643	499165	121871	786019	226259
Wheat	308022	69108	324091	76868	248638	47241	309031	123507
Maize	12068	5734	11281	12178	17636	10422	55983	119995
Other cereals	525470	154969	445011	124599	452850	129061	343800	97863
Total :	5888981	3424304	6273763	3577589	6504707	3192499	6386797	4353938

CEREAL PRODUCTION IN ORISSA

K. L. MOHANTY

Agriculture is an important industry of Orissa. About 80% of the population lives on this primitive industry. The value of the crops produced in a year is about 60% of the total income of the state. The rest 40% of the National income, is derived from Industry, Commerce and Forest etc. Hence, the economy of the State is purely agrarian in nature.

Rice is the staple food of Orissa, while Ragi is another important food crop of the state in the Eastern district. Pulses form an indispensable component of the diet. For a population 175.4 lakhs in the year 1961, the production of cereals and pulses in the state was fulfilling 75 percent of the respective requirement estimated on the basis of calorific value. During the period of seven years from 1961 to 1968 the population increased by at lesst 15.0 percent whereas the production of foodgrains during the period has increased by about 8.2 perecent. Foodgrains production during the period has not been able to keep pace with the population growth. The gap between the requirement and production has further widened as compared to that in 1961. But compared to the position in 1951 there has been substantial improvement in production of foodgrains almost double as the population has increased by about 37 percent

Production of cereal crops in Orissa.

Crop	Unit	Preplan	Ist Plan	2nd Plan	3rd Plan	67-68	68-69	69-70
Rice	Lakh tonnes	20.07	21.24	37.43	32.86	37.55	42.11	44.47
Other Cereals	— do —	9.95	0.56	0.66	1.30	2.63	2.99	3.19

The total foodgrains production reached the level of 40.28 lakh tonnes in 1960-61 from 23.12 lakh tonnes in 1950-51. The annual growth rate during the period ot these ten years was about 7.4 percent.

Due to severe drought in the year 1965-66, the last year of the 3rd five year plan period, the foodgrains production has reduced to 37.30 lakh tonnes. During the subsequent years i.e. 1966-67 and 67-68, the production increased to 43 55 and 43.57 lakh tonnes respectively even inspite of recurrence of Flood and drought in certain parts of the State. However, the production of foodgrains has been almost doubled during the period of 17 years from 1950-51 to 1967-68 which implied an annual growth rate of about 5.2 percent.

Inspite of the existing gap between requiremment and production of foodgrains, Orissa has'been exporting rice outside the state. The annual export of rice ranges between two to three lakh tonnes. Import of wheat from outside the state acts as partial substitution of the rice exported. The total cropped area of the state is about 66 lakh-hectares out of which 43 lakh hectores are under paddy.

The average yield per hectare of autumn rice is 4-25 quintals, of winter rice is 8.43 quintals and of

Taichung

summer rice is 24.13 quintals. The normal yield of high yielding varieties in summer is about 35 quintals per hectare. The average yield of all types of rice taken together is 9.77 quintals per hectare.

The introduction of high yielding varieties of paddy, wheat and other cereals have brought out practically the revolution in the field of agriculture. In the year 1965-66 the variety of Taichung Native-I paddy, introduced in the village Putting of Cuttack district, brought the success getting a record yield of 132 mds of paddy by Sri Upender Biswal. His success was again repeated by Sri Laxman Kumar Dharua of Bolangir district who achieved a greater success by producing 895 mds of rice per acre. This again was repeated by Sri Rama Raul of Chatrapur and Nilakanth Behera of Parlakhemundi, both in Ganjam district by achieving a record yield in paddy cultivation of Orissa.

This revolution has brought about 4.26 lakh acres under high yielding paddy cultivation by 1969-70 and it is expected to bring out about 10 lakh hectares of high yielding paddy cultivation under this programme by end of the 4th Plan.

Wheat is grown in limited areas of 14.508 heatares. About two third of wheat area lies in the western belt in Sundergarh, Sambalpur Bolangir, Kalahandi and Koraput districts. Dwarf stiff-strawed high yielding varieties which respond to liberal use of fertilisers have been recently introduced. These varieties have so far occupied one third of the wheat area and in near future will replace the conventional varieties. The average yield of high yielding varieties (17.0 quintals per hectare) is twice as much as the average yield of old tall varieties (8.5 quintals per hectare).

It has been proposed to bring about 24,000 hectare under high yielding wheat crops by the end of 4th Plan to meet the requirement.

Sri Dutiya Chandra Patel of Sambalpur has established the potentialties in the field of wheat cultivation by recrod yield of 157 mds. wheat per hectare.

Local varieties of maize is grown in an area of 67,962 hectares. The area under maize is concentrated in the districts of Koraput, Phulbani, Kalahandi and Keonjhar. Two third of the total area under maize lies in these districts and about 20 percent of the total maize area is found in Koraput district. About 95 percent of the total maize area is grown in Kharif season (June-September). The Hybrid maize has so far covered only about 8 percent of the total maize area. The average yield of hybrid maize is twice that of the local maize variety Local variety on average gives a yield of 8.20 quintals per hectare.

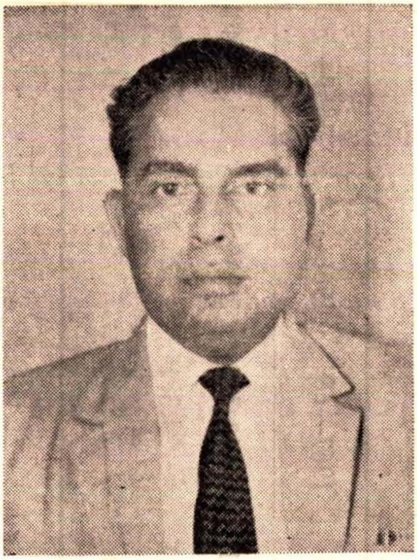
Ragi is the most important millet crop grown in state and shares 39 percent of area under all millets. This is grown almost all round the year in one or other part of the state. The average yield is 9.86 quintals per hectare. This crop is raised in rotation with other crops like oilseeds and pulses and needs less water.

The total production of cereals during 68-69 was 45.10 lakh tonnes out of which rice accounted for 42.11 lakh tonnes. The average yield of cereals in rabi (October-March) season is more than two and a half times of that in kharif. During 1967-68, area covered by cereals in rabi season was 3.5 percent of the total area of the year under cereals and this gave 8.7 percent of the total cereal production. This evidently shows that increase in cereals area in rabi season will play as important role in increasing the foodgrains production. Vigorous attempts are being made for replacement of smaller millets by high yieding varieties of paddy maize, Jowar & pulses through diversification of cropping pattern. This will lead to increase in the quantitative and qualitative production of cereals of the State.

Area Yield and production of cereals and other foodgrains in Orissa (68=69).

Name of the crop	Area in hectare	Plooducrion in matric tonnes	Yield per hectare in quintals.
Rice	4311428	4211743	9.77
Wheat	14508	16361	11.28
Maize	67962	55759	8.20
Ragi	153442	151230	9.86
Jowar	13928	11425	8.20
Bajra	1496	1382	9.24
Other Small Millets	161272	62881	3.83
Total :-	4726936	4510781	9.54

CEREAL PRODUCTION IN ASSAM



Dr. K. C. MAHANTA
Director of Agriculture, Assam

It may perhaps be worthwhile to go through the soil structure of the State which will provide the readers with necessary information as to how this can be regarded as cereal growing area.

The Assam soil is acidic in reaction which is found to be limiting factor in the cultivation of various crops; but the soil on the bank of the river Brahmaputra and its principal tributaries is alluvial. On the other hand both the banks of the great river Brahmaputra offer great contrast as regards acidity. The soils of nothern bank are less acidic in reaction than the soils of the southern bank. The old alluvial soils are more acidic than the new alluvial soils of these areas.

The total area of Assam is 35·8 million acres of which, only 14·2 percent of the total area is suitable for cultivation. About 80 percent of the total cultivable area of the State lies in Brahmaputra Valley where about 80 percent production is mainly rice. It is, therefore, evident that Cereal Production in Assam is mainly confined to the plain districts of the Brahmaputra Valley and the agriculture statistics should, therefore, be viewed from the out-put of plain districts. About 90% area of the hills are unsuitable for paddy cultivation.

Of all the cereals, rice is the principal crop in the State followed by maize and wheat. The area covered and the production achieved under the different varieties of cereals in Assam since 1955-56 in hectres. Are shown in the table I and table II below.

Table I—Area under Cereals in Assam (in Hectares)

Crops	1955—56	1960—61	1965—66	1966—67	1967—68	1968—69	1969—70
1. Rice	17,03.666	18,38,899	19,30,354	19,73,701	20,13,796	20,80,330	20,82,740
2. Maize	16,655	15,214	23,578	23,733	24,381	26,157	26,894
3. Wheat	1,759	3,760	4,796	5,673	6,723	7,478	11,800

Table II—Total production (in Tonnes)

Crops	1955—56	1960—61	1965—66	1966—67	1967—68	1968—69	1969—70
1. Rice	16,40,038	17,51,442	18,47,325	17,49,723	19,13,790	21,36,547	19,00,744
2. Maize	8,211	6,576	12,278	12,699	13,097	14,046	14,473
3. Wheat	833	3,078	3,350	3,548	4,293	4,718	7,230

Statement showing the Area, Production and Average Yield of Cereals in Assam

	Rice			Wheat			Maize			Other cereals and Small Millets		
Year	Area	Production	Average yield	Area	Production	Average yield	Area	Production	Average yield	Area	Production	Average yield
1	2	3	4	5	6	7	8	9	10	11	12	13
1966—67	19,73,701	17,49,723	888	5,673	3,548	625	23,733	12,699	535	6,447	3,175	493
1967—68	20,13,796	19,13,790	965	6,723	4,293	639	24,381	13,097	537	6,494	3,220	496
1968—69	20,80,330	21,36,547	1,027	7,478	4,718	631	26,157	14,046	537	6,004	2,983	491
1969—70	20,82,740	19,00,744	913	11,800	7,230	613	26,894	14,473	538	6,270	3,114	497

Area—in Hectares
Production—in tonnes
Average—Yield in Kg/Hectare.

In Assam, rice is the staple food and it occupies about 75 percent of the total cultivable area in the State. The rice cultivation extends from one end to the other end in the plains districts where the rainfall varies from 100 cms. to 200 cms. It generally grows well in the high, medium and low-lying areas. It also extends to the very low-lying areas where water stands up 2-4 meters for about six months and also to the altitude of 5,000 ft. in the hilly tracts. Hill varities are grown in the hills from 2,500 feet above. Thus, cultivation of rice in the State covers a wide range of climatic and geographic condition. This accounts for growing different varieties of rice throughout the State and each Zone has its own characteristic to grow specific type of rice.

As regards to climate, Assam is marked by torrential rains and extreme humidity in the rainy months and dense fog during the winter. The rainfall is, however, unevenly distributed throughout the year. Though the rainfall starts from the month of March, about 66 percent of the total rainfall is received between June to September. In fact the warm and moist climate of the State favours the rice cultivation.

Rice can be grown throughout the year and in Assam there are three main seasons for its cultivation viz. Ahu (Autumn Paddy) for summer, Sali (Winter Paddy) for winter and Boro (Spring Paddy) for spring seasons. The seasons indicate the harvesting time. By and large, the sum total of production of the three seasons were found to be sufficient for the State up to the year 1950-51 and the State was almost self-dependent on her rice production. But now there has been a population explosion in the State. The rate of population growth is tremendous. There were hardly 4 million people in Assam in 1901 which swelled up to 12 millions in 1961—an increase of three times in 60 years. Till 1951, the growth rate was one million in ten years; but from 1951 to 1961 it jumped up to 3 millions. If the present rate of growth continues, the estimated population in Assam in 1971 would be about 15.8 millions. That is the reason why Agricultural Development in Assam cannot wait. Therefore, the State has to face a challange of time as also the innumerable hazards like high floods, severe occasional droughts, hailstorms etc. These have considerably told upon the total production of cereals in the State.

At present the people of Assam have to experience two to three successive high floods a year.

Government of Assam have been endeavouring to meet the needs of the alarming population and also to overcome the various natural calamities in Assam. Necessary infrastructure have been created to the extent possible to help and assist the cultivators of the State in their efforts to get higher production. The schemes are being continuously implemented both in the laboratory and also in the field and it is hoped that these measures will place Assam Agriculture on a scientific footing, Accordingly, new strains of crops, new chemicals, fertilizers, scientific cropping patterns, pest and disease control measures, efficient irrigation system have been introduced in the State. The cultivators of Assam are responding favourably and are doing their best to help themselves and help the country in cereal production.

The Taichung Native-1, a high yielding variety of rice, was introduced in Assam in 1965-66 which played a great role in increasing the total production of rice. Since last 3-4 years more high yielding varieties of rice such as I.R-8, Jaya are being extensively cultivated in Assam and these gained permanent footing with valuable contribution in Agricultural economy of the State. A local high yielding variety of rice–the MONOHAR SALI has been evolved in the rice research Station of the State, which has become very popular as winter crop. The average yield of MONOHAR SALI is about 20 qtls. per acre the highest being recorded up to 40 qtls. Other high yielding varieties of rice PANKAJ and JAGANNATH have been tried in Assam during 1969-70. JAMUNA & SABARMATI have also been tried during 1970-71.

If these new varieties prove sucessful under Assam conditions, the State will have some more varieties of high yielding varieties in the list of farmers for their cultivation.

The high yeilding varieties of paddy have been spreading to the nook and corner of the State with excellent results. The area under high yielding varieties increased from 11 thousand acres in 1966-67 to 78 thousand areas in 1967-68. This rose to 1·71 lakh acres in 1968-69 in the State, to more than 3·0 lakh acres in 1969-70 and is expected to go above 4·50 acres during 1970-71.

In addition to this the State Agricultural Department have also devoted to rice research for improvement of the local varieties wtth high yielding and non-lodging characters.

In regard to wheat, it may be stated that it is a newcomer to the Assam soils. Wheat cultivation was almost unknown to the cultivators. Now these wheat varieties have become very popular with the farmers and are being grown all over the State. The yield performances are very promising and wheat is going to be the second important cereal crop in Assam next to paddy. The Assam soils have been found to be very suitable for wheat cultivation. The notion that wheat does not grow in Assam is totally gone. Excellent results with maximum yield upto 70 mds. per acre, which can be perhaps compared to the wheat yield of Punjab, have been achieved.

The State started with 300 acres of high yielding varieties of wheat in 1966-67 and during these few years its area has gone upto 8,000 hectares (above 20,000 acres) with an estimated production of about 50 thousand tonnes. Kalyan Sona, Sonalika, Safed Lerma and Sarbati Sonara varieties of wheat are spreading to the remotest corners of the State. The wheat varieties have acclamatised under the Assam conditions and have come to stay and play a vital role in the State's economy. It is also hoped that if the present trend goes on unabated, Assam may herself prove to be an important wheat growing State in India.

Maize is another major cereal crop in Assam which is extensively grown in hilly districts of K. & J. Hills, Mikir Hills, Garo Hills and Mizo Hills.

The Hybrid and composite varieties have now been introduced and have become popular among the hill people. The High Yielding maize varieties have been found to be suitable only upto the altitude of 3,000 ft. At higher altitude the local improved varieties are grown with good results. At present the State Industrial Development Corporation has already taken up plans to set up a starch factory in the State. This will surely help and encourage the formers to take up extensive cultivation of maize in the State. both in the hills as well as in the plains.

The timely supply of production inputs and farm machineries is the most important factor in increased agricultural production. The Government have been endavouring to ensure quick and timely supply of agricultural inputs to the farmers, have set up a Seed corporation in Assam to handle production, procurement and distribution of seeds of high yielding varieties and other improved varieties in the State. To ensure supply of quality seeds to the farmers by the Seeds Corporation and other seed dealers, the Seed Act 1966, has been enforced in the State from Oetober, 1969.

An Agro Indusires Development Corporation has also been set up in the State to undertake procurement and distribution of fertilizers, plant protection chemicals and machineries to the farmers of the State. This is expected to improve the position to a considerable extent in the near future. Large number of Tractors, Power Tillers, Dusters & Sprayers and other small implements as also fertilizers have been supplied by the Corporation in Assam during the past two years.

An Agricultural University has also been established in the State to strengthen research, extension and Agricultural education. The University has started the work

Assamese Farm Men and Women Working in Cereal Field and is expected to emit results beneflcial to the farmers.

A very practical infrastructure has been created in the State for development of Agriculture especially cereal production on scientific lines, It is hoped that the cultivators of the State would come forward and accept the facilities available within the State for speedy improvment in the agricultural sector.

We have faith in our farmers and the farmers are already in the race for agricultural production and are keeping up the slogan for increased production.

If the present trend goes on well the future of the farmers of Assam is bright and the State may look for exceeding the target of 5% growth rate of agricultural production as envisaged in the 4th five year plan period.

CEREALS IN MAHARASHTRA: 'WHEAT'

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Amongst cereals wheat has a special importance in the diet of urban population in Maharashtra. There is the deficiency of 7 to 8 lakh tons of wheat production in the State. Wheat does not come under monopoly procurement commodity so no exact figures of production are available. However, as the open market rates are not affected by the removal of restrictions on wheat zones, it may be predicted that the production of wheat is increasing to meet partially the dificiency of the state.

Out of total area of 9 lakh hectares under wheat only 1.5 lakh hectares are under irrigated wheat and rest of the area is brought under rainfed conditions. The average yield per hectare comes to nearly 452 kgs. which only includes the rainfed and irrigated conditions. The cause of low yield of wheat as compared to the other states in the north will have to be studied critically. In addition to low percentage of irrigated area, the winter season in Maharashtra is very mild. The duration is short and the intensity of cold per day is very low. Moreover, it is conspicuously noticed that the winter season is dry in Maharashtra while in rest of the States occasional rains are received during winter. This has a profound effect on the productivity of wheat crop and was confirmed by the dry spell of 1968-69 in the northern India.

Although there are number of natural limitations which come in the way of production of wheat crop, yet efforts are being made to boost the yield per hectare in Maharashtra State. The yield of rainfed crop is steadily increasing because of the use of high yielding varieties coupled with improved package of practices for growing of rainfed wheat. Formerly N-59 variety was recommended as a high yielding variety for rainfed conditions, but recently the research has shown that new high yielding varieties NI-747-19 or NI-5439 can replace the old one and increase the production and quality of wheat. In case of improved packages of practices emphasis is being laid on seed-rate, spacing and quantity of fertilizer and method of application of fertilizers. The farmers in Amraoti and Aurangabad districts are reaping the benefit of the recommendations of new variety and it is slowly catching the imagination of farmers in other districts. There is practically no problem of diseases under rainfed conditions but in some parts of Vidarbha region the variety N-59 is reported to be susceptible to stemborer and foot rot but such type of attack is not noticed on the other varieties under field conditions. Efforts are being made to develop three gene dwarf wheat varieties with deep root system so that they can be grown in the rainfed area of the state and help to boost the yield.

As regards irrigated area a number of high yielding varieties of wheat are being used by the farmers. The average yield per acre has risen from 5 quintals to nearly 10 quintals. Some of the progressive farmers can reap the harvest of 20 to 25 quintals per acre. The Krishi Pandit (1968) Shri Baburao Sukhadeo Patil of Bijorse, Nampur (Satara) of Nasik district obtained record yield of 44 quintals of grain per acre of the variety NI-917 which was evolved from the cross PC 591 and Exotic 73 (Charter). The quality of grain is very good. Maharashtra State is pioneer in evolving the first Mexican hybrid wheat variety NI-747-19 obtained from the cross RFPM 196 and Mondhya 3-2. Since 1965 this high yielding variety is very popular with the farmers. The chapati making character of this variety is preferred by the farmers. Recently the

Harvesting of Paddy in Konkan (Maharastra) other Mexican hybrid variety (RFPM 80×NP-7103) is showing better performance than NI-747-19 in respect of yield, quality (lustre of grain) and non-shattering habit. It is very likely that this variety will replace the other varieties in a short period (The seed of Mexican hybrids need not be changed every year because they have been selected in advanced generation).

Some of the farmers use Mexican varieties such as Sarbati Sonora, Kalyan Sona, Safed Lerma and Sonolika. When the season is favourable they get a good harvest otherwise the yields are not competing with the strains evolved by the Department of Agriculture. Recently it is observed that the chapati making character of these Mexican varieties is very poor, so these Mexican varieties do not fetch better premium in the market. Moreover, the cost of cultivation of these varieties is more than the varieties evolved by the department. These varieties require more seed rate, fertilizer, water and its better management. Hence, economically the high yielding varieties evolved at Niphad are preferred to Mexican types.

As regards the diseases, both the types are fairly resistant to rust in the field conditions. Amongst them Safed Lerma (S-307) and Chhoti Lerma (S. 331) are good from rust resistance point of view but are very poor in grain characters. The Mexican types are susceptible to the attack of *alternaria* and loose smut. Since last year, these varieties are being attacked by pink boll-worm in Vidarbha region.

The average yield of these high yielding varieties ranges between 15 to 25 quintals per acre. The cost of production of Niphad varieties comes to nearly Rs. 500 per acre and that of Mexican types Rs. 700 to 800 per acre.

The state is making progress in evolving rust-resistant, dwarf and quality type of wheats that will be made available to the farmers in near future; which will help to wipe out the deficiency and the state will be self-sufficient in wheat production within a few years.

CEREAL CROPS IN GUJARAT STATE

J. V. MAJAMUDAR

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Rice, wheat, jowar and bajra are the main cereal crops of Gujarat State. Among all the above crops bajra is an important crop occupying about 35 lakh of acres out of 101 lakhs of acres under food crops. This being an important bajra growing State and having large area under this crop, the attention of the State Government was drawn since long for its improvement.

Initially the improvement of bajra work started in 1932 with the exploitation of local material. By the year 1939, an improved variety of bajra N-207 was evolved at Nadiad, which yielded about 20 percent more than the local bajra. With the formation of the Saurashtra State in 1950, the improvement of bajra was taken up at Junagadh, Amreli and Jamnagar. As a result three improved strains N-28-15-2, L-11 and Babapuri were evolved, to satisfy the needs of Saurashtra State districts. In the Second Five Year Plan the research work on bajra was intensified at Talod and Deesa. But the real improvement came during the Third Five Year Plan period. In 1962, the Millet Specialist section was established with head quarters at Jamnagar and sub stations in various Agro-climatic zones of the Gujarat State. In 1963, we got assistance from the Rockefeller Foundation by way of Germ - plasm and male sterile American Bajri. This was the real beginning of the improvement of bajra work in the State.

With the use of Male Sterile 23A and improved varieties of Punjab we were able to find out first high yielding hybrid (HB-2) in 1965. This yielded on an average 70 percent higher than the local improved varieties.

In 1968 we got another superior hybrid known as J-104 or HB-3 which has been released by the Central Varieties Release Committee for Gujarat as well as other States of the country. This yieids about 20 percent more than the firs-hybrid with bolder grain and attract-tive colour and has been liked by the farmers.

The hybrid seed has become most popular in Gujarat State and the farmers are very eager to get fresh seed every year. In the year 1969, the area under hybrid bajra was 4 lacs of acres which has risen to 11 lacs of acres in 1970. The average grain production of bajra is 7 lakhs tonnes per year which rose to 11 lakhs tonnes in the year 1969 and 17 lakhs tonnes in the year 1970. This shows the advantage of the hybrid seed in the Gujarat State.

The seed production work is being handled by the Gujarat Cooperative Marketing Society with the technical staff of the Agriculture department. The foundation or parent seed is produced by the Millet Specialist of the State and further multiplication of hybrid seed in farmers' fields is done by the Gujarat State Cooperative marketing Society. The seed produced by the Farmers is purchased by the Gujarat State Marketing Society and sold to the farmers through the Village and Taluka Cooperative Societies. The seed is being certified by the State Hybrid Bajra Seed Production Officer. It is packed in standard packing of 1·5 kgs. and 3 kgs with the certificate tagged on the bag itself. This procedure works very well and benefit to the farmers has been seen immediately during the same year.

The seed producer is paid Rs. 4 per kg. by the Marketing Society and after adding the processing, storing and other charges on losses etc. it is selling the seed to the farmers at the appropriate rate.

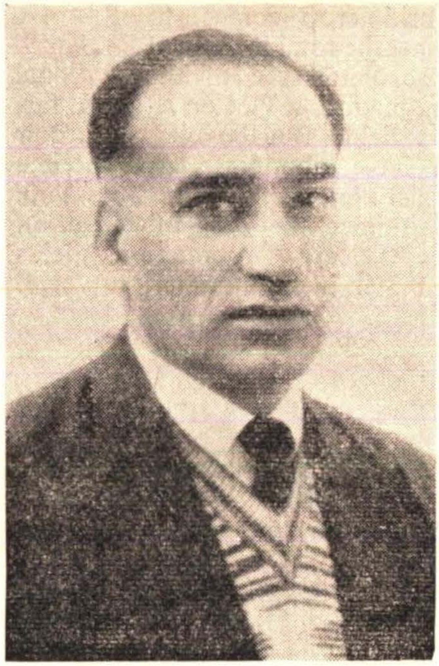
The cost of cultivation in the Kharif season of the Commercial

Cereal Crops in Gujarat State

Hybrid crop comes to Rs. 476 against the total income of Rs. 1,659. These figures are of the National Demonstration Plot on a good farmers' field. But the average farmer will have about Rs. 800 income against the expenditure of Rs. 400. In summer the cost of irrigation raises the cost of production. Yields are better in the summer crop also.

The average yield of bajra in the State is about 390 kgs. per acre while the hybrid bajra yield is about 600 kgs. per acre. The highest yield recorded so far is about 3,700 kgs. per acre. In Gujarat State mostly the bajra is a rainfed crop. Only in about 2 lakh of acres bajra crop is grown as a summar irrigated crop.

'CEREAL PRODUCTION: A PROFITABLE AVOCATION'



Dr. B. S. JOGI

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Once hills were associated with perennial poverty and there seemed to be no way out of the abject poverty that was the lot of the people. Then, it gradually became clear that turning to orcharding on a large scale was the only answer. Everything was tuned to that effect in the orchestra of Agricultural Planning. Horticulture became the way of life of many farmers in higher reaches where apple and other temperate fruits offered high dividends.

Not only that middle and lower areas of Himachal Pradesh appeared to have been given a secondary treatment but also the nationwide food crisis focussed the attention of all planners in the Pradesh towards raising the production of cereals so that the Pradesh does not remain dependent upon other areas for cereals for all time to come.

Meanwhile came the redeeming feature of this predicament in the form of evolution of high yielding varieties of wheat and hybrid and composite varieties of maize and the improved varieties of other cereals. This generated a new hope and farmers took courage to switch on to growing cereals. This started a new phase in the agricultural pattern in Himachal Pradesh. This pattern could be devided in two phases of agricultural production programme in the Pradesh.

The First Phase

The progress made in the field of cereal production in Himachal Pradesh has been a checkered history. To switch over to improved varieties from the traditional varieties was a tedious job as not only higher yield was the prime necessity but also the duration of the crop was also a basic condition for acceptance by the farmers. Longer duration of maturity would have meant the missing of the next crop in hills.

As elsewhere in the country, improved varieties like Ridley

NP-792, NP-829, NP-770, NP-809, C-286 etc. were tried in Himachal Pradesh at different elevations from sea level. As these were a sort of transitory varieties because the real achievements were to be made in time to come, these did break the apathy of the farmers who started thinking in terms of new methods of agriculture.

Paddy is also one of the most important crops of Himachal Pradesh. But the yield per acre was not more than 827 lbs. while average yield in Japan was 3,000 lbs. C-988, C-4, T-137 and T-21 were some of the varieties tried in the first phase of agricultural production in Himachal Pradesh.

Maize has the real potential of turning this deficite area into a surplus one as it is sown all over the Pradesh and with assured rainfall, its production can be increased manifold. Maize being the staple food of the majority of people in most of Himachal Pradesh, it has a big future.

Hybrid varieties of maize, were initiated in Himachal Pradesh such as Illinois-1656, Ganga-101, Ganga-3, Ganga-5 etc. These varieties did not suit well to the peculiar conditions of Himachal Pradesh. Similarly, in the case of other cereals the stalemate continued dispite the shadow of deficite looming large upon Himachal Pradesh.

Not much headway could be done in the production of cereals in the first phase of agricultural production as neither the desired varieties had been evolved, nor the trend towards horticulture could be checked in abeyance of assured income from cereal production alone.

Second Phase

The second phase of agricultural production may be said to have started with the year 1966 when hilly areas of Punjab were merged with Himachal Pradesh. The problem of shortage of foodgrains became all the more acute because of restrictions put upon the movement of food grains by the neighbouring states.

By the time the high yielding varieties of wheat and hybrid as well as composite varieties of maize have started to show signs of resurgence in the field of agriculture, we have to take speedy measures to explore the possibilities of getting maximum advantage from our fields in the maximum period possible.

For Rabi crops the absence of irrigational facilities proved the main hurdle while we had ample fertile land in valleys and other low lying areas of the Pradesh. The Pradesh Government established a separate cell for minor irrigation facilities as geo-physical conditions in the hills were not suitable for bigger canals. This did start yielding dividends. Lift irrigational facilities are now being tapped speedily.

The real break-through came due to high yielding varieties of wheat. Kalyansona-227, P. V. 18 and S-308 varieties have become very popular in entire Himachal Pradesh except Kinnaur and Lahaul-Spiti districts which have dry and peculiar climatic conditions. Wheat is sown from September to December in the rest of Himachal Pradesh while it is sown in April in Kinnaur and Lahaul-Spiti districts. Nada dores variety has been found to be very useful for these Mexican varieties have gone a long way in rehabilitating the faith of farmers in cereal production which is so important today.

Similarly Him-123 and Ganga-101 hybrids as well as Amber and Vijay composite varieties of maize have given such results as have astonished farmers who are confounded as to how to dispose off their surplus stocks in certain areas of the Pradesh. As maximum area of the Pradesh can be utilised for this very important Kharif crop because of assured and regular rainfall during monsoons, more and more stress is also being laid upon covering more and more area with these varieties.

The production of paddy has also gone up considerably because of the introduction of new varities and adoption of improved practices by the farmers. The new varities Ram Jawain-100, Phool Patas-72, C-988, Dunder-43, R-575, Narin-18, Basmati-30 and DK-2A are some of the varieties which hold good promise. DK-2A is a variety that has been evolved at Agricultural Research Station Dhaulakuan in Sirmur district.

Similarly, in the field of pulses and lesser millets much headway has been achieved with the introduction of new varieties and improved cultural practices.

The tables given below for two years 1967-68 and 1968-69 give some figures about the area and production of principal food crops in Himachal Pradesh.

TABLE-I

Area Under Principal Crops In Himachal Pradesh

Name of Crops	*1967-68*	*1968-69*
	(Area in	*'000 hectares)*
Wheat	311.1	324.0
Maize	239.8	252.1
Rice	97.4	96.0
Barley	41.0	45.8
Millets	28.1	27.2
Pulses	38.7	44.7

TABLE-II

Yield of Principal Crops

Name of Crops	*1967-68*	*1968-69*
	(Production in	*'000 tonnes)*
Wheat	262.8	295.3
Maize	388.6	404.2
Rice	110.3	98.5
Barley	46·2	77.9
Millets	12.3	14.7
Pulses	11.7	14.7

These tables, however, do not give the entire picture of the gigantic task that we have undertaken in Himachal Pradesh today. There is vast area under plough in the Pradesh that cannot be put to produce cereals with any advantage. In this area old varieties are grown in the hackneyed old way and thus, theover all picture in terms of percentage and average is rather blurred.

The research work to evolve varieties to suit the different agro-climatic conditions prevailing in the Pradesh is still in progress and when results are received and applied to the fields, a new picture of Himachal Pradesh is bound to emerge in which cereal production is in well proportion and balance to the horticulture and other cash crops.

A Farmer happily displays the rich wheat crop of Mexican Wheat

CERELAS IN RAJASTAHN

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Rajasthan is the second biggest state of India comprising of 1,32,152 sq. miles, first being Madhya Pradesh with 1,71,217 sq. miles and is followed by Maharashtra as third which is 1,18,717 sq. miles in area. Due to unfavourable geographical situation which affects it with a severe climate and low rainfall, the population is much thiner than many states. It stood 11th in order of population with 2,01,60,000 persons, in 1961 census, with an average density of 59 persons per sq. mile.

Out of the total area of the state of 340.23 lakh hectares, only 151 lakh hectares, i.e. 44.4% of the area, is under cultivation. The state can be divided in 4 regions depending upon the agro-climatic conditions. The western region with low rainfall, below 30 cms, consists mainly of the sandy soils and forms a major part of the Thar desert. The northern most area with an underground rich part also gets low rainfall but is agriculturally advanced due to canal irrigation facilities. The eastern part comprises of alluvial loam soils with a medium rainfall of 50-70 cms. The southern part forms a part of the Arawali Hill range with black cotton & clay soils rich in organic matter & heavier rainfall above 60 cms.

In accordance with the natural regions, follow the cropping patterns of the different areas. The main cereals grown in Rajasthan, in the order of production, are wheat, barley, bajra, maize, juar & paddy.

Of the total nett cultivated area 73% is under food production of which 53.5% is cultivated with cereals crops and they account for 82.8% of the total food production.

Different cereals have their distribution in agreement with the regional climate, and people in the area have developed their tastes for the same. Thus, out of 26 districts of Rajasthan, the dry climate having bajra, is cultivated in 18 districts with more than 1,00,000 hectares each. Maize is popular in 6 districts only, where rainfall is high or irrigation facilities a reavailable (with more than 50,000 hectares in each district). Juar gains superiority in 10 districts where bajra does not thrive so well. Paddy is not an important crop with only 78,000 hectares in the state with 3 packets in high rainfall or canal irrigated districts. Wheat & barley are grown throughout the state uniformly as rabi (winter) crops mostly with irrigation except in heavy soils where they grow without irrigation also.

Area, production and districtwise distribution of the cereals is given below which will show the importance of each of the cereals.

Table Showing Area, Production & Distribution of Cereals in 1968—69

	Name of Crops	Area in Hectares	Production in M. Tonnes	Important district which are Cultivated
1.	Wheat	11,54,000	11,71,000	all districts.
2.	Barley	4,94,000	5,71,300	all districts.
3.	Bajra	45,63,000	4,49,100	18 districts.
4.	Maize	7,94,000	4,23,000	Bhilwara, Chittorgarh, Udaipur, Dungarpur, Banswara. Ajmer.
5.	Juar	9,33,000	1,91,000	10 districts
6.	Paddy	1,29,000	57,000	Banswara, Dungarpur Udaipur, Kota, Bharatpur.
		80,67,000	88,64,000	

High yielding varieties Programme

Since 1967 when the H. Y. V. P. started all over the country, Rajasthan has also taken long strides in this programme and contributed its share in raising the total production of cereals in India. The progress has been continuous and the farmers have shown that old axiom of calling cultivator orthedax does not stand. They are not only using new seeds but also adopting new fertilizers and improved techniques of farming. A brief description of each crop is given below.

Bajra

Hybrid No. 1 was recommended throughout the state. The average yield of irrigated Bajra is estimated at 10-15 mnds. per acre, but hybrid bajra produced on the average 30-35 mnds. per acre, yields upto 80 mnds. per acre were obtained by many progressive farmers. It has been extended over 7,03,486 acres during 70-71. It is growing in popularity and Hybrid No. 3 & No. 4 have also been introduced.

Juar

CSH No. 1 was introduced as approved variety in the Hadoti division. This variety was found to be very susceptible to various pests and diseases, and therefore, needed high costly pesticides. Its extension has, therefore, been limited and during 70-71, it was cultivated in 28,000 acres. The average yield of juar ranges from 12-18 mnds. but the hybrid juar has yielded generally 30 mnds. per acre.

Maize

Ganga 3 & Ranjit were distributed earlier. Ganga 3 and Ganga 5 are now under distribution in Udaipur division and other maize growing districts. The average yield of maize is 18-20 mnds. while the hybrids yield 40-42 mnds per acre. However, generally the local varieties, when grown with full recommended practies, equal the hybrids. The exsension programme of these varieties has, therefore, been restricted. The coverage during 1970-71 was 56,991 acres.

Paddy

Paddy forms a small area in Rajasthan but under new river projects, its cultivation is extending. The new varieties I. R. 8 and Jaya are receiving attention of the farmers and the adoption of improved techniques have given very hlgh yields over 100 quintals per hectare and which promises a good future for the crop.

The increase under high yielding varieties has been 41,643 acres during 70-71.

Mexican Wheats

Sonara 64, Lerma Rajo started the wheat revolution but the next group of varieties like Kalyan Sona, Sonalika, Sharbati Sonara, 5307, 5308 have taken over the fields. Their popularity increased like wild fire and from a few hundred acres, they commanded 4, 71, 474 acres in 68-69 and the target set for 70-71 were 8,00,000 acres. The farmers have realized the significance of adding necessary fertility to the crops & the fertilizer have also increased commensurately. The new varieties have yielded up to 123 mnds. per acre; while an average of 50-60 mnds. has been obtained generally against earlier average yield of 20-25 mnds. per acre.

Improved Varieties of Cereal Crops

In addition to the new High Yielding varieties of crops, Agriculture Department has also recommended following improved varieties.

Bajra

R. S. K. and R. S. J. are two varieties which have been under distribution in Rajasthan. The latter variety is more suitable for the drier parts of the State.

Juar

Swarna juar is recommended for juar growing regions. Another variety Adanga and also Sultanpur selection are approved for Jhalawar district.

Maize

Bassi selected is a popular variety liked by the farmers in the whole state. With its yellow grains it yields upto 35 mnds. per acre and has throwed well in comparison to all other varieties.

Malan is a variety grown in heavy soils of southern Rajasthan & yields a good crop, upto 80 mnds. per acre.

Wheat

RS 31-1 evolved in Rajasthan is very popular and a high yielding variety which has been used as a parent for the production of high yielding varieties, C 591, N. P. 718, C 281 and Malvi Ekdania are other varieties which are largely grown in areas suitable for each type.

Barley

RS 17 is a bold high yielding variety selected from local barleys. It has been under distribution over a long period and has provided base for evolving new type which are now under tests in the State.

National Demonstrations & Crop Competition

In the Natural Demonstrations Crop Competition organized in the state very high yields have been obtained in these cereals and they provide a very great potential for further development.

Paddy I.R. 8

In a National Demonstration in 67-68 the highest yield of 152.90 per hectares was obtained in Kota district.

Wheat

In crop competitions Mexican Wheats have yielded up to 123 *quintals per hectare.*

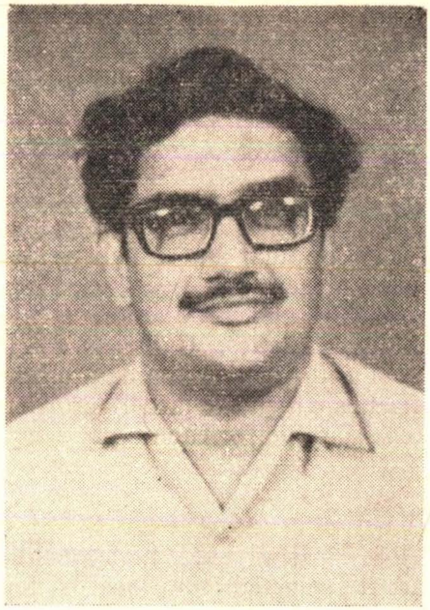
Bajra

In National Demonstration hybrid bajra No. 1 has produced over 52 quintals per hectare.

Maize

An yield up to 72 quintals per hectare was recorded in Chittorgarh district in a National Demonstration.

CEREAL PRODUCTION IN TAMILNADU



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A solid and stable economic structure can be built only on one foundation - that of increased food production. The rate of growth of population has outpaced the agricultural production. The constant growth of the population has considerably stimulated the demand for food stuffs. Consequently, the need to increase the yield to the utmost possible extent has become particularly urgent and unavoidable. The farmers of Tamil Nadu have also been fulfilling this aim of increased production. The table given below proves this fact.

Food Production in Tamil Nadu

Year	Food production in lakh tonnes
1950 - 51	31·63
1955 - 56	45·45
1960 - 61	53·13
1965 - 66	50·60
1969 - 70	63·30
1970 - 71 (Expected)	67·00

In twenty years the food production has been doubled. It is really an achievement and success in the fight against the erratic, uncertain and meagre seasonal rains and regular pest and disease menace.

Agriculture in this State is as ancient as Tamil and Tamilian culture. We can cite many adages from agriculture where way of living is compared with the operation of Agriculture.

இன்சொல் விளைநிலனா ஈதலே
வித்தாக
வன்சொல் களைகட்டு வாய்மை
எருவூட்டி
அன்புநீர் பாய்ச்சி அறக்கதிர்
ஈனவோர்
பைங்கூழ்ச் சிறுகாலைச் செய்.

—ஔவை.

It depicts each operation from sowing to harvest comparing with the meritorious and desirable characters of human life. Even in Kandapuranam, we come across incidents where lakhs are engaged in scaring away the birds in field of 'Thenai' crop. We learn from literature that Thenai flour and honey formed an important part in feasts of ancient Tamilians.

All these go to explain the interest the ancient Tamilians had towards Agriculture.

The area, and production particulars for the important cereals in Tamil Nadu are tabulated below.

No.	Crop	Area in hectares	Production in tonnes
1.	Paddy	26,95,200	45,32,200
2.	Cholam	73,15,000	57,51,000
3.	Ragi	3,36,100	3,36,700
4.	Cumbu	4,59,300	3,09,000
5.	Varagu	2,23,300	2,34,100
6.	Samai	1,86,300	92,000
7.	Tenai	19,900	15,200
8.	Maize	12,860	13,900

The average yield per hectare for major cereals have been estimated as follows:

Paddy	1,410	kgs/hectare
Cholam	751	,, ,,
Cumbu	733	,, ,,
Ragi	1,002	,, ,,

In Tamil Nadu except paddy among cereals, other crops are mainly grown as rainfed crops and the total gross irrigated area forms 46·2% of the total area sown. The various irrigation sources and area benefitted may give an idea about it.

No.	Irrigation sources	Area benefitted (Hectares)
1.	Government canals	8,61,900
2.	Private canals	1,119
3.	Tanks	9,71,843
4.	Wells (a) Tubs wells	5,250
	(b) Wells sole irrigation	6,32,757
5.	Other sources i. e. spring channels	45,606

Tamil Nadu Government have planned to exploit underground water resources. Now there is a greater awareness in all areas about the value of wells as a means of providing water for raising of nurseries in advance before the water is released in the river system and as a means of saving crops at a later stage when there is insufficient irrigation from normal resources which will, otherwise, result in the failure of crops for want of one or two wettings. Even in deltaic areas and ayacuts of canals and tanks where one crop is raised, larger number of wells can be sunk with advantage to raise a second crop in the off season period with the aid of well water. So, earnest efforts have been taken to increase the number of tubewells, filter point tubewells, new open wells and deepening the existing open wells. Necessary equipments like power drills, and rock-blasting units are being hired out at cheaper rents by the Agricultural Engineering wing of the Agricultural Department.

The food production committee, formed under the leadership of the then Food-production Commissioner, Thiru E. P. Royappa highlighted the following items to increase the food production :—

1. The need for raising two crops in single crop lands.

2. Bringing new areas under paddy cultivation.

3. Expansion of the High Yielding variety programme.

4. Activisation of minor irrigation programme.

5. Augmenting and effective utilisation of Agricultural machineries and implements and

6. Arrangements needed for the free flow of Agricultural credit and Fertilisers.

Based on the above recommondations the double crop conversion programme was introduced in Thanjavur with rewarding results. Evolution of the High Yielding Paddy strain ADT. 27 beforehand by the Research wing came in handy and helped in registering the conversion of 2·1 lakh acres of single crop Samba land. This progress is being maintained with steadily increasing per acre yield due to free flow of credit and fertilisers and timely plant protection measures. Recent evolution of " Karuna " paddy strain is an asset to the Thanjavur farmers who found it terribly bad to see the ADT. 27 paddy crop lodging with slight heavy manuring and in rains. This 'Karuna' variety does not lodge even under heavy manuring and rains. This strain has been introduced only in Thanjavur district this year and it has gained the appreciation of farmers. The area under double crop conversion is expected to increase when the proposed modernisation of Cauvery delta scheme is implemented. Another effective step for increasing the gross cultivated area for advancing the Kuruvai cultivation and for supplementing the Mettur irrigation during periods of scarcity is the crash programme undertaken in Thanjavur district to sink large number of filter points. The existing scope of sinking of about 1,000 filter points per year is proposed to be enhanced considerably by obtaining loans from the World Bank through the Agricultural Refinance Corporation so that about 22,200 more filter points and tubewells can be sunk in the course of three years.

Tamil Nadu Agricultural Department has shown keen interest in the expansion of High Yielding Varieties programme. The following tabulation will speak for itself.

Achievements in High Yielding Varieties Programme
Area covered (in lakh acres)

Year	Paddy	Hybrid millets	Total
1966 - 67	4·75	0·53	5·28
1967 - 68	11·99	0·81	12·80
1968 - 69	15·69	1·41	17·10
1969 - 70	28·21	2·25	30·46
1970 – 71 (From 1-4-70 to 21-11-70)	31·33	2·01	33·34

The High Yielding Varieties of paddy that have been taken into account are I.R. 8, ADT. 27, Co. 25, Co. 29 and among other millets CSH. 1, Cholam, HB. 1 and HB. 3, Cumbu and Hybrid Deccan maize are the notable strains.

High Yielding strains are one of the means placed at the farmers disposal by science and technology in the struggle against want caused by population growth. Up-to-date, systematic and rational manuring is one of the two important means to achieve bigger and better harvests of hybrids, the other one being Plant Protection measures. It was not very long that there was fertiliser in the market but no buyers. The profitability of application of fertilisers for crops was not well understood. In addition, there was a strong lobby which propogated that chemical fertilisers are harmful to the soil and continuous application harms the land. Strangely in many irrigated parts of Tamil Nadu it was found that there was no response to fertiliser and particularly phosphatic fertilisers and potash, but the Government recognised that it is only by systematic and careful demonstrations that the farmer can be convinced of the utility of fertilisers. The fact that judicious chemical fertiliser application at the right time after proper soil analysis will give good results, had to be conveyed in a convincing approch so that the farmers could appreciate. Large scale fertiliser demonstrations were, therefore, taken as an integral part of the development schemes of the Tamil Nadu Agricultural Department. They were really the eyeopeners and the progress in the use of fertilisers in this State shown below will prove beyond doubt.

Consumption of Fertilisers (Quantity in Lakh tonnes)

Year	N	P	K
1960 - 61	0·325	0·036	—
1961 - 62	0·33	0·08	0·01
1962 - 63	0·43	0·10	0·05
1963 - 64	0·55	0·11	0·07
1964 - 65	0·70	0·19	0·07
1965 - 66	0·72	0·27	0·18
1966 - 67	0·35	0·44	0·32
1967 - 68	0·96	0·30	0·30
1968 - 69	0·13	0·35	0·31
1969 - 70	1·48	0·42	0·33

Ever since man started cultivating land to grow his food, he had to wage war against pests and diseases which competed with him to steal away the harvests thus reducing the availability of food to him, his family and country. Now, we have to seek a new method to fight against the pests and diseases vigourously and systematically since they destroy our crops. Easily among the most efficient methods of rapid insect control and by far the most economical is the new aerial - spraying technique. This department realising the full benefit of it, is steadily progressing in taking up the aerial-spraying on a massive scale. The following statement shows the earnest efforts made and the achivements.

Year	Area, aerially sprayed (Acres)	
	Paddy	Ragi
1966 - 67	11,000	—
1967 - 68	1,66,000	—
1968 - 69	2,35,000	3,000
1969 - 70	1,18,600	—

As an incentive to the farmers, Government continues to distribute pesticides at 15%– subsidised rates. A target of 56·00 lakhs acres is fixed for taking up plant protection measures for the year 1970–71 for food crops. It has also been programmed to distribute 5,400 numbers of plant protection equipments at concessional sales this year.

In addition to all the above schemes, a scheme to help the small farmer, to become a surplus producer, with the necessary inputs and latest technology, is to be implemented in the districts of South Arcot, Madurai and Tiruvnelveli from this year. It is intended to cover small farmer who own two or three acres of wet-land or three to five acres of dry-land. It is expected that under the proposed scheme atleast fifty thousand small farmers in each of the three districts will be covered during the fourth plan period. The object of the scheme is to increase the ability and resources of the small farmer to take advantage of the modern techniques in agricultures, The scheme will meet mostly the difficulties faced by the small farmer like funds for sinking wells, installing pump-sets, application of scientific inputs like high yielding varieties of seeds, fertilisers and plant protection equipments. It is expected that the scheme will be extended to more districts.

Another important scheme that will add importance for the prospects for seventies in cereal production is the integrated dry-land agricultural development project implemented at Kovilpatti taluk of Tirunelveli district. The objects of the project are :

1. Carrying out research on dry farming at specially selected centres. (Regional Research station, Kovilpatti)
2. Practical application of the results on soil and moisture conservation practices.
3. Cultivation of drought tolerent and short duration crops.
4. Adoption of new techniques of fertilisation like foliar spraying of urea and
5. Adoption of timely plant protection measures.

The technical know-how and the inputs will be made available on easy terms. Costly machineries like power sprayers etc. will be kept in a pool and lent to ryots on nominal rents. Periodic inspection of the fields of the participants will be made and advisory work on plant protection, soil reclamation and water conservation will be intensively undertaken with a view to improve the yield potentials considerably.

Dryland farming, which forms the major portion of the cultivated area, continued to receive adequate attention till 1969–70. Soil conservation measures had been undertaken in about 8 lakh acres. During 1970-71 an additional area of 96,000 acres will be covered under soil conservation schemes. It is proposed to take up the cultivation of HB. 30 Cumbu (Bajra) in the dry lands of Tirunelveli and Ramanathapuram districts over an area of 1·5. Lakh acres. Thus, Agricultural Department of Tamil Nadu has been striving hard to increase the cereal production from every possible piece of land. The learned readers may agree with me that it is possible to achieve the desired results from the various schemes proposed by the government only with the active cooperation of the cultivators. The Tamil Nadu Government and Agricultural Department hope that the farmers will extend their cooperation in implementing the several productive schemes of 'cereal production' in Tamil Nadu.

A NEW ADMINISTRATIVE PATTERN FOR A NEW AGRICULTURE

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Never in its long history had agriculture made so great strides in so short a time as during the late sixties. In fact, the change has been so revolutionary and the needs and possibilities so new that it would not be inappropriate to term it a 'New Agriculture'. This new agriculture or the so called 'green revolution' has helped farmers harvest biggest ever crops. Any student of history would know that all revolutions-whether agrarian, economic, social or political-raise the expectations of people rather immensely. The State is invariably called upon to meet new commitments and obligations. There are new stresses and strains on the administration at every level. It is, in fact, an inescapable aftermath of a revolution. However, all the same, it often becomes rather impossible to contain all these demands, howsoever, genuine, without introducing basic changes in the infrastructure of the system. This so called 'green revolution' is no exception. It too has concomitant obligations which too can be met only through a new pattern in agricultural administration.

The Problems

Unlike the agriculture of yester years, the new agriculture promises much and expects much. As for instance, the new varieties of wheat have a high yield potential but this could be tapped only by using heavy inputs and following the most up-to-date cultural practices. The seed rate, spacing, depth and time of planting, placement of fertiliser, timing, quantity and method of irrigation and application of weedicides and pesticides have all to be followed rather scrupulously. Even the slightest deviation could mean much. For example, application of 2-4-D is recommended after 28 to 33 days of sowing. If it is applied early, the weeds would not be controlled and if it is applied too late, deformity of ears and lower yields would be the result.

The farmer has thus, to keep abreast of the latest developments in the field of agriculture. He has to be in constant touch with various centres of agricultural research and education. However, there are so many sciences-biological, chemical, mechanical and a host of others-and there are so rapid advances that it is just impossible for the sixty five million farming families of India to remain directly in touch with the research institutes, agricultural universities and other radiating centres of scientific agriculture. What the farmers need is somebody with the requisite technical know-how right on the spot to guide and advise them.

The conclusion, hence, is irresistible that the administrative pattern that was evolved to meet the needs of the situation years back can no longer be regarded as appropriate. A new administrative pattern has to emerge to meet new demands and new challenges. The tempo and volume of work at all levels-village, block, district and State-have now increased manifold. It would, in fact, be no exaggeration to state that the tempo and volume of work of new agriculture at the village level are of the same order as that at the block level a few years back. Likewise, the tempo and volume of work at Block level are of the same order, if not more, as at the District level earlier. This amply suggests the need for a new pattern at various levels all along the line.

Village-Level Set-up

The concept of single multi-purpose village-level worker, evolved about two decades back, was quite appropriate for a simple and seasonal agricultural extension programme of that time. The situation has, however, recently changed so dramatically that the village-level worker of the existing type has become completely out-of-date. His technical competence is too low to meet the new obligations and his clients so numerous as to be manageable. There is obvious need for a new type of village-level worker of a much higher technical competence who could concentrate efforts on a much smaller area all through the year.

An Agricultural Graduate for Each Village

The only way out is to provide one agricultural graduate in each village with a cultivated area ranging between 500 to 1,000 acres. It could perhaps be argued that in a vast country like India where there are over 5,60,000 villages, it may be just impossible for any Government to employ as many agricultural graduates. It is not necessary either. What is needed is that the Government and agro-industries should join hands to assist the agricultural graduates in settling down in the villages as farmers-cum-extension worders-cum dealers in agricultural inputs.

An agricultural graduate conversant with modern scientific agriculture should be able to earn an income of not less than Rs. 500/- per acre per crop or Rs. 1,000 per acre per annum. Thus, an agricultural graduate having five to ten acres land should be able to earn an income of not less than Rs. 5,000 to Rs. 10,000 per annum or over Rs. 400 to Rs. 800 per month. He can also make almost an equal amount by distributing such inputs as seeds, fertilisers, pesticides weedicides and small implements. Besides, he can earn an appreciable amount through consultancy service to the farmers for his visits to their fields and advice. Yet another source of income could be custom service for tractor-ploughing, tubewell, irrigation, etc.

On the whole, it should be possible for an agricultural graduate to earn anywhere between Rs. 10,000 and Rs. 20,000 per annum from all these source. No small amount, indeed! No agricultural graduate can ever hope to earn even half that amount through state or private service. It may, however, be not possible for the agricultural graduate to have this much income for some time in the beginning. It may take a few years, say three years to reach this level of income. During these three years, the State Government should assist the agricultural graduate by paying him a gradually declining subsidy, say Rs. 2,000 in the first year, Rs. 1,500 in the second year and Rs. 1,000 in the third year. This is too small a cost as against employing an army of ill-trained persons.

Block Level Set-Up

At the Blcok level, a general agricultural extension worker will not do any more. It is necessary to provide specialists from the following fields: (i) Agronomy, (ii) Soil and water management, (iii) Plant protection, (iv) Agricultural engineering, (v) Horticulture and (vi) Animal husbandry, etc.

District-Level Set-Up

At the district level, specialists, of a still higher level in all these disciplines plus agricultural economics and farm management would be necessary. The main function of these specialists would be to bridge the gap between the research stations and extension services by bringing the latest fruits of science and technology to the field and feeding the research centres with the problems encountered in the field. It would, therefore, be desirable that these specialists should be borne on the cadre of agricultural univertities and should work under their technical direction while being operationally responsible to the District Agriculture Officers and working hand-in-hand with the extension staff.

State-Level Set-Up

At the State level, the responsibility for research and education should be transferred to the agricultural universities, which should carry it out by establising one campus in each important agro-climatic region. The state Department of Agriculture should be mainly charged with the regulatory functions.

The new system, thus, provides for a technically adequate and closely krit administrative machinery with its ramifications down to the village level. It ensures an intimate link between the millions of farmers spread over hundreds and thousands of villages, on the one hand and various institutions and organisations on the other. With the changing times and changing agriculture let the administrative pattern too change.

MODERNIZATION IN RICE MILLING INDUSTRY

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Neeed for Modernization in Rice Milling Industry

Our country has not been self-sufficient in rice for pretty long time-almost 35 years. Since 1932, when Burma was separated, India has been importing 1·5 to 2·0 million tonnes of rice every year from other rice producing South-East Asian Countries.[1] The present rice production of 38 million tonnes is yet insufficient to meet the demand of growing population. However, in the recent pastsuccessful efforts by Intensive Agricultural Development Authorities and introduction of high yielding paddy seeds have already ushered in new era of higher paddy productivity. It is estimated that due to various measures contemplated, the paddy production would increase from present production of 60 million tonnes to 81 milion tonnes in next five years. But for larger availability of rice, existing paddy processing units deserve special attention. In the country there are at present 5,200 paddy processing units consisting of 45,000 hullers, 3,000 shellers and 4,000 huller-cum sheller combinations which process approximately 33 million tonnes of paddy every year[2]. Moreover, in rice milling industry, there are large number of uneconomic and inefficient traditional huller and huller sheller combinations which drain out country's food resources. One of the contributing factor towards the loss of available rice for consumption has been the haphazard growth of rice mills in the private sector with the sole motive of earning as much profit possible.

It has been established that the average recovery from paddy to rice is 60 percent in huller mill and 63 precent in sheller and huller cum sheller combinations. By these traditional and old methods, it has been roughly estimated that about 1·52 million tonnes of rice valued at Rs. 1,520 millions is

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lost. Again, these milling devices are responsible for the breakage in rice during processing to the extent of 15 percent. Further, other by-product bran from sheller and huller cum sheller combinations rice mills does not have much value and is unfit for edible oil purposes. It should be remembered that the bran is an important source for extraction of edible oil. Annually about 2·97 lakh tonnes of rice bran oil valued at Rs. 891 million is thus lost in the process.

There are other losses in traditional milling also. Generally paddy is allowed to dry before milling either in the field itself or in open yards. In such cases, tremendous losses occur due to grain shedding, rodents and birds and the grain develops sun checks. Such losses have been estimated to be about two percent of the paddy production. Some recent researches in progress have shown that there are vast differences in yield in the harvest of paddy at different moisture levels. The results indicate that as much as 15 to 20 percent extra yield can be obtained if paddy is harvested at a higher moisture level of 20 to 22 percent and mechanically dried to a moisture level of 14 to 15 percent. Of course, this calls for a change in the harvesting practice itself[3].

The storing of paddy is done generally either in a godown as a open heap or in bags. Such storage is susceptible to pests and rodents attack. It is said that the losses in such storage amount to about 6·6 percent of the stored quantity in a year[4].

As a first step towards modernization in rice milling, seven modern rice mills set up in cooperative sector have already established their superiority in terms of higher yields of rice and by products over traditional rice mills. The yield of rice in modern rice mills ranges from 68 to 72 percent. In case of raw paddy it is observed that there is an increase in the out-turn of rice to a extent of 2 percent on an average over sheller rice mills and 6 percent over huller mills. The out-turn of parboiled paddy ranges from 1 to 1·5 percent more over sheller and huller mills[5]. In addition to the increase in the rice out-turn, modern rice mill equipments give additional recovery of germs which gets lost in the traditional milling process. The percentage of the broken rice is also restricted to about five only. Another by product bran obtained from modern rice mill is of much higher value and can be used for edible oil purposes. Moreover, rice produced in modern rice mill is of superior quality in terms of lower incidence of foreign matter, objectionable odour and uniform polish. Besides gain in the milling process, modern mill equipments also limit the scope of losses in premilling processes such as drying and storage, with the help of mechanical dryers and silos. It is estimated that modern milling equipments can easily help in obtaining 3 to 4 million tonnes of additional consumable rice and save foreign exchange by reducing the imports of rice. Therefore, to generate a revolution in food solvency and save foreign exchange, it is incumbent to check losses in milling process and moderize this vital industry. The need for modernization assumes greater significance in view of the high yielding paddy seeds.

Although the use of improved seeds and fertilizer enhance the cost of paddy cultivation, the increase in these costs can be met with by the increase in the end product. In the case of paddy, it is not only sufficient to increase the productivity but under increasing cost conditions it is imperative to obtain higher proportion of rice from paddy. The following tables (1 and 2) illustrate the comparative advantages of modern mills over traditional mills in terms of higher recovery and better quality rice and by-products.

What is Modernization

Modernization in rice milling industry refers to the latest improvement in the milling technology to reduce the costs, save losses in premilling process and getting higher rice recovery. Modern rice mill equipments include mechanical dryers, bulk silo storage, modern parboiling system and improved rice milling machinery. Milling machinery consists of paddy cleaners, efficient paddy separators (rubber roll shellers) cone or abrasive polishers, bran separators and grading equipments. First large capacity cleaners remove the foreign material from the paddy and then it is fed to the mechanical dryers to reduce the moisture content of the procured paddy to the safer moisture level of 14–15% for storage and milling. New scientific bulk silos provide enough aeration and have easy access to fumigation. Furthermore this automatic process of drying and storage considerably reduces labour and gunny costs. The use of rubber roll shellers and abrasive polisher provide uniform polish. New parboiling equipments attached with milling plant operate faster and steaming of paddy in hot water tanks is complete within four hours instead of two days in the traditional parboiling system, which causes disagreeable odour and colour to parboiled rice.

Cost-benefit of Modernization

By now it has been established beyond doubt that modernization in rice industry is not only desirable but also economically feasible.

The average productivity of paddy per hectare is about 1·20 tonne and the marketable surplus is about 35%. At this rate of production and marketable surplus a mill of four tonne per hour capacity would require about 56,400 hectares, under paddy to feed itself. It has been calculated that in a district like Thanjavur where the average size of holding is about 1·9 hectares and paddy occupies about 84% of the gross cropped area, a modern mill of four tonne per hour capacity should contact about 2,66,000 farmers. But when the high yielding varieties are extensively grown, this modern mill would require only 5,288 hectares, i.e., one-tenth of the previous area to feed itself. The implications of the reduction of the feeding area can be felt in several ways. This will reduce the transport and administrative cost of procurement to the minimum and will also help in the better integration of production and processing of paddy[9].

The Modern Mill at Tiruvarur (Tamil Nadu) had invested Rs. 2·59 lakh in mechanical driers and scalpers. The mechanical driers will be able to save the losses which occur due to drying in open yards and also improve the quality of rice which is reflected in higher prices for rice. This would give a net gain of Rs. 4 per tonne of paddy dried, after accounting for all the costs. For a quantity of 23,000 tonnes of paddy which can be handled in a year by this mill, the net gains will amount to Rs. 92,000. At this rate of net gains the invest-

TABLE I

Comparative Recovery of Rice and By - Products from Huller, Sheller and Modern Rice Mills [6]

Particulars	Huller Mill	Sheller Mill	Modern Mill
1. Yield of headrice	65%	65–68%	68–72%
2. Yield of by - products	Mixture of hush, broken & bran 35%	Bran 5% Broken 2% Hush 25–28%	Bran 4% Broken 2% Germs 2% Hush 20–24%
3. Quality of head rice	Contains about 20% brokens	Contain 10–15% brokens	Contains less than 5% brokens
4. Quality of by - products	Not usable for human consumption	Some - what usable for human consumption	By - products of higher value

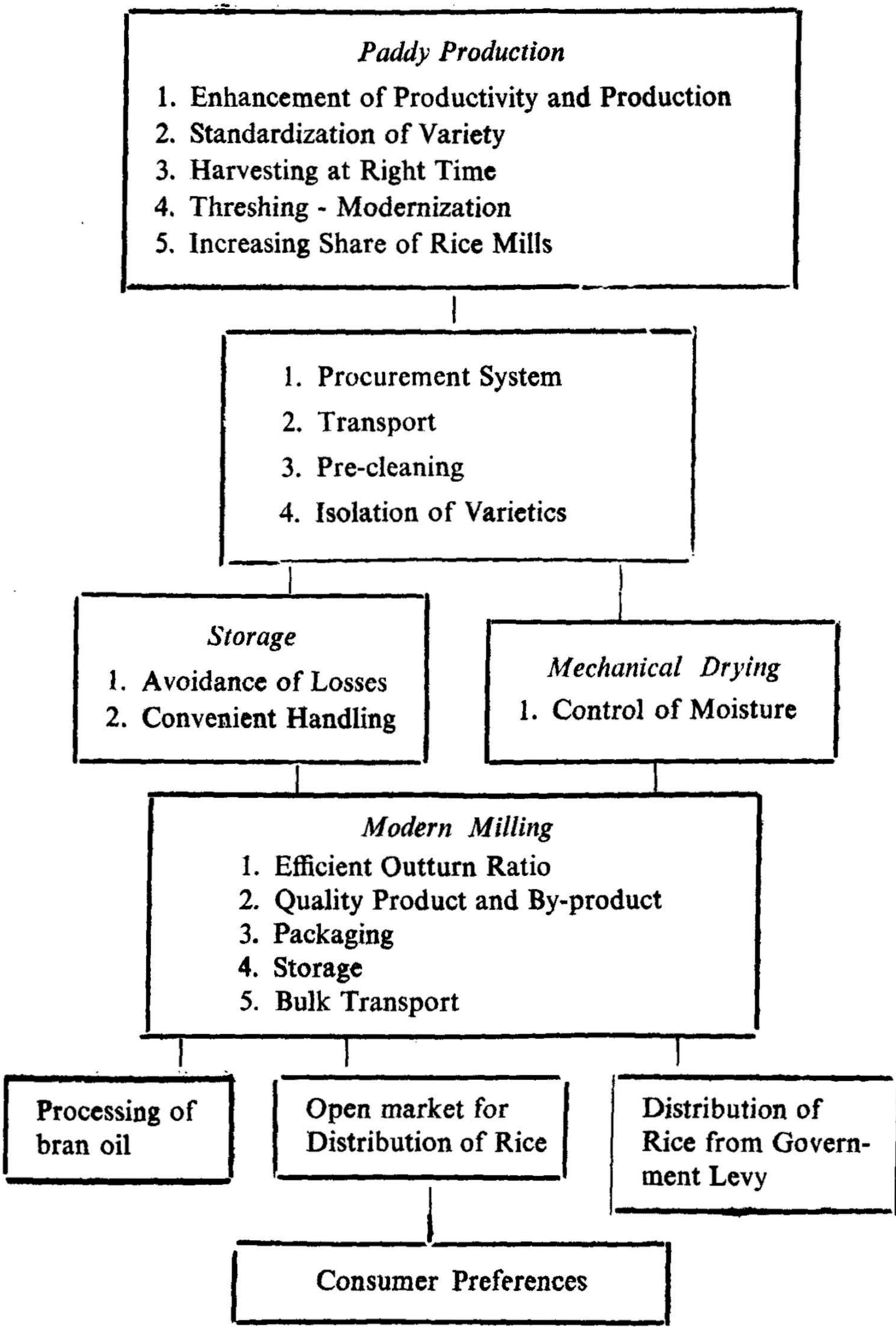
TABLE II

Comparative Recovery of Sheller and Modern Rice Mill in Madhya Pradesh [7]

Particulars	Sheller Mill (%)	Modern Mills (%)	Difference (%)
Recovery of headrice	62·96	66·05	+3·09
„ „ Broken	3·65	2·90	–0·75
„ „ Bran	5·01	4·95	–0·06
„ „ Germs	—	1·94	+1·94
Total	71·62	75·84	+4·22

CHART I

Modernization in the Paddy Rice System [8]



ment of Rs. 2·59 lakh can be recovered in a period of 3½ years (using capital budgeting technique)[10].

Similar calculations were made for silo storage system also. The investment in this case was Rs 24·49 lakh. Here it is contended that at this cost, the silo storage system is not economical. Of late it is learnt that the same capacity silos can be construted at a cast of Rs. 15 lakh which is justified in the light of the savings of the losses. When the system of modernization is considered in its totality, the investment of Rs. 24·49 lakh in silos is justified.[11]

Based upon the data collected from the Modern Mill at Tiruvarur, it is estimated the excess recovery will be about 4·4% of head rice and four percent of germs, eventhough the yield of brokens is reduced by 1·5%. The investment in the rice milling machinery alone was Rs. 4·67 lakh. If the modern mill operates to its full capacity, the excess recovery will amount to Rs. 4·42 lakh. If we consider the present value of Rs. 4·42 lakh for a period of ten years (i. e. the life of the machinery) the investment is justified. In fact, the investment of Rs. 4·67 lakh can be recovered in a period of 2¼ years[12].

The outturn of Modern Rice Mill at Raipur was compared with the average outturn of 28 randomly selected sheller rice mills in Raipur-Bilaspur districts and it was found that the modern mill yielded an excess recovery of 4·22% of headrice and by-products. (Refer to Table 2) These sheller rice mills on an average utilized 53% of this rated capacity. It is said that the cost of modernizing a one - tonne - per - hour - sheller - rice - mill will be Rs. 50,000 by way of fixed investment and Rs. 21,000 by way of running expenses. It is proved that the excess recovery of 4·22% of head rice and by-products will justify the investment needed for modernization. In other words, if we charge and interest and depreciation of 10% each on the fixed investment of Rs. 50,000, the per year total cost will be Rs. 31,000. The excess recovery alone amounted to 3–5 times the cost in monetary terms.[13]

In another survey in Andhra Pradesh, it was seen that the sheller rice mills utilized on an average only 20% of their rated capacity. A conservative excess recovery of just one percent of headrice was assumed. Here, it is observed that the modernization proposals seem to be feasible once the mills can start utilizing more of their rated capacity.[14]

Pace of Development in Modernization

On the recommendations of the Ford Foundation team, seven modern rice mills have already been established at Tiruvarur in Madras State, Tadepalligudem in Anhra Pradesh, Raipur in Madhya Pradesh, Baragarh in Orissa, Memari in West Bengal, Bikramganj in Bihar and Mandya in Mysore State.

The emergence of Food Corporation of India added new dimensions in the modernization Programme. Food Corporation of India has already established 24 modern rice mills of four tonne per hour paddy processing capacity and may set up another 25 of the same capacity in the next five years. Besides, Fourth Five Year Plan has also made a provision to set up 200 modern rice mills of two tonne per hour capacity and another 100 modern rice mills of one tonne per hour capacity in the cooperative sector. It has also been proposed to modernize 200 existing cooperative rice mills.[15]

In addition, towards manufacture of modern rice milling equipments, Government of India has decided to license three manufacturing units in the country — Dandekar Bros. Ltd., of Bombay, Damodar Enterprise at Calcutta and Binny Engineering Works Ltd., Madras to manufacture 600 modern rice processing units per year in collaboration with Satake and Kyowa Engineering works of Japan and Schule of West Germany. Jt is also proposed to encourage existing manufactures to produce modern equipments and develop small scale ancilliary units to undertake manufacturing of components for assembling units.

Research Programme in Modernization

To provide momentum to the modernization programme in the country, intensive research activities are being carried out by the Indian Institute of Technology at Kharagpur and Central Food Technological Research Institute at Mysore. In the Indian Institute of Technology at Kharagpur. the scholars engaged in active research, have designed experimental components "which throw off husk only and retain rice intact without any loss". A chamber has also been designed, which is artificially heated to find out climatic conditions conducive to the quick growth of paddy of maximum size possible. Artificial moisture is also gassed into the chamber. Experiments are also being conducted to find suitable soil quality besides "fertilizing the soil by a system of pumping by air in to it."[16]

Besides, the research development and training of technical personnel, IIT Kharagpur has started a short term course in rice Engineering with the financial support of Ford Foundation.

Simultaneously, Central Food Technological Research Institute at Mysore has also drawn a programme for the development and manufacturing of vital components of rice mills to substitute the existing parts in the tradltional rice mills. These are "rubber roll shellers, paddy cleaners and the unit for inactivation of liabse in rice bran to prevent the development of rancidity."

In case of parboiling methods, research activities are being carried out at two centres in India viz. CFTRI at Mysore and Jadavpur University at Calcutta. Researchers at these Institutes have devised a modern process to eliminate the defects of traditional parboiling processes. Realising the importance of modernizing the rice milling industry, group working in the Faculty for Management in Agriculture and Cooperatives in the Indian Institute of Management, at Ahmedabad, undertook research studies in the paddy rice system in India. Two research studies entitled "Modernization in Paddy Rice System" and "Under-utilization in Seller Rice Mills" present comprehensive account of the rice milling in India, focus attention on comparitive economic advantages of modern rice mills over traditional mills and problems confronting this industry. The Institute also organised a seminar on "Modernization in Rice Industry" to create greater awareness among the policy makers and the people engaged in the industry towards the need for modernization.

Issues in Modernization

While it is economically sound for the millers to go in for modernization, the Government will have to perform a catalytic role for speeding up the process, The following issues need attention :

1. Some sort of vertical integration is necessary among the paddy producers, millers and consumers. Probably the tradition set up by the Tanjore Co-operative Marketing Federation will be an example to build up a facilitative relationship between paddy producers and millers, where a share of increased gains due to modernization is being passed on to the paddy producers.

2. What should be the role of the Government in the modernization programme ? They can enforce a strict quality control, adopt a discriminative licensing policy, allow concessions in their taxation policy for modern mills and can provide subsidies and other incentives, which will encourage modernization at a faster rate.

3. Often it has been said that the hullers should be scrapped, but none has thought of an effective alternative. The marketable surplus of paddy is estimated to be about 34–40% of the production, which enters the market and milled by the shellers and modern rice mills. The rest, 60–65% of the production retained by the producers for seed and consumption purposes. A major portion of this is milled in small lots by the farmers in the huller mills which are located even in small villages. The sheller and modern rice mills will not be able to handle such small lots on custom basis. So, the hardship caused to them by the scrapping of hullers can be well imagined. Probably it is necessary that some sort of modernization is attemped for hullers also, as is being done in Japan.

4. With the increase in paddy productivity should one go for mills of large capacity or not? This again depends upon the area a mill can successfully tackle. Linked with the size is the problem of location also. A large number of traditional mills are already inexistence in paddy producing regions. In many a places the mills were set up based on some other criteria as in Srikakulam district of Andhra Pradesh. Even though the paddy production does not support the number of rice mills in this district, they have been thriving upon the supply of paddy from the adjoining districts of Orissa State prior to the formation of food zones.

5. Modernization programme needs fairly huge investment. An huller mill costs Rs. 3,000 - Rs. 5,000, which can be easily managed by an individual. A sheller mill of one tonne per hour capacity will cost about Rs. one lakh for which the unorganised financial agencies will come forward. But a modern rice mill of 2 tonne per hour capacity with mechanical drying and silo storage facilities will cost about Rs. 15 to Rs. 20 lakh. In this case the question of financial assistance arises. Some of the existing organised financial agencies like Agricultural Finance Corporation, Commercial Banks and National Co-operative Development Corporation may be able to take

up financing the modernization programme.

6. On an average the existing mills operate only about 50 per cent of their installed capacity. This may be due to the seasonal nature of the industry where the inventory costs may outstrip the off season milling revenue under the existing market conditions. In our surveys we were surprised to note that the utilization of the rated capacity was more in single paddy crop areas than in double paddy crop areas. But this under - utilization has much implication while planning for new mills. It may be ideal to plan for new mills based on the utilization of rated capacity than the rated capacity itself.

7. Modernization makes the paddy processing a technical job. This needs the right type of qualified and trained persons. This aspect also needs much attention in terms of developing facitilities for training the required manpower.

Concluding, therefore, modernization programme in rice milling industry has already been accelerated through various measures undertaken by Government and institutions. However, there is urgent need to give modernization programme a high National priority.

BIBLIOGRAPHY

1. Directorate of Economics and statistics, Ministry of Food and Agriculture, Government of India, " Bulletion on Food Statistics" 1969.

2. Ibid 1969.

3. Gupta V. K., Gopalaswamy T. P. and Mathur D. P., " Under Utilization in Seller Rice Mills (A study in Selected Districts on Andhra Pradesh)", Indian Institute of Management, Ahmedabad 1970, p. 99.

4. Choudhari S. C., "Marketing and Storage of Food grains", The Indian Journal of Public Administration, Vol. XII. No. 3, p. 695.

5. Central Food Technological Research Institute, Mysore, Report on Evaluation of Modern Rice Mills in Comparison with the Existing Mills.

6. Gupta V. K., " Modernization of Rice Mills", paper presented in National Food Congress, May, 1970.

7. Gupta V. K., Gopalaswamy T. P. and Mathur D. P., " Studies on Modernization in Paddy Rice System", Indian Institute of Management, Ahamedabad, 1969, p. 176.

8. Gupta V. K., " Dynamics of Modernization in the Paddy Rice System in Modernization in Rice Industry", Indian

Institute of Management, Ahmedabad, 1969, p. 15.

9. Desai D. K., " Economic Implication of Modernization in the Paddy Rice System in Modernization in Rice Indnstry," Indian Institute of Managment, Ahmedabad, 1969, pp. 43-44.

10. Ibid, pp. 44-46.

11. Ibid, p. 46.

12. Ibid. p. 46-47.

13. Gupta V. K., et. al,, 1969, op. cit. pp. 175-181.

14. Gupta V. K., et. al., 1970, op. cit. pp. 94-99.

15. The Economic Times, March, 13, 1969.

16. Parpia H. A. B. and Desikachar H. S. R., " Modern Process for Parboiling of Rice " in Modernization in Rice Industry, Indian Institute of Management, Ahmedabad, 1969, pp. 83-87.

AN ERA OF NEW FARMING !

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The farming of to-day is much different from that of yester years. Gone are the days when one would just stir the soil and sow the conventional crops in the conventional season and just forget all about that. It is no more so ! Now it is an era of farming with altogether different requirement, different norms and different methodology. The new farming has no respect for the traditional inhibitions and conventional crops either. Now the crops could be grown out of the conventional seasons and conventional practices could be discarded in favour of new ones. Traditional practics could be bade good bye. This new agriculture is both fascinating and revolutionary.

Growing crops out of season

The plant breeders have now developed such hybrids and varieties and agronomists and other area specialists such methodology that now many of the crops could be grown out of conventional seasons. As for instance, maize millets *urd lobia* and *moong*, the traditionally *kharif* crops could now be grown in summer too in areas of assured irrigation and not so aggressive heat. The farmers, thus, need no more leave their fields fallow after *rabi.* They can now take an extra crop suited to their area. The varieties suitable for summer planting are now known. These are: *Lobia* - Pusa Phalguni ; *Urd* - T-9 ; *Moong* - T_1, Pusa Baisakhi and T-44 ; *Maize*- Ganga - 3 and G-5 ; *Jowar* - CSH-1 and Swarna ; *Bajra* - Hybrid - and D - 174.

Growing unconventional crops

Quite a few new crops too have since appeared on the scene. Of these, soyabean and sugarbeet are the most promising. *Soyabean* : With 40 per cent protein, soyabean is the richest gourde of vegetable protein. It could be an effective weapon in our war against protein hunger. It has particular importance for a country like ours where the bulk of the population is vegetarian.

Soyabean has already made inroads in some areas. In Tarai area of U. P., in particular it now finds prominent place in cropping sched -

Soyabean to fight Chronic Protein Hunger

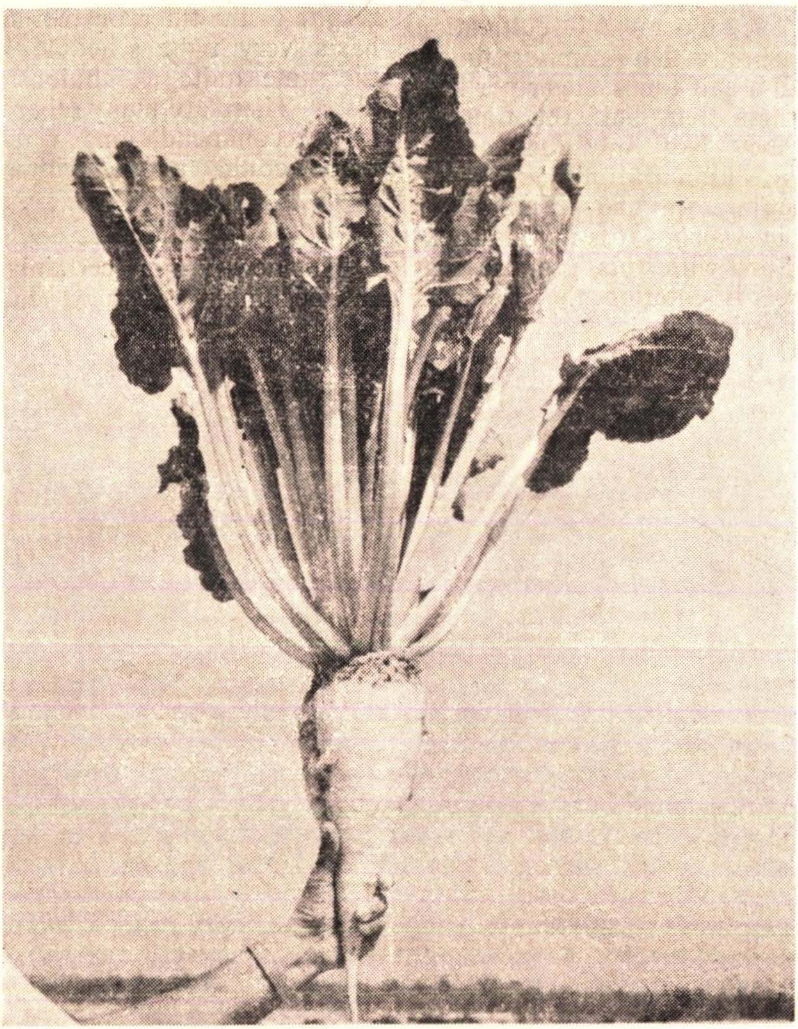
ules of many a farmer. They are now even taking two crops of soyabean—one in the conventional *kharif* season and the other in summer.

The major work on various aspects of soyabean has been done at the U. P. Agricultural University, Pantnagar. As a result of trials with large volume of exotic and indigenous material, the University has now identified varieties suitable for cultivation in the main *kharif* season as also in summer. Bragg, Lee, Hardee and Clark-63 have been found to be the most suitable varieties for cultivation in *kharif*. Of these, Bragg—a medium maturity variety with yield potential of about 35–40 quintals per hectare excels others. Whereas, Hark, Harosoy, Adelphia and Merit have been found to be ideal for summer culture.

Often, it is enquired as to what are the immediate sources for its utilization. For the benefit of these people, it may be stated that

there is already great demand for soyabean. Every year, the Government of India has to spend valuable foreign exchange to import soyabean seed and oil for industry, particularly the antibiotic, vanaspati, baby food and protein food industries.
Sugarbeet : The story of sugarbeet which is just seeking to emerge on the scene of Indian agriculture is quite fascinating. It is a study of the stuggle of the two crops for the top place. In the political parlance, it could be said to be **a** struggle between a traditionalist and a revolutionary.

Sugarcane, as they say, is a lazy man's crop. With the coming up of a wide array of new high yielding hybrids and varieties of wheat, paddy, maize and millets, the grower, particularly in the North, is quite bitter about the sluggish sugarcane that takes almost a year to turn out a meagre yield and no handsome return either. The crop is no more that sweet, he



Sugarbeet is the only answer to the sugar industry of the North often complains! Many growers have already abandoned sugarcane cultivation altogether whereas many others are thinking seriously to do the same. But it is no healthy trend, particularly in a State like Uttar Pradesh where sugar constitutes the biggest industry-employing directly and indirectly hundreds and thousands of people. All the same the farmers connot be forced to grow an unremunerative crop. A ticklist problem, indeed!

A problem for which administratiors have still no answer, the scientists at Pantnagar have found out one. They recommend cultivation of sugarbeet which promises almost one-and-a half times sugar per hectare in less than half the time as sugarcane, Not only this. sugarbeet cultivation also allows for an extra grain crop, maize, millets or paddy in *kharif*. It is in this background and with this promise that sugarbeet is entering the scene of Indian agriculture.

The trials at Pantnagar have revealed Helleshog-26740, U.S.H-7, U.S.H.-8, U.S.H.-9, G.W.H.-14, Magnapoly and Big Triplex as the varieties suitable for cultivation in the North. Of these, the former variety with a yield potential of about 700 quintals per hectare has been found to be the most promising.

This is not all about the new farming. It has many other fascets too. As for instance, the concept of relay farming provides for continuous cropping with virtually no respite to the tiller or the soil. It has a very tight schedule but all the same quite a fabulous return also. There are many other ingenious recommendations which farmers could adopt with advantage.

This new farming certainly marks the beginning of a new era-an era of hope and progress.

WEED CONTROL AS A TOOL IN SOIL-MOISTURE AND NUTRIENT CONSERVATION

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In arid farming, specially the aspect of soil and water conservation forms the very basis of agricultural production, This indeed can hardly be denied with wake of recurring droughts in the country. In such a programme of soil and water conservation, weed control forms one of the cardinal principles, as the weeds share soil-moisture and nutrients denying the lawful right of the crops to flourish. In most areas of India, to conserve soil and water, too much dependence on bunding alone is being placed. But, as per Cox and Jackson (1942) weeds are second to soil erosion in the national losses of agriculture. The extent of damage depends upon the nature of weeds, their stand, host crop, other biotic and edaphic factors. The actual annual loss caused by weeds is estimated to be 500 million dollars in U. S. A. alone (Ennis, 1955). In view of this, during these days

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the science of weed control is gaining tempo.

Somehow, the weeds generally escape notice when they are too small. The losses caused by weeds can be mainly attributed due to their uncontrolled growth which depletes the soil-moisture and nutrients from the cultivable lands. Any effort, therefore, in the direction of checking or minimising the depletion of soil-moisture and nutrients through control of weeds would go a long way in improving the Agricultural technology and thereby increased agricultural production. In as much as the weeds cover the bare soil and protect the land from the beating action of the rain, thus preventing soil-erosion, they are desirable in such uncultivated areas such as forests. Nevertheless, provided there is adequate soil-moisture, conditions in India are suitable for plant growth at any time of the year. This means that Indian agriculture is vulnerable to weeds and since soil-fertility levels are not high, weeds tend to be more harmful in crop fields. In this paper efforts are made to review weed control and the aspects of crop losses caused due to weeds by way of depletion of soil-moisture and nutrients as it has a direct bearing on soil and moisture conservation.

Erosion control and conservation of soil through weed control

Development of improved methods of weed control greatly enhance the practicability of minimum tillage in crop production (Ennis Jr. *et al.*. 1965). The use of herbicides coupled with minimum tillage is said to improve soil structure, increase moisture penetration, reduce water run-off and evaporation and the soil losses by water and wind erosion. The minimum tillage along with herbicides are reported to show an increasing promise in fallow years of crop rotations. The reports of large scale adoption of herbicides along with minimum tillage by Bowers (1960) in Illinois, Schaller (1960) in Iowa, Hanson and Robertson (1960) in Michigan, Blake (1960) in Minnisota, Jones (1960) in South-East and Gamble (1960) in the Great Plains, support the statement of Ennis Jr. *et al.*, (loc. cit.).

Extent of Soil-moisture depletion by weeds

In the present context of larger area under rainfed condition in our country, the need for conserving soil-moisture for successful crop production through every means need not be over emphasized. As weeds compete with crop for moisture, timely control of weeds form one of the important methods of soil-moisture conservation.

Nijhawan (1944) stated that by keeping the land weed free it was possible to save 300 to 500 tons of water in an acre of soil upto the depth of six feet. While Robins *et al.*, (1952) has mentioned that fields infested with wild oats, wild mustard and wild raddish or other weeds, reduced the yields, chiefly because of use of water by weeds. The water requirements of rageweed *(Ambrosia species)* is about three times that of millets and lambs quarter *(Chenopodium album)*, twice as much of feterita (sorghum) and yellow mustard *(Brassica campestris)* and as much as four times of well developed oat plants. Pathak (1958) observed that soil-moisture to a depth of 18 inches was highest (20%) for the cultivated but weed free plot and lowest in cultivated plots (18%)

while it was intermediate (19%) in 2, 4-D sprayed plots. Hosamani (1966) pointed out that the evapo-transpiration losses are nearly double when the onion plots were infested with weeds as compared to the weed free crop. The daily loss of soil-moisture from O to 45 cm depth in onion plots with weeds was 1·35 mm per day, whereas, it was only 0·68 mm per day from a weed free plot during the same stage of the crop. It may be inferred that moisture lost by evapo-transpiration through weeds is often much greater than that lost by evaporation, surface run-off or deep seepage. By avoding water losses by transpiration through weeds by clean cultivation, crop production could be increased from 10 to 25 percent (Arakeri *et el.*, 1959). Under dry farming conditions, at Sholapur, the transpiration coefficients at flowering stage of some weeds were - 556 for *Ischaemum pilosum*, (Kunda), 813 for *Cynodon dactylon* (hariyali), 1108 for *Teprosin prepurea*, and 1402 for *Tridax procumbus* while it was only 427·7 for sorghum and 369·9 for bajra (Kanitkar *et al.*, 1960).

Finnel (1960) studying the various factors of water accumulation in different crops has stated that weed growth generally depressed moisture accumulation particularly in Northern and Southern areas of the Great Plains States of U. S. A. He obtained highly significant negative correlations between weed growth and moisture accumulation in all the crops he studied viz., wheat, oat barley and sorghum. The soil-moisture extraction pattern of different weeds as reported by Davis *et al.*, (1965) - Cocklbur grew to a depth of four feet, had a root system width of 14 feet and soil-moisture extraction profile area of 44 square feet. According to Bodade (1965) every tonne of weeds removes three inches of rainfall which is sufficient to stunt the growth of the crop for want of soil-moisture.

Extent of depletion of plant nutrients by weeds

The deficiency of nutrients in the soil is one of the major factors limiting crop production. Since, weeds have a strong and a more extensive root system, they grow vigorously depleting the available nutrients in the soil faster than the crop.

Asana (1951) obtained reduced wheat yields to the extent of five mds. due to the growth of unchecked weeds which used as much as 17 lbs of nitrogen per acre. One plant of common yellow masturd (*Brassica campestrius*) removed twice as much nitrogen, twice as much P_2O_5 and four times as much K_2O required that for oat plant (Robbins *et al.*, (1952). Thakur and Negi (1954) observed that Nilkalami (*Ipomea pestigradis*. L) depleted the soil 30 lbs. of nitrogen per acre. Frank and Grigs (1959) noticed that *Chinopodium album* utilised nitrogenous manures in a better way than peas. In potato crop the weeds removed 63,11 and 87 kg. of nitrogen, P_2O_5 and K_2O per hectare at Delhi (Divekar, 1965). The unchecked weed growth for three months in onion crop depleted the soil 77 kg. N, 19 kg. P_2O_5 and 77 kg. K_2O per hectare at Delhi (Hosamani, 1966). Singh and Tomer (1966) observed that in fodder sorghum in Agra, weeds removed on an average 2·14 kg. of nitrogen and 6·87 kg. P^2O_5 per hectare.

Extent of losses in yield due to weeds

The extent of damage due to weeds, vary a great deal depending on the composition and the intensity of weed population, associated crop, climatic conditions, fertility status of the soil etc.

Under the conditions of limited rainfall, at Hays, one weed for each three feet of sorghum row spaced 20 inches apart, prevented grain production. And under more favourable moisture conditions, one weed for every two feet apart reduced the sorghum yields by more than 50 per cent (Phillips, 1960). At Nebraska, Burnside (1967) observed that each 50 lbs of weeds (dry) was equivalent to one bushel of grain. In India too, Verma and Bharadwaj (1963) have reported that losses in different crops range from 5 to 50 per cent due to weeds alone. All the losses enumerated above are mostly due to the depletion of soil-moisture and plant nutrients by weeds.

Extent of gain in yield due to weed control

Korsmo (1930) on the basis of 3,554 experiments conducted in Europe, concluded that weed control in different crops by different methods increased the yields by 21 percent. Moore (1960) quoted Day who estimated that the profit derived from weed control research in elevan Western States of U.S.A. was 700 million dollars. An estimated increased income by control of weeds from wheat, oat barley, pea, sugar beat, hay crops and flax were 44, 6, 18, 8, 6, 4 and 3 million dollars respectively. In potato a net profit of Rs. 514 per acre was obtained in Punjab by control of weeds through herbicides (Verma and Bharadwaj, 1953). Similarly, in case of cotton, a maximum yield of 13.1 md. of *kapas* per acre (132 per cent higher than control) was obtained (Verma and Bharadwaj, loc. cit.). At I.A.R.I. New Delhi, weed control in sugarcane with herbicides in combination with cultural practices gave 51 percent increased yields over unweeded plot, resulting in a net profit of Rs. 450.86 per acre (Verma and Bharadwaj, loc. cit.). Due to successful control of weeds in rice at Bhubaneswar, Sahu and Jena (1968) obtained a net profit of Rs. 486.84 per acre.

Summary

Under rainfed conditions conservation of soil-moisture and nutrients forms the most important aspects of agricultural production. Weeds through their strong and a more extensive root system grow faster than the crop, depleting the stored soil-moisture and nutrients. Every effort to conserve the soil-moisture and nutrients by way of weed control is self-rewarded as evinced by the increased crop yields and net profits. Weed control greatly enhances the practicality of minimum tillage, which in turn helps conserving moisture. Keeping the land weed free it is possible to save 300 to 500 tons of water (upto six feet) per acre. Besides, nutrients as much as 60 lbs of nitrogen per acre could be saved in the weed free plots. Thus, it may be equated that each 50 lb of dry weight of weeds is equivalent to one bushel of grains. And crop losses ranging from 5 to 50 percent due to weeds can be saved if weeds are removed and soil-moisture and nutrients conserved thereby.

REFERANCES

Arakeri, H. R,, G. V. Chalam, P. Sathyanarayana and R. L. Donahue (1959) Soil management in India. Asia publishing house, Bombay. pp. 125–141.

Asana, R. D. (1951) Common weeds and their control. Ind. Fmg. I (4): 13–17.

Blake, G. R. (1960) Where do we stand on minimum tillage. Crops and Soils, 12 (7).

Bodade, V. N. (1965) Comparative response to herbicides on jowar (*sorghum Vulgare*). Sorghum News Letter 8, pp. 33–40.

Bowers Wendell (1960) Where do we stand on minimum tillage. Crops and Soil) 12 (7).

Burnside, O. C. (1967) Sorghums number I enemy - Weeds. what to do about them. Crops and Soils. 20 (2): 10–11.

Cox, J. F. and L. Jackson (1942) Field crops and land use. John Wiley and sons publication, New York. P. 125.

Davis, R. G., A. P. Wiese and J. L. Pafford (1965) Root moisture extraction profiles of various weeds. Weeds 13. 98–100.

Divekar, C. B. (1965) *The efficiency of a pre-emergence application of simazine and crag and cultural methods of weed control in potato (Var. Upto date).* Ph. D. thesis submitted to I.A.R.I., New Delhi.

Ennis, W. B. (1958) The challanges of modern weed control. Weeds. 6 (4): 363–369.

Ennis, J. R. W. B., W. C. Shaw, L. L. Danielson, D. L. Klingman, and F. L. Timmons (1965) Impact of chemical weed control on farm management practices. Adv. Agr., 15: 162–210.

Finnell, H. H. (1960) Moisture storage and crop yields in the dry farming areas of the Great Plains as affected by natural and farm operational factors. Production Research Report No. 39 of U. S. D. A.

Frank, P. A. and B. H. Griggs (1957) Effect of herbicidal sprays and nitrate accomulation in certaion weed species. Weeds. 5 (3): 206–217.

Gamble, M. D. (1960) Where do we stand on minimum tillage. Crops and Soils. 12 (7).

Hansen, C. M. and L. S. Robertson (1960) Where do we stand on minimum tillage. Crops and Soils. 12 (7).

Hosamani, M. M. (1966) *A study of herbicidal efficiency and selectivity of tenoran io carrots and onions.* Ph. D. thesis submitted to I. A. R. I., New Delhi.

Jones, T. N. (1960) Where do we stand on minimum tillage. Crops and Soils. 12 (7).

Kanitkar, N. V., S. S. Sirur and D. H. Gokhale (1960) Dry farming in India. I. C. A. R. New Delhi publication. pp. 225–241.

Korsmo, E. (1930) Weeds in modern agriculture. Field Crops. Aber., 9: 1–8.

Moore, R. M. (1960) Weeds and weed research in Australia. Second Australian weed conf. Canbarra. Vol. 2, pp. 1–11.

Nijhawan, S. D. (1944). Conservation of soil-moisture. Ind. Fmg. 5 (2): 58–60.

Pathak, C. H. (1958) Effect of pre-emergence treatment with 2, 4-D on weeds in corn and various soil properties. Ind. Agron. J., 3 : 99-108.

Phillips, M. M. (1960) Controlling weeds in sorghum. Kansas Agric. Exptl. Circular 360.

Robbins, W. W., A. S. Crafts and R. N. Raynor (1952) Weed control. A text book and manual. McGraw-Hill Book Co. Inc. New York. pp. 10-11.

Sahu, B. N. and A. C. Jena (1968) Weed control in low land rice fields. Ind. J. Agron., 8 : 4-12.

Schaller, F. (1960) Where do we stand on minimum tillage. Crops and Soils (12(7).

Singh, R. R. and P. S. Tomer (1966) *Effect of Simazine, 2, 4-D (od. Salt) and cultural practices on weeds and yield of fodder jowar (Sorghum vulgare).* Second weed conf. P. A. U., Hissar.

Thakur C. and N. S. Negi (1954) Chemical control of 'Nilkalami,'—A menace to Sugarcane crop. Proc. Sekd. Bienn. conf. Sugarcane Res. Dvl. workers P. 549.

Verma. R. D. and R. B. L. Bharadwaj (1963) Control of Farm weeds by use of weedicides. I. C. A. R. Research Series No. 30.

REGULATION OF MARKETS IN UTTAR PRADESH

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The recent break through in Agricultural Production has already highlighted various problems in the field of marketing of agriculture produce. These problems of assembling, processing, grading and standardization, storage, transport and distribution of surplus agricultural produce are bound to grow more serious, unless remedial action is taken to organize marketing on a sound basis, so as to meet the challenge of over production bringing in its wake new problems which must be solved.

2. The present conditions obtained in the agricultural markets are very unfavourable to the cultivator who has to pay innumerable charges, levies and exactions in cash as well as in kind without having any say in the disposal of this produce. The existing marketing system is a cobweb of malpractices which has reduced the producer-seller to the status of a silent and helpless spectator of his own fleecing due to the prevelance of exhorbitant and unauthorized market charges and fraudulent practices including under-weighment through manipulation of scales and use of defective weights. It is estimated that out of Rs. 100 paid by the consumer of agricultural produce, the produce-seller hardly gets Rs. 71.60 in wheat, Rs. 65.00 in barley, Rs, 76.80 in linseed, Rs. 74.00 in groundnut and between Rs. 40 and 50 in different fruits and vegetables. In view of the above position and considering the fact that there can hardly be any incentive to the producer-seller for increasing agricultural production unless there is improvement in the marketting of his produce, 'U. P. Krishi Utpadan Mandi Adhiniyam' was enacted in Uttar Pradesh in November 1964.

3. There are about 250 main assembling markets in the State,

Of these, 78 main markets have so far been regulated under the aforesaid Adhiniyam. Notifications declaring the intention of Government to regulate sale and purchase of agricultural produce have also recently been issued in respect of 101 other markets and it is proposed to cover all the 250 main markets during the current year itself.

4. In accordance with the provisions of the Adhiniyam, the market committees of the regulated markets, are charged with the responsibility of ensuring a remunerative price for the producer-seller and a fair deal in disposal of his produce in the market, to create orderly marketing conditions in the markets and to provide for the consumer the desired standards of produce at reasonable price. For the purpose, it is of utmost importanee for these 'Market Committees' to construct their own market yards having suitable auction floors and auction halls, grading halls with necessary cleaning arrangements and grading facility, proper godowns, parking place for carts/trucks, cattle sheds, water troughs, a rest house, fair price shops for agricultural inputs like insectisides, seed, fertilizers and implements etc. Consumer goods, building material, arrangement for dissemination of information relating to market prices and stocks etc., space for the premesis for traders, transport agencies, banks, post offices, railway siding etc. In the new context of increasing agricultural production it would be necessary to establish new markets for fruits and vegetables, to provide a net work of cold storages and processing factories and to plan out all our programmes for meeting the challenges of growing surpluses.

5. The market committees of the markets regulated so far have been facing resistance from the traders, vested interests and in the absence of properly developed market yards are failing in their duty of exercising proper supervision and control over the disposal of agricultural produce. They are faced with the difficulty of obtaining land at reasonable prices as also of the huge investment required for the purpose. It is high time that the Central/State Government should come forward to provide adequate loans either from their own resources or through agricultural refinance corporation and other banking institutions, in which case Government may come forward as surety. The feasibility of making Government purchases through the media of market committees at prevailing market rates, of having uniform rates, specification, of avoiding duplication in matters relating to licensing products and maintenance of records under the 'Adhiniyam' and the Essential Commoditing Act 1955 needs to be examined on the priority basis, by the State and Central Government. The need for strengthing and streamlining the State Agricultural marketing Organization for meeting the growing challenges with which this organization is faced, in giving timely, effective and proper guidance to a large number of non-official bodies as also supervision of their work, is urgent and deserves consideration.

6. Last but not the least important is the exercising of restraint by the market committees themselves in the utilization of their surplus funds for purposes other than those for the construction of their own market yards and for the provision of other facilities for the benefit of producers. It is very necessary for

them to plug all holes to avoid frittering away of their resources which are yet meagre and which must be built up, as expeditiously as possible. Market committees if properly run can be a great boon for the uplift of farmers by constructing modern market yards with necessary amenities and facilities, roads, small bridges, culverts, warehouses, cold storages, processing units etc. and by providing facilities of agricultural education through literature, films, slides shows etc. one thing good about them is that they are their own organizations run for their own welfare. It is heartening that the Agriculture Department of the State is making strides to achieve the desired objective in the sphere of agricultural marketing under the scheme for regulation of markets. Our goal is distant, journey full of ordeals and heavy financial outlay present a challange to our progress yet a sincere effort will not go in vain and the future will herald a new era in this direction.

RESEARCH ACTIVITIES FOR OUTDOOR STORAGE IN BULK OF CEREALS IN FARMS

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Background

Until very recent years, grain storage in India was not defined as a problem. Farmers stored for their family needs in underground pits lined with twisted ropes of straw or with bricks or with woven reed mats on which cow dung was plastered and dried. Other farmers used large earthen vessels or brick and mud bins built into their house. Large jute bags stacked in one room was also a common sight. However, many of the traditional systems are inconvenient from a materials handling standpoint and lack the design features needed to preserve high quality in the different food grains. Research investigations have documented severe waste to food-grains caused by insects, rodents, mold, theft and even birds before and after storage. This was graphically summarized in 1969 by H. J. Barre (Ref. 1) when he pointed out India's annual food grain requirement was about 100 million tons, during 1965–66 when production was 10 percent short of the amount needed due to severe drought conditions. His study revealed that, if unnecessary losses could have been avoided by using advanced handling and storage practices, the food grain production in India would have been adequate even during years of drought.

The recent trend to grow high yielding variety (HYV) cereal crops has changed traditional storage patterns. Most production areas are yet unprepared to dry and adequately store this new abundance. Generally farmers who traditionally borrow money at high interest rates to plant their crop, must sell at harvest time to have money enough to pay their debts, keeping only enough grain for family needs. However, times are changing! Bank credit is more available at lower interest rates; the market prices have fluctuated and tend to bottom out at harvest time with higher prices four to six months later; some money sources are advancing loans on stored grain; most important, the technology and techniques for keeping quality in stored grain has advanced to a point where storage losses are unnecessary and can be prevented.

Storage Needs are Changing

In addition to the traditional family food storage requirement there now appears to be a trend toward commercial grain storage both by individual farmers and and collectively in local villages. Indications are that this new interest is brought about; *first* because improved storage structures have been designed and are available; *second*, effective techniques for fumigation have been recommended; *third*, credit has become more available; and *fourth*, in addition to a literacy increase the better market reporting and other communication facilities have stimulated an awareness to the advantages for storage.

Need for Economic Research

One urgent plea for better storage programs is that an awareness must be created for effective research directed at storage problems. While we have limited positive results obtained from experiments conducted on different type storage facilities, little is known about traditional village grain storage practices. Questions still unanswered that need researching are many, for example (Ref. 2):

1. How much foodgrains of the different types does the average farmer store, and for what purposes?

2. What is the actual economic loss of damaged foodgrains to the farmer over a one year period?

3. How much will a farmer spend on protecting foodgrains against pest-caused losses and how much should be spent?

4. What food commodities other than the foodgrains need protection, and how do the problems of foodgrain storage relate to the storage of these foods?

5. Hcw do the indigenous storage methods compare with the recently developed grain storage practices in effectiveness?

6. Will a farmer store more of his grain at harvest time if he has adequate farm storage facilities?

7. How would farm loans using stored grain as mortgage security, influence the amount of grain stored on farms?

Present State-of-the-Art

There are a number of Institutions and Agricultural Universities working on grain storage research in India. Most of these are listed in the end of the article. Considerable research has been done and reported for the control of storage insects and mold. Some attention has been given to large storage structures or elevators for market collection centers and limited research has resulted in some recommendations for inside storage bins ranging in size up to 15 quintals ($1\frac{1}{2}$ ton) to meet, essentially, domestic food requirements.

There is now an emphasis on self-contained outdoor storage bins that meet all requirement criteria for good grain storage. These range in size from 2 tons to 30 tons and more, and are suitable for bulk grain storage on the farm. These bins are made from one or more material combinations of steel, plastic, mud, woven mats, cow dung, brick, granite block, reinforced concrete, asbestos, and holes or pits dug in the ground.

Until recently very little attention was given to engineering considerations such as the convenience aspects for materials handling in removing grain from the bin.

A variety of very satisfactory storage bins are now under study or offered to the market. The most popular outdoor sizes seem to be 1, 2, 5, 6, and 7 ton capacities.

Design Criteria and Information for Farm Storage

Research information is scanty, incomplete, and needs much more investigation. A very worthy contribution is from A. P. Bhatnagar (Ref. 3) of Punjab Agricultural University. Twelve grain bins of 15 quintal capacity each were studied in the laboratory, inside, under roof. The study consisted of 4 local type mud bins, 4 steel bins and 4 polythene lined mud bins. Mixed varieties of local wheat grain were used which arranged 7 per cent grain moisture. Monthly observations were made on the grain moisture, insect infestation, germination and grain temperature. The conclusions drawn from this study are quoted as follows:

" 1. The grain moisture in the bins under study, decreased with time.

2. The grain moisture drop was more in the polythene lined mud bins and steel bins than ordinary mud bins.

3. The grains from middle and bottom locations displayed an increase in moisture whereas the top level decreased, when temperatures were low.

4. Moisture migration in the bins, while not apparent, cannot be completely ruled out although analysis of variance does not support it.

5. The incidence of grain infestation by insects is very high in mud bins followed by polethene lined mud bins. The steel bins had the lowest infestation incidence.

6. The germination decreased more in mud bins than the other two types. There was higher germination percentage in steel bin grains than in polythene lined mud bin grains,

7. Temperature in the bins always remained 2° to 5° higher than the ambient, however, sampling accuracy was questioned."

In a Brazil test on farm storage of corn (maize) Floyd Herum et. al. (Ref. 4) concluded that while open type bins helped drying of the ear it was not possible to control the different kinds of insects. The study conculuded that immediate shelling of maize into closed type storage would avoid most of the damages and losses attributed to crib storage. With shelling of ears, storage volumes are more than halved for a given quantity of grain handling and fumigation are greatly enhanced.

In his work at the Indian Grain Storage Institute, Hapur, G. K. Girish (Ref. 5) has summarized the general requirements for safe wheat storage and grouped them as follows :

(a) Envirenmental requirements

(b) Functional requirements

(c) Structural requirements

The researcher will find that in general rccommendations are to dry cereal grain below the 10 percent grain moisture level, store in a semiairtight container, fumigate with one of the safe insecticides such as alluminum phosphide (phostoxin tablets) (Ref 6) and seal the bin.

Any one of a wide range of structures ean be satisfactorily used to maintain grain quality. These essential requirements for food outdoor storage structures and prefabricated bins have been summarized by B,R. Birewar et.al, (Ref. 7) and listed as follows :

(1) It should be weather tight

(2) It should be as air tight as practical and easy to fumigate

(3) The structure should not allow the entry of rodents, insects or pests

(4) It should be economical to purchase and maintain

(5) Easy to fabricate or construct

(6) It must be functional under all conditions

(7) It should have adequate capacity

(8) Design should be functional for forced aeration is needed

(9) It should be convenient to load and unload and also be locked, strong, and theft proof.

A very useful and comprehensive study on preservation of food grains in rural storage was made by T. Ramasivan, K. Krishnamurthy, and S. V. Pingale (Ref. 8) in which it was determined that of the grain produced in India, only 30 percent is the marketable surplus handled by traders and government, and 70 percent of the production stay in rural areas with farmers. In Mysore State the ratio was 49 percent sold and 51 percent kept on farms. We now know that since this 1966 study a much larger percent of production is channeled into the market because of much higher production per acre. An evaluation is made of the important features and materials used in traditional rural storage structures. It eovers, underground structures, above ground structures, as well as an evaluation of structures both for indoor and outdoor storage.

This comprehensive report states that grain storage structures used in rural areas are in general far from satisfactory. The walls of these structures are not moisture proof and often water seeps through to cause fermentation and caking of grain. Also, both insects and rodents can enter into most of the bins.

Where mud is used in both the indoor and outdoor structures moisture can penetrate the walls and rats can dig holes through to consume and spoil the grain, (Ref. 9).

Trends in materials and Design Concepts

Metal Bins

By far the largest number of outdoor type manufactured bins are the steel bins. A recent survey by the Indian Grain Storage Institute listed 31 manufacturers of metal storage bins.

Other Types

With steel becoming more scarce and expensive there are other materials now under trial that could have an even longer life, have less unit cost and satisfy the criteria for good farm storage. Concrete, asbestos. and granite stone (where available) are beginning to gain prominence in competition to all-metal bins.

An Asbestos Company at Coimbatore is now offering the market a 1, 2 and 7 ton prefabricated bins while a 2 and a 5 ton reinforced spun conerete tube bin is now being erected in place by a company at Bangalore in Mysore State Recently a 30 ton grainite stone bin in two rooms with a common R. C. C. roof wrs completed in the Raichur district of Mysore State.

Easier credit and success of the high yielding varieties is encouraging many commercial farmers to store and hold large quantities of grain up to six months or more trying to realize a higher price. Indoor storage structures have served their place in the preservation of family food supply and will continue to do so. However, the practice of commercial bulk storage on farms is here. There is an urgent need for well engineered outdoor structures that incorporate: convenience in handling; long life; easy maintenance; attractiveness; functionability. They should be erected by local skills; made from local or available material; and be paid for from market increase and saving of grain over a period of not more than 3 years.

Side Pressures on Bin Walls—Need for More Design Information

For the type of bins under discussion, pressure on the side wall can be calculated from the following equation:

$$P=1/2\ Wh^2+\tan^2(45^\circ-0/2)$$

Where

P=Total pressure in pounds per foot or wall length

W=Weight of material in pounds per cubic foot

h=Height of the wall in feet

0=Angle of repose of the grain

To assist the design engineer much work is yet to be done in addition to the very excellent work of the Indian Standards Institution on grain storage standards.

From an engineering standpoint there is considerable research work yet pending to develop design information on India foodgrain storage. Some of this needed research will include:

1. A srandard method of measuring grain that can be used throughout India in marketing in quantities less than the metric tonne.

2. Metric standards on

(a) Grain storage loads, pressures and capacities

(b) Equivalent fluid densities for maximum weights of various commercial grains

(c) Graphs for grain bin loads and capacities for different shaped structures in use

(d) Density, specific gravity and weight - moisture relationships of stored grain

(e) Metric graphs and tables on friction co-efficients of grain

(f) Thermal properties of grain and grain products

(g) Moisture relationships of grains

(h) resistance to air flow through grains and storage components.

(i) Standards, guidelines, and specifications on drying the different crops.

(j) Standards on construction, installation, and rating of equipment for drying farm crops.

(k) A centigrade psychrometric chart using metric system for enthalpy, wet bulb, water vapor and dry bulb temperatures.

Some recent concepts in outdoor storage design

The Agricultural Production Program, Coimbatore-3, Tamil Nadu, has recently conducted trials with bulk storage bins made from asbestos and manufactured by Asbestos Cement Limited, Pottanur, Coimbatore district. Development work has been going on for about two years by the APP Team Field Problem Unit, Tamil Nadu and the Principals of Asbestos Cement Limited. The first proto type bins were of three foot diameter made in 18″ with rings. Later the interlocking rings were increased to 24″ width. Bins are now offered to the market in three or four foot diameters and are placed on an asbestos funnel-like spout which is embedded in brick and cement. These bins are usually constructed to a storage height of eight feet. A larger eight foot diameter bin holding 7 ton is under test in Tamil Nadu and Mysore State. Haws and Richardson (Ref. 10) report that for 15 months the ring type asbestos bins have been completely satisfactory for storing maize and paddy at Coimbatore. Insects, moths and rodents have been no serious problem.

Four different methods of storage are being tested with newly harvested ADT-27 paddy placed in storage at 10% moisture:

1. Asbestos ring bin lined and sealed with plastic liner
2. Asbestos ring bin not sealed plastic liner
3. Asbestos ring with no plastic liner and ring points not sealed
4. Asbestos ring bin with no plastic liner but with joints sealed

It is reported that moisture accumulation inside these bins has not materially affected the grain during this monsoon season.

On 28th December, 1969 the larger 7 ton bin was filled with paddy at 10% grain moisture content. On 24th March, 1970 grain moisture had dropped to 9·8%. After five months there was a slight infestation of the lesser flour beetle at the top, controlled easily with fumigation.

The APP Field Problem Unit in Mysore State is now setting up asbestos bin tests in Mysore.

Steel Storage Bins

The steel bin has been popularized and gained wide acceptance for bulk storage of grain both inside and outside. The Punjab Agricultural University, Ludiana (Ref. 3) and The Grain Storage Research & Training Centre, Hapur (Ref. 5) along with others have pioneered in the use of steel bins. Other organizations have also reported this research (Ref. 11, 12 and 13). The research has demonstrated that steel bins when made essentially air tight can receive grain at 10% or less moisture content and maintain good quality provided the bin and grain is treated against insects. Insect damage has been greatly reduced but not eliminated in air tight bins where prophylactic treatment was not used against insect infestation. Until the research is more conclusive there is good reason in the author's opinion, to use a recommended insect fumigant to treat the grain when filling a bin. Good fumigants are available, of very low cost and is a cheap insurance and safeguard against the ever present insects (Ref. 2).

There are now over 31 known manufacturers of metal bins. The Tata Iron and Steel Company (Private) Ltd. has given some 80 bins over India for research and demonstration. The picture shows one of three Tata 6 ton bins on test at Mysore State Seed Farms.

Aluminium Bins

Aluminium prefabricated bins for outdoor grain storage are available in capacities of 15, 30 and 35 tonnes (metric).

Information on aluminium bins is documented in the Indian Standards 631-1961.

The bins and additional source of information is available by contacting the head office, Indian Aluminium Company Limited, 31 Chowringhee Road, Calcutta.

The literature gives very little storage performance information. The bins are also mentioned in reference 12.

Underground Bins

It would now appear that trends are away from underground storage bins because the above ground bins are more convenient from a materials handling standpoint and grain quality can be better maintained. For those wanting information, considerable research and development work has been done on underground bins by both the Central Food Technological Research Institute at Mysore, and others.

Concrete Bins

The Concrete outdoor storage bins have not gained in popularity as have the metal bins. The reason might be that first concrete lacks portability and easiness to erect on location. A more prominent reason may be that most storage research has been done in the Punjab and Gangetic Plan where stone material for concrete is relatively unavailable.

The Dhan Kothi R. C. C. bin has been made from prefabricated rings and designed to hold capacities of 1.5, 2.0, 2.5, 3.0, and 6.0 tonnes. Information is available with Concrete Association of India, 82/64, Janpath, New Delhi-1 or their branch offices.

In Mysore State the Agricultural Production Program Engineering Field Problem Unit, has successfully used spun RCC pipes for grain storage, named the Mysore Grain Bin, Pipes are manufactured and available throughout the Hard Rock Area of South India where RCC materials are plentiful.

Engineers have tried to incorporate all the recognized features needed for preserving good quality in grain with particular attention given to making the structure moisture proof and essentially air tight. After erection the high quality RCC is painted inside and out with several coats of cement and water proof compound to seal any pores, the floor has a hot tarfelt moisture barrier and the screw down door openings have thick rubber seals around their edge.

An added feature is the convenience for materials handling and for entering the large bins to clean and fumigate. A bagging spout is provided at the top of the door on the larger bins and cross boards can be removed to finish unloading and cleaning.

The slight increase in cost for this added convenience can be justified.

Information can be made available from the Department of Agriculture, Seshadri Road, Bangagalore 1, Mysore State.

Sized Granite Stone Bins

Larger farmers growing the HYV paddy such as IR-8, are now yielding 3 to 4 tonnes per acre. Through out South India it is not uncommon now to hear farmers talk of the need to store 20 up 100 tonnes of paddy, particularly in the water intensive irrigation schemes.

Engineers of the Mysore APP Field Problem Unit have attempted to solve one farmer storage problem of 30 tonne by working in cooperation with an American Peace Corps volunteer in the Tungabhadra in Raichur.

REFERENCES

Ref. 1 Storing and Handling Food Grain in Northwest India; H. J. Barre, Professor, Ohio State University, Columbus, Ohio, ASAE Paper No. 69–580.

Ref. 2 Ford Foundation, "Rural Wheat Storage in Ludhiana District, Punjab."

Ref. 3 Performance Study on Grain Storage Bins; Associate Professor, A. P. Bhatnagar, College of Agri. Eng., Punjab Agri. Univ. Ludhiana; Journal of Agri. Eng. Vol. No. 2 Dec. 1969, Page 48.

Ref. 4 Farm Storage of Corn in the Semi Tropics; Floyd L. Herum, Assoc. Prof. Dept. of Entomology. The Ohio State University, Columbus, Ohio. Paper No. 69-587 American Society of Agri. Engineering.

Ref. 5 Environmental Requirements for wheat Grain Storage; G. K. Girish, Indian Grain Storage Institute, Hapur (U. P,), India, Page 154, Bulletin of Grain Technology Vol. VII, No. 3, September 1969.

Ref. 6 Storage of Wheat by Farmers in Delhi; M. K. Zutzhi, Directorate of Plant Protection, Quarantine and Storage. New Delhi; Page 143, Bulletin of Grain Technology, Vol. IV No. 3, September 1966.

Ref. 7 Structural Requirements of Grain Storage; B. R. Birewar and D. M. Ellis (F. A. O. Agrl. Eng. Expert) Indian Grain Storage Institute, Hapur; Page 229, Bulletin of Grain Techonology. Vol. VII. No. 4, December 1969.

Ref. 8 Studies on Preservation of Food Grains in Rural Storage, T. Ramasivan, K. Krishnamurthy, and S. V. Pingale; Page 177, Bulletin of Grain Technology, Vol. IV, No. 4, December 1966.

Ref. 9 IS: 602-1955, Code of Practice for Construction Indian Standards Institute, 19 University Road, Civil Lines, Delhi-8.

Ref. 10 Dr. L. D. Haws, APP Team Leader and Mr. J. B. Richardson, Agricultural Engineering Advisor-APP, University of Tennessee/USAID working in collaboration with the Department of Agriculture, Tamil Nadu and the Agricultural college & Research Institute, Coimbatore: Annual Report, July 1, 1969 - June 30, 1970, Page 11.

Ref. 11 Rural Wheat Storage in Ludhiana District, Punjab by H. R. Willson, the Ford Foundation, Amar Singh, Punjab Agri. Univ., O. S. Bindra and T. R. Everett, the Ford Foundation, 32 Ferozshah Road, New Delhi, January 1970.

Ref. 12 A Storage Structure to Suit Every Need. Information Leaflet No. 86, Farm Information Unit, Directorate of Extension, Ministry of Food & Agriculture, Community Development and Cooperation, New Delhi.

Ref. 13 "Store Your Wheat Grain Safe in PAU Bin", by A. P. Bhatnagar, College of Agrl. Eng., Punjab Agri. Unlv., Ludhiana.

Centers for Research on Bulk Storage Bins suitable for Farm Use

1. Director of Agriculture, Department of Agriculture, Seshadri Road, Bangalore 1, Mysore State.

2. Entomology Division Indian Council of Agricultural Research, New Delhi 1.

3. The Grain Storage, Research and Training Centre, Department of Food, Government of India, Hapur, Uttar Pradesh, India.

4. Director, Central Food Technological Research Institute, Mysore.

5. Director, Storage and inspection, Ministry of Food, Agriculture, Community Development and Cooperation, Krishi Bhavan, New Delhi 1.

6. Concrete Association of India, 82/84, Janpath, New Delhi-1.

7. Director of Research, University of Agricultural Sciences, Hebbal, Bangalore 24, Mysore State.

8. Director of Research, Agricultural College & Research Institute, Lawley Road P.O. Coimbatore 3, Tamil Nadu.

9. Director of Research, Orissa University of Agriculture & Technology, Bhubaneswar-3, Orissa.

10. Director of Research, Jawaharlal Nehru Agri. University, Jabalpur, Madhya Pradesh.

11. Director of Research Andhra Pradesh Agri, University, "Dilkusha" Raj Bhawan Road, Hyderabad-4, A. P.

12. Director of Research, Punjab Agriculture University, Ludhiana, Punjab.

13. Director of Research, Agricultural College, Poona-5, Maharashtra.

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PREVENTION OF LOSS TO CEREALS

S. V. PINGALE

Loss is difficult to define. What may be considered a loss in a particular situation may cease to be so in a different situation. The term has, therefore, to be used in relation to a situation. For cereals as food material loss would mean a reduction in the dry weight.

Losses occur on account of:

(a) Mechanical agents:

(i) Shedding: Grain is dislodged from the plants due to birds, animals. hail and due to delayed harvesting.

(ii) Harvesting: In the course of harvesting some grain may be lost in the field. When harvested by hand losses are low.

(iii) Threshing and winnowing: Some grain remain in the husk etc. and some shrivelled kernels and light grain are blown off with chaff.

(iv) Transport: While being carried, some loss may occur due to spillage, leakage from bags or from the bulk.

(b) Biological agents:

(i) Birds: Pigeons, sparrows and some other birds cause a loss by consumption, scattering and fouling.

(ii) Rodents: Squirrels and rats bring about the loss by consumption, fouling, destruction of bags and scattering larger quantities.

(iii) Insects and mites: These cause loss to quality and quantity and are believed to be the single agency responsible for most of the loss.

(iv) Mould: These bring about reduction in weight, food value and germination.

(v) Theft.

The quantitative loss can be reduced or increased by changing the moisture content and foreign matter content. Loss calculated on dry weight basis is not affected by these changes. In practice, loss is not, however, worked out on dry weight basis and the conventional method, therefore, provides scope for dubious practices.

PREVENTION

Losses brought about by any of the agents mentioned above are completely avoidable. The contention that some loss is bound to occur when a cereal is handled can be rendered untrue. It may not be economical, however, to reach this perfect stage of handling foodgrains free of any loss. The endeavour, therefore, has to be to keep the losses to the minimum by avoiding such losses as can be easily eliminated.

Losses brought about by mechanical agents are avoidable with greater care in carrying out the operations. It is the experience that a small farmer who is able to devote greater attention to each operation practically suffers no loss. A thorough cleaning, avoiding defective operation, keeping birds scared and stopping all likely leakages during transit would be a paying proposition.

Biological agents need to be dealt with on a different footing. Here it is to be appreciated that it is a matter of survival and death for the adversary that is to be dealt with. A rat has to obtain its food and it will also make every effort to secure it. Same is true with birds, insects and those responsible for thefts. Preventive measures to be adopted, have to, therefore, take note of the ingenuity of these agents.

Birds and rodent damage can best be prevented by using steel bins for storage of cereals. Steel bins can now be had in any capacity desired. Cost is also such as can be recovered from the savings in the course of a few years. In case of birds and rats, complete control of these pest is not easy. Partial control only reduces competition and favours better growth and multiplication of the residual population. This does not mean that their control should not be attempted. It needs to be appreciated in organising their control, that it has to be a continuous process to be carried out relentlessly.

A number of rat poisons are available in the country. Initially, a poison like zinc phosphide may be used with advantage to effect a drastic reduction in the population. This poison can at best control about 80% of the existing population. Mainly younger generation is killed. This poisoning operation then be followed by use of anti-coogulants like 'rodafarin' or 'ratafin'. These anti-coogulants be used continuously for a period of about four weeks. This twin prolonged programme generally reduces the rat population to a level that may not cause significant damage for about 6-8 months. In case the programme is adopted for the entire village, the area will be rendered rat free for 2-3 years. More than 200 villages in the country to-day have been made rat-free by this process. Cost of each rat destroyed comes to Re. 0.1, when a surviving rat on an average means damage worth a rupee each year. In case of field rats, simplest technique is to use aluminium phosphide tablets (trade name

Celphos') for fumigation of burows. Cost in this amounts to Re. 0.07 per burrow and the population continues to be under check for a year.

For insects storage in the bins, when bins are air-tight and filled to the capacity, will normally take care of insects due to depletion of oxygen. On the farm grain is not left undisturbed for long. The principle of air-tight storage is, therefore, not strictly applicable. It is advisable to use EDB ampules for fumigation as soon as the grain is placed in the bin. This keeps the grain free of any damage for a period of upto 2 years. Cost of the treatment amounts to Rs. 2.0 per ton of grain. EDB—ampules and Celphos tablets can be had from and Pest Control Agency. Failing this may be obtained from Excel Industries, Bombay.

Food grain storage is an advanced technological field and India has made considerable progress in developing the required know-how. Prevention of wastage by using the technology is now acknowledged to be a sound technique of growing more food like other techniques of using better seed, fertilizer etc. Conventional thinking in respect of losses and these being natural needs to be abandoned early.

BULK STORAGE OF FOODGRAINS

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All round emphasis on agricultural programmes in recent years has resulted in the " Green revolution " in the country and the problem of storage has simultaneously assumed huge proportions. Storage of food grains is important in times of bumper crops as well as during lean periods and is considered essential for many reasons. Grain is needed for consumption between two consecutive harvests. Some grain is needed for seed purposes. In case of paddy, storage is found to improve the cooking quality. Buffered stocks are maintained by the Government to control the prices of foodgrains in the open market and to meet the demand of foodgrains during unexpected calamities like drought, floods and also wars. Therefore, storage of foodgrains is practiced all over the world.

Storage of food grains

In our country foodgrains are stored by farmers, traders, warehousing corporations, co-operatives, State and Central Government and Food Corporation of India. The storage period varies considerably ranging from a few days to a few years. The quantity stored, type of storage practised, care taken for preservation from losses also vary considerably. In our country, it is estimated that 60-70 percent of grain is stored at farmer level and only 30-40 percent is marketable surplus which is handled by traders and other agencies.

Foodgrains are stored either in bulk or in containers like jute bags. At the level of farmers in rural areas, the storage is mostly in bulk and some times in bags. They use various above - grounds structures made of baked & unbaked clay, matted bamboo strips, metal drums, ropes made of paddy straw different types of rooms etc. for grain storage in bulk. In some areas farmers store grain in underground dugouts also. Grain in bags is stored in rooms in their houses. Traders store the grain in bags in general.

After world war II various State Governments erected sheds known as Lahore sheds, M. B. sheds etc. for storage of foodgrains in bags. During recent years, Central Food Department, Warehousing Corporations, National Cooperative Development Corporation and Food Corporation of India constructed storage structures of different designs and capacities for storage of foodgrains in bags.

Bulk storage of foodgrains

For large scale storage of foodgrains in bulk, the Central Food Deptt. constructed the first silo with steel bins at Hapur in 1958 with a storage capacity of 10,000 tonnes. Later another silo with steel and concrete bins with a total capacity of 19,000 tonnes was constructed at Calcutta. A battery of circular shallow R. C. C. bins with capacities of 2,000 & 4,000 tonnes each were constructed at Kanpur, Bombay & Manmad. In the modern rice, mills, R. C. C. silos were constructed for storing paddy. Two metal flat (shallow) storage structures, with a capacity 2,500 tonnes each, were constructed at Hapur. These bulk storage structures are well equipped with temperature measuring devices, mechanical loading & unloading facilities and aeration equipment which are needed for easy handling and preservation of grain from spoilages. Different State Governments also constructed medium size bulk storage structures. Some are hexagonal in shape with hopper bottom and erected in a battery/honey comb shape with each bin having a capacity of about 33 tonnes of wheat. Some are partly above and partly under-ground structures, constructed in a battery/honey comb shape with each bin having a capacity of about 30-35 tonnes.

Advantages of bulkgrain storage

Storage of foodgrains in bulk has a number of advantages. The foodgrains like wheat are brought into the market mostly in bulk. Later inspection grading auctioning etc. are carried out when the grain is piled in heaps and it is bagged & transported after the sales transported transaction. Handling of grain in bulk at the market place can easily be mechanised. If bulk storage is adopted simultaneously it will be very convenient from the marketing angle.

Mechanisation of handling at storage places also is very easy when grain is handled in bulk than in bags. Maintenance of stocks free from insect infestation is easier and less expensive, when grain is stored in bulk. Bulk storage can easily be made rat and bird proof. Where land is expensive upright bulk grain storage is advantageous in that 5-6 times more quantities of grain can be stored than in bag storage per unit area of land. Bag storage requires use of jute bags which is an additional expenditure. Stocking of bags, 15-20 bags high, requires skilled labour which is becoming rather expensive and some times difficult to get. Therefore, bulk storage is considered advantageous from many angles and inevitable in future in our country.

Handling and transportation of bulk grain

Bulk grain is free flowing in nature and settles in a heap with an angle of repose characteristic of the grain and depending upon its moisture content and percent of foreign matter in it. Bulk grain is handled just like any granular material using hand or power shovels, and moved from place to place using elevators, belt conveyors, chain conveyors, screw conveyors and pneumatic equipment.

Belt conveyors produce a lot of dust in the atmosphere and it is necessary to use efficient aspiration system along with them. SKT chain conveyors are used for moving grain vertically as in unloading of ships. BKT chain conveyors are used for movement of grain either in an inclined or horizonal planes. The horse power requirements of chain conveyors depends upon the material to be conveyed, chain design and weight, capacity to be handled, length of conveyor and speed. Chain conveyor may work out to be cheaper than belt conveyor, if installation, building aspiration system needed for belt conveyors are also taken into account alongwith cost of the conveying equipment. Pneumatic conveyors take much more power than chain conveyors but they are flexible and can be used where no other conveying system can be installed.

In circular bins of about 50-100 tonnes capacity sweep augers and air sweep flours are used for emptying the bins.

Transportation of bulk grain is done using special type of rail-wagons, trucks, barges and ships.

Problems of storage of grain in bulk

The problems of storage vary with the quantity of grain stored and also type of grain, moisture content and dockage present in the grain and type of storage structure used. All common stored grain pests are found to attack bulk grain. The insect infestation in large bulks may result in hot spots and the heating is known as dry heating. The temperatures may rise upt 40–43°C due to dry heating in some pockets in the grain mass.

Bulk grain does not attain the temperature of the surroundings quickly as the grain is a bad conductor of heat when there is a fluctuation of temperature both diurnal and seasonal in the surroundings, convection currents in air are set in the grain. This effect is more pronounced in metal storage structures than in R. C. C. structures. Due to these convection currents, on the top surface and sides, the moisture content of the grain can increase more than 15% even though the average moisture content of the grain may be much below this level. A moisture content of 15% and above in cereals is favourable for the growth of micro-organisms. There is mould growth and caking in those places where the moisture content has increased, resulting in hot spots. This heating is known as wet heating. Wet heating also can take place as a consequence of dry heating. The temperatures may rice upto 60°–63°B due to wet heating in some pockets in the grain mass.

Control of insects in bulk grain stored indoors at the farm level is carried out using EDB ampoules. Control of insects in out-door storage structures at the farm level or in large bulk storage, is carried out using Aluminium Phosphide tablets. For fumigation, the tablets are introduced into the grain stream at a preseribed dosage before falling into the silo bins. The tablets can also be introduced in the case of shallow storage bins using applicators. This fumigant is very effective in controlling infestation by all stored product insects.

Moisture migration in bulk grain can be prevented by aeration at an appropriate time. Aeration can also be used for cooling bulk grain and it can easily be adopted for re-circulation of fumigant in the grain mass. Depending upon the relative humidity and the temperature of the atmosphere outside and the temperature and moisture content of the grain, aeration schedule is marked out.

Conclusion

Experience gained all over the world indicate that storage of grain in bulk has a number of advantages and is economical in the long run. The merits of bulk storage are well recognised in other countries and most of the grain is stored in bulk either in elevators or in flat storage structures. To facilitate storage in bulk, other complementry facilities, like bulk transport and handling are fully developed in these countries. In our country bulk grain storage with the trade, Govt. and their agencies is not more than 2-3 percent of the total at present. In future, bulk storage will inevitably take the place of bag storage atleast where large scale handling & storage are practiced in view of many decided advantages.

However, there are some problems at present in adopting bulk storage on a larger and wide scale. Facilities for transportation of bulk grain by rail have to be provided all over the country. Production of less nnmber of varieties of different food grains and grouping of varieties of one grain on their physico-chemical characteristics etc. are necessary to reduce the number of varieties to be handled and stored to the minimum. If larger bins are not kept filled, it will be un-ecomomical for storage and operation. Also construction of a number of smaller bins to store many varieties in smaller quantities will again be not economical.

Hopper bottom bins are convenient for operation, but cost of construction will be about 15–20 percent more than flat bottom bins and also have less of storage capacity. In general, if the bins have to be emptied more than four times a year, hopper bottom design proves more economical. There is a difference in the cost of construction of metal and concrete bins. In case of metal bins the erection will be low and also erection will be easier than cement bins. On the other hand, the availability of steel and its cost have to be considered in addition to maintenance costs. A battery of RCC bins will provide additional storage place in the form of star bins, which is not the case in a battery of metal bins.

With more and more of production in the country, marketable surplus will increase and marketing methods will have to change. Simultaneously handling, transportation and storage methods also have to change to cope up with increased marketable surplus. A judicial selection of places for storage and buffer reserves, an effort for adopting bulk storage of grain in general selection of type and capacity of storage bins and simultaneous development of bulk handling and transport of grain, will go a long way in solving many future problems of grain handling & storage in the country.

ROLL OF SMALL FARMERS' DEVELOPMENT AGENCY IN PRODUCTIVITY

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The Green Revolution will have no meaning if the small farmer is not made viable. The over dependance of the small farmer on cereals and specially of the conventional type has been his bane throughout the ages. Innovations should aim at improving the Socio-Economic status of the small farmers who are the backbone of a developing country like India. In this article the author pinpoints the difficulties of the small farmer and has suggested some ways of overcoming it.

The Small Farmers' Development Agency has been set up with a view to increase productivity in general with particular reference to cereals. The Agency set up in South Arcot, Tirunelveli and Madurai has each a total allotment of 1·60 crores. When the schemes are fully implemented as per the production plans, there will be substantial increase in the availability of rice and millets.

In the context of the present day production leap in agriculture, one should not lose sight of the significance of the human factor. Agro-technological changes with their sweeping and far-reaching implication should take note of the sectors of the society which are to carry through the burdens of changes without creating imbalances. All these innovations and inventions should aim at improving the socio-economic status of the small farmers who are the backbones of the developing country like India. Hence, any programme which overlooks the small farmers will miss the core of the problem. Many countries have adopted different systems of agricultural pattern like U. S. A., Australia and Newzealand depending more and more on large scale holdings and utilising less and less of human labour. In a country like India which is predominantly agricultural, the genesis of the revolution will have to be located in the small farmer as the small holding will have to play a predominant role in our economy.

In Tamil Nadu alone there are 47 lakh farmers cultivatirg a total extent of 150 lakh acres and the net price of land available for effective cultivation will be approximately 3·2 acres. Agriculture by its peculiar nature of operations can be made a profitable venture if only there is a personal and individual attention and this could be ensured only by a farmer having a limited holding. It is not the intention that a small farmer will have an upper ceiling in income considering the present day price level. It should be our endeavour to ensure that even the small farmer utilises the full benefits of the land, and water potential and maximises his income by adopting mixed forming practices. By the concept of small farming, therefore, we consider an individual utilising the land for production not only of cereals but also for production of milk and meat, eggs and poultry, swine and sheep. Such an integrated, interrelated approach is the basic concept of Small Farmers' Development Agency which has been established in a number of districts in the country.

II. Small Farners' Development Agencies which are independent institutions intended to workout programmes of development of small farmers and also execute number of schemes for their welfare, have been established in SouthArcot, Madurai and Tirunelveli as for as Tamil Nadu is concerned. Under the development programmes of the past Plan-periods, while the progressive and viable farmers took full advantage of the various facilities made available, the small farmers could not derive any substantial benefit since many road-blocks such as non-availability of adequate and timely credit, inadequacy of marketing and warehouse facilities and absence of custom service, confronted them on their way to progress. The approach under the Small Farmers' Development Agencies Scheme is to correct these inadequacies and take effective measures to ensure that the benefits of full scale development schemes percolate down to the weaker section of farmers. Here, it is necessary at once to clarify that the Small Farmers' Development Agency Scheme is intended to cover only "potentially viable" farmers, that is to say, such small farmers who can be helped to became economically viable by providing special and specific facilities. The Agency will be studying how far the special incentives go to meet the objectives.

With regard to the definition of small farmer, it is baffling proposition as to whether we should merely go by the acerage or by the total income. A farmer with a limited holdings, concentrating on commercial crops may get substantial income than the farmer who may concentrate on minor millets. However, as a working. proposition, it has been decided to define the small farmer as one whose holdings are between 2 and 3 acres of wet land or between 3 and 5 acres of dry land. Tenant cultivators are also included under the scheme.

Finance

The Agency is not to extend credit from its own funds. It, however, acts as a catalyst and endeavours to promote a systematic flow, on a slightly more liberal pattern than elsewhere, of short-term, medium-term and long-term cooperative credit from primary societies, Central Banks and Land Development Banks and also, where necessary, credit from commercial banks, to the eligible cultivators, Besides doing this very important co-ordination work the Agency provides, in a judicious manner, from its own funds, subsidies to the small farmers for various purposes and also outright grants to the cooperatives to cover risks. On loans for capital items, the subsidy is as high as 25%. The total cash outgo from the funds of the Small Farmers' Development Agency in each district it about Rs. 160 lakhs. Purposewise classification of this amount is given in Table 'A' appended. But, at the same time, Table 'B' will throw in bold relief the multiplier effect this small amount would produce, by making available a total volume of credit amounting to about Rs. 2,300 lakhs from different agencies.

Activities

A perusal of Tables *A* & *B* would have given a rough idea of the different programmes undertaken under the scheme. The small farmers are assisted in relation to specific requirements like irrigation, land improvement and soil conservation and provided with technical know-how for introducing new cropping patterns and stepping up per-acre yields by taking to modern methods. Adequate custom services are also made available to him for important agricultural operations, chiefly, land preparation, manuring, harvesting etc., through the State Agricultural Department and the Agro-Industries Corporation. As already referred to, the strategy in respect of food crops is the use of high yielding varieties. Special attention is devoted to cereals production In paddy, ADT 27, Co. 29, IR 8 IR 5, Jaya, Padma etc. are popularized according to the suitability of the lands and the seasons. H.B. 1 and H.B. 3 cumbu strains are recommended for sowing under irrigated canditions or as rainfed crops. Deccan maize is popularized to be grown in rotation in red well-drained soils. In Tirunelveli, ragi and cholam are also popularised. The cash crops to be encouraged will be sugarcane and groundnut. Some aid for laying rural roads and extending the link roads will not help the small farmers to cross the barrier fully, they are encouraged to take to subsidiary occupations, like dairy development and poultry and sheep breeding.

For implementing the schemes at the field, a separate Agency has been created in each district with the Collector as the Chairman. These Agencies have been registered under the Registration of Societies Act. They receive funds direct from the Government of India. A Project Officer of the grade of Joint Director of Agriculture working under the Collector, is in charge of the scheme in each of the three districts.

It will be seen that an Agency like this created with independent powers and separate project of its own is an experiment at Institutional Farm Development with Government of India directly assisting a district agency. As an experimental measure, it is worth bold implementation. The success of the Agency depends upon locating all the small farmers in a village cataloguing their requirements, preparing credit plans for them and quickly and imaginatively sanctioning loans at the appropriate time. This calls for coordinated and integrated approach from the district developmental authorities as well as credit institutions. It is a tool to help the small farmer who otherwise is not in a position to get all the inputs for agricultural operations in time and hence will be looked upon in the future as a catalyst of revolutionary changes.

The risk fund contribution by the Agency to the Central Bank for the purpose of credit cover for the risk taken is a commendable venture. It is expected that the small farmer will be able to plan ahead and work out schemes for full utilisation of the land resources.

There are many benefits which are expected to flow out of this Small Farmers' Development Agency. With regard to the farmer—

(a) he will be in a position to adopt all the package of practices without hesitation as the credit flow will be steady, continuous and regular;

(b) he will be in a position to undertake capital development works like sinking of borewells, purchase of machinery, land levelling etc. as there will be specific provisions for the same;

(c) he will be helped to change from mono-cropping to multiple-cropping with the special assistance provided.

In fact mixed farming is the pattern for the future and sooner the farmer undertakes multiple-cropping, the better will be his economic status.

(d) As the Marketing Complex is proposed to be strengthened, the farmer will be assured of goods prices for his commodities.

(e) On account of Dairy Development, Poultry, Sheep Breeding Schemes, there will be better availability of nutritious food in the rural areas.

For the Community as a whole, the benefits will be—

(a) increased availability of vegetables, milk and meat;

(b) most of the banking and marketing institutions will be strengthened which will help them to undertake bold programmes of development in other areas also;

(c) continuous availability of grains at Market Centres at reasonable prices;

(d) Small Farmers Devt. Agency will set the pattern of credit and marketing and will be a factor in stabilising the prices;

(e) there will be better appreciation of the services of the rural artisans and village industries which are proposed to be helped with the assistance of S. F. D. A.

The Agency can definitely be looked upon as a factor in increasing productivity in general. As far as Tamil Nadu is concerned the total production of rice, millets, pulses is as follows:

	Rice	Millets	Pulses
	(in lakh tonnes)		
1968-69	36.59	13.45	1.02
1969-70	45.32	16.08	1.21
1970-71	53.03	16.03	1.65
1971-72 (Target)	54.00	17.00	2.00

It is seen that there has been a substantial increase in production;

but with the accelerated programme like S. F. D. A., there is bound to be increase in the production of rice, millets and pulses. It has been estimated that the per acre income to the farmer in respect of the following crops will be as follows :—

Paddy	Rs. 895
Groundnut	Rs. 450
Cumbu	Rs. 590
Ragi	Rs. 390

Even with two to four acres under multiple cropping, if a farmer is in a position to raise poultry and dairy, he will be in a position to earn substantially income comparable to that of a small scale industry. The success of the Programme lies in integrating all these activities and placing them on proper and scientific lines.

Japan and Taiwan have been able to register substantial increase in the per acre production though the holdings are small. India has necessarily to look to such countries instead of countries like United States and Canada where large scale holding is a pattern of cultivation. Even with reduced holdings, but with intensified efforts, it is possible to double the income of the farmers by increasing productivity. Such individual farm plans suited to the requirements and the needs of the small farmer should be prepared for a number of areas on the pattern of Intensive Agricultural District Programme. Making a small farmer viable is the joint responsibility to be shared by Government Agencies as well as various enterprises in the non-Governmental sectors. There is a good scope for voluntary agencies like Farmers' Forums, Tonnage Clubs and various other voluntary agencies to actively associate themselves in such programmes right from the inception and focus the problems which require immediate attention.

TABLE - A

CASH OUTGO FROM SMALL FARMERS DEVELOPMENT AGENCY

		(Rs. in lakhs)
(1)	Risk Fund for Well Sinking	21·380
(1a)	Subsidy for Well Sinking	94·125
(2)	Risk Fund for S. T. M. T. & L. T. Loans	136·590
(3)	Demonstrations, cashew cultivation orchard etc.	4·13
(4)	Subsidy for land reclamation implements etc.	20·75
(5)	Risk fund on Dairy Development	8·460
(5a)	Subsidy for Dairy Development	19·660
(6)	Risk fund for sheep breeding and Poultry Development	1·672
(6a)	Subsidy do do	18·002
(7)	Custom Service	23·00
(8)	Communications	3·00
(9)	Subsidy for contruction of godowns	15·51
(10)	Interest rebate for marketing	2·50
(11)	Cost on Project Staff	6·06
(12)	Managerial Subsidy for Coop. Credit Structure	16·189
(13)	Member, Education Programme and Training of village artisans	10·46
	Total Rs.	489·18
	or Rs. 489 lakhs	

TABLE - B

TOTAL VOLUME OF CREDIT GENERATED

Purpose	SFDA S. Arcot Dist.	SFDA Madurai
	Loan amount (Rs. in lakhs)	
Loans for Well sinking/deepening	225·00	142·50
Loans for electric motor	105·00	75·00
Loans for Land levelling	...	65·00
Medium term loans	10·00	18·00
Short term loans	1,805·50	1,677·00
Loans for Dairy Development	102·00	30·00
Loans for cashew cultivation and orchard	...	30·90
Loans for Poultry Development	1·20	1.20
Loans for Sheep breeding	...	10·50
Loans for construction of godowns	16·25	...
	2,264·95	2,050·00

RICE–ITS ORIGIN AND USE

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Rice forms the princip alfood of more than half of the human race. During his history man has used atleast 3,000 species of plants for food. Rice which is the oldest among these still enjoys the position of being the major plant species that feeds more than half the world's population. Rice has been in existence in China, India, Jawa and Africa long before the era for which historic evidance became available. In India rice has been under cultivation for more than 5,000 years.

Decandele was of the view that India might be the original home of rice. According to Watt, the chief habitat of rice is to be found in South India from where it could have spread to Indo-China. Vavicov, the Russian scientist, records in his expeditions that South West Asia might be the centre of origin of cultivated rice. The wealth of forms and varieties found in the South West Himalayas and in other neighbouring countries indicates the probability of the South or South East Asian countries as the centres of origin of rice. In many languages of South East Asian countries, agriculture and rice or food and rice are synonymous indicating prosperity. In ancient Chinese work, it is recorded that the sowing of rice is an important cermony nearly 5,000 years ago in China and that the emperor alone enjoyed the privelege of owning rice, the less important cereals being left over the less exalted members of the family. There are records to show that rice was grown in Jawa as far back 1,084 B. C. Susruta (1,000 B. C.) in his ayurvedic materia madica recognised the differences among rices existing then in India. Ancient Hindu scriputres and literature bear ample evidence to the fact that in India rice is the chief offering to God. The Indian food offered as " Sraddhos " since vedic times is rice soup and honey. In Upanishad, rice is referred to as one of the ten kinds of cultivated seeds. Magasthenes (315 BC), the Greek ambassador from Selukas to the court of Chandragupta Maurya, has mentioned the sowing of rice in his account. In Kautalya Artha-shastra, Vishnugupta, the minister of the Great Mauriyan king Chandragupta refers to the names of two varieties of rice namely ' Sali ' and ' Vrishi '. Rice has been mentioned in Manusmriti (200 BC), Markandeya Purans, Vishnu Purana, Purananuru etc. A type of rice with red kernal under the name 'Senneal' appears to have been the predominent variety under cultivation in Tamil Nadu during the Chola deriod. (Seventh Century).

The use of rice in all the social customs, festivals and Hindu religious ceremonies connected with birth, marriage or funeral, reveals its intimate association with the life of the Indian people. The custom of throwing rice upon newly married couple as a blessing is quite common in many Asian countries even today.

There is reference to paddy crop cultivation under irrigation in China in the book of poetry supposed to have been written in Chinese in about 781-771 B. C. In Ceylon rice has been grown from time immemrial. Till about 543 B. C. it was grown rainfed. The earliest references to tanks to conserve water for irrigating rice was in 420 B. C.

In Phillipines rice cultivation is of great antiquity the crop was introduced in Japan from China in about 100 B. C. In Philippines native life was largely organised around production of rice and there is a belief among the native folk that if the success of rice could be accured by ceremonial means, other crops will a utomatically take care of themselves.

No reference to rice is found in ancient Egyptian tombs or writings. There is no mention of rice in Bible. The Greek historian Diodore of Sicily describes the plant and its cultivation from reports made to him by Aristotle who took part in the expeditions of Alexander the Great to India between 344–324 B. C. Rice was, therefore, known to Romans and its cultivation should have existed in Sicily even in very early times.

Records show that during Roman Empire rice was imported and appeared in the Roman market as a cheap product recommended by Greek doctors as a readily digestible food. Rice was introduced in the Nile delta by Arabs, in Madagascar by Malayas, in East Africa Islands by Indians, by the Moors to Spain, by Spaniards to Italy and by the Turks to South East Europe. The Portugese introduced rice into Brazil and by Spaniards to America and South America. Hawaii knew about rice in 1853 A. D., The French took it into New Guledonia and Germans to New Chinea. Farmers of New South Wales grew it under rainfed conditions as early as 1891. In Australia, its cultivation as a commercial crop started in 1924.

In Malay Peninsula, precautions are taken to ensure the well being and prosperity of the rice sown upon which the success of cultivation depends. Prayers are offered before sowing, planting and harvesting of the rice crop. A new born Malay baby is laid at birth on a platter of parched rice; on the 40th day he is taken to a river bank and parched rice, dyed with turmeric is sprinked on the river water and several packets of cooked rice are offered to the spirits.

At circumcision, a boy is sprinkled with parched and dyed rice and given boiled glutinous rice coloured yellow with turmeric to eat while he is by way of ceremony rubbed with two coconuts and two small packets of rice. On the occasion of the marriages, rice is applied to the foreheads and hand of the betrothed. Building of a new house, launching of a new boat, planting of rice and new ventures of any kind demand ceremonies in which rice is used. In Thailand rice has a lucky character and plays an important of part in all domestic and official ceremony. The Goddess " Ceres " presides at the sprouting of cereals and children are taught to revere her before meals.

The first successful introduction of rice culture into USA was made in 1685. A ship sailing from Madagascar suffered heavy damage on a storm and sailed into the port of Charleston, South Carolina for repairs. The captive of this ship gave a small quantity of paddy seed to a local planter as gift and this became the famous ' Carolina ' rice which represented the standard of high quality rice throughout the world.

Consumers of rice vary in their preference for different types of rice. In USA, preference is for the long grain types. Chineses like long rice while Japanese preference is in the method of consumption. The Scandinavian countries consume rice mostly in the form of sweetened deserts. In parts of India, red rice is considered more nutritious than the white grain rice. Some people prefer purple grained rice. In Burma certain mountaneous varieties of rice are considered specially tasty and more nutritious than the ordinary varieties under cultivation. A quantity of raw rice is thrust into the joints of small gamboos, a little water added and the crifice is closed. It is then roasted and eaten with a little butter and salt and it is most delicious. Among certain South American hilly tribles, there is a preference to musty rice. The preference to varieties differs according to the customs rice is preferred to parboiled rice in certain locations while among certain classes of people it is consumed only in the form of parboiled rice. Parboiled rice is more nutritious than raw rice and is also utilised for breakfast preparations like Dosai. Iddlies, Idiappam etc. A few varieties are reputed for their excellent quality and they are specially suited for particular type of preparations made out of rice. The quality of rice required for making puffed rice, popped rice and beaten rice is quite different from that of the variety used for ' Puttu ' In the case of varieties used for making ' Briyani ' those with aroma and taste even among the scented varieties. Varieties like Basumathi, Jeeragasamba, Rascadam, Rajabhogum Sugadas, Black Puttu, White puttu etc. fetch better prices in the market as they are particularly suited for specific preparations to suit the differing tastes of the people.

In addition to the ordinary food and feed uses of rice and its byreproducts certain types of broken rice are utilised widely in the manufacuture of specialised alcoholic beverages and drinks. There is historical evidence to show that a kind of beer, prepared from rice has been in use throughout India. The term 'Sura' frequently mentioned in the Institutes of Manu about 2,000 years ago, refers to the spirit prepared from rice. The Portugese soldiers in India were reported to have liked the fermented drink prepared from rice in place of the imported wine of their own country. In an appeal to the king of Portugal, the chief of the army reported that if steps were not taken to check the acquired form of intoxication, the army would be completely demoralised. It was reported by Britishers that people of India had not only known and practised the art of distillation from time immemorial but their apparatus appeared to be so simple that no fiscal regulation, however stringent, could completely control or prohibit the rural production and consumption of the intoxicating drinks. In addition to beer, rice is also utilised for the preparation of wine and spirit in Jawa where the rice is boiled and stirred with "Razi" which consists of onions, black pepper and capsicom. The resultant liquid is allowed to remain exposed in open tubs until formentation takes place. Then it is poured in earthern vessels and buried for several months. In Thai, rice is cooked without water or steam and condiments consisting of ginger and other spices are sprinkled over and the mixture is wrapped in Banana leaves. In 24 hours after wrapping, a sweet liquid exudes which is collected, reserved and used as a drink. Broken rice is widely used in the manufacture of specialised alcoholic drinks. "Sake" is a beer of wide spread consumption in Japan and is made exclusively from broken rice. In China, much of the broken rice goes to the brewery for the manufacture of wine, known as 'Shemshu'. This colourless mild wine is a standard drink in many of the Chinese upper class homes where it is usually served after slight heating in the noon and evening meal. The Chinese also prepare the 'Mandarine Wine' which keeps good for many years. Some of the rice wines are also perfumed. In South East Asia, a distilled liquor known as "Rice Whisky" is produced in great quantities and it is prepared out of broken rice. The finer beers of "Brewers rice" is used for broken rice.

Besides its use as food for consumption, drinks and beverages, the by-products of rice are put to several uses also. Rice oil obtained through a solvent process is used mostly in the manufacture of margarine and soap. The rice glue or the Japanese cement is made by mixing rice flour with cold water and boiling the mixture. In Japan, the rice straw supplies the basic raw material for rural industries and for making ropes, rings, baskets, shoes, hats, raincoats and building materials such as room partitions etc.

Though rice is mostly used as food for consumption, in some countries, it is used in the manufacture of starch, beer, wine and other alcoholic beverages. Over boiled rice is used for starching cloth. Rice powder is used as a cosmetic. An alcoholic beverage known as "Saki" is the national drink in Japan and it is prepared from fermented rice.

Certain cultures of fungi turn the starch of the rice grain into glucose. Yeasts convert glucose into alcohol. Generally, glutinous varieties are considered to be better suited for the manufacture of Rice Wine. In India, the entire rice produced is used for consumption as food in different forms and very little goes for industrial purposes. Rice production in the country is still short of its requirements and the deficit is covered with imports from other countries.

The introduction of improved plant types that do not lodge and that respond to fertilisers created a revolutionary change in the type of varieties grown in India. The utilisation of the dwarf *indica* varieties like T(N) 1, IR 8, as donor parents for improving the plant type of the tall indica varieties proved to be a phenomenal success and it resulted in the development of improved new varieties capable of giving yields exceeding 12 tonnes of grain per hectare as against the normal yield of 3 tonnes per hectare recorded by the traditional local varieties under cultivation. With the spread of high yielding varieties in larger areas, it is hoped that the food deficit in our country will soon be wiped out and that India would reach a comfortable situation with regard to its food requirements.

As the possibility of a surplus production of rice in Asian countries is in sight, it is time to think of intensifying research not only on the development to high quality rice varieties with higher nutritive value but also on the scope for the utilisation of rice and rice products for industrial purposes.

BHARAT KRISHAK SAMAJ

(FARMERS' FORUM, INDIA)

Dr. D. A. BHOLAY

Secretary General,
Bharat Krishak Samaj

Why Farm Organization?

Once inaugurating the rally of farmers our late Prime Minister Shri Jawaharlal Nehru said that "*A stable agricultural economy depended on two things. First of all there must be more and more production and secondly there should be proper organisation of agriculturists*". There is great necessity for more knowledge and education among the farmers. Our Samaj with its constructive approach and non-agitational character is playing not a mean role in the great task of providing enlightenment to the farmers which is extremely essential for strengthening the unity of the country and making prosperous, through greater productivity. Increased production as a sound base for increased personal income is the primary and fundamental objective of our organization, founded by the late Punjab Rao Deshmukh in the early fifties of this century.

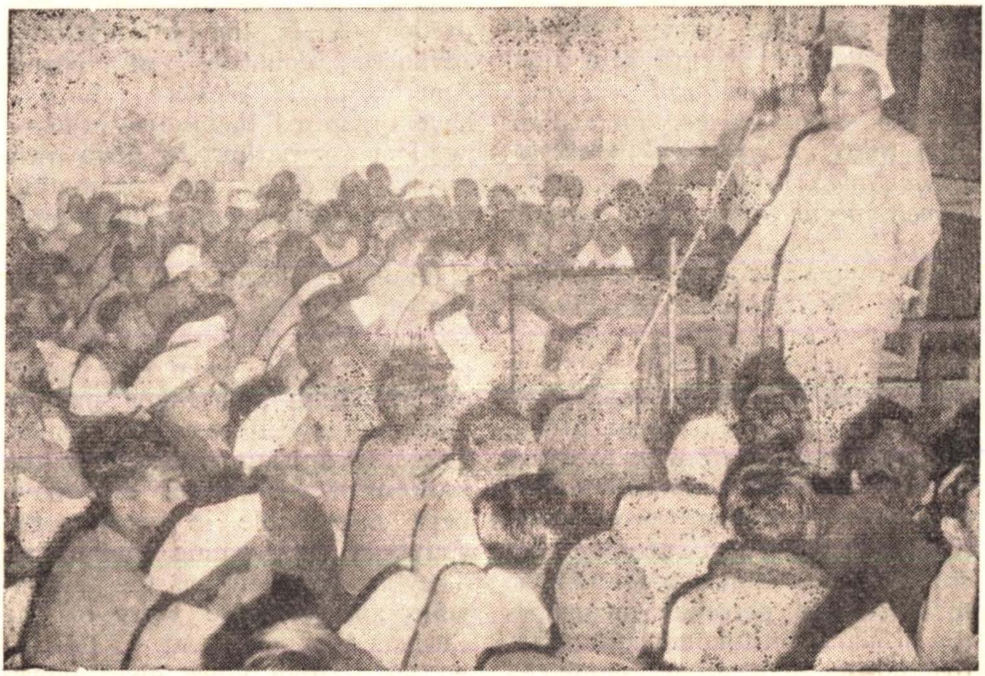
The idea of farmers' organization is not new. Millions of farmers all over the world, and particularly in the agriculturally advanced countries of North America and Western Europe, have organised themselves in independent associations of their own for safeguarding and promoting their mutual interests. They represent broad cross-sections of the opinions of farmers of their respective countries and on this account their leaders are listened to with respect when they speak on legislation and other matters affecting the welfare of the farmer. These organizations fight for the interest of the farmer and have been responsible in raising the status of the farming community. They are considered as the responsible and effective voice of the farmers they represent. The united and strong voice gives considerable scope and weight to their actions which may otherwise receive scant attention. Moreover, such organizations of farmers tend to give them a feeling of belonging to a large community whose problems and aspirations are entirely their own and this results in the most efficient contribution to the overall economic development of their country.

Birth of Bharat Krishak Samaj

In India the need for a strong representative organization of the farmers was felt since long, realizing the miserable economic and social condition of our farmers who form about 80 per cent of the country's population. In spite of this fact, and that about 50 per cent of the national income is from agriculture and allied vocations, agriculture remained the only major industry in the eountry without any organization.

It was realized that without an organization of farmers themselves it would never be possible to reach individually the millions of farmers in the country. It was, therefore, necessary to have a farmers' organization which could solve not only the individual problems of farming but also the collective problems of the farming community and also of the country in a steady and constructive manner.

The necessity for such an organization was particularly felt after the launching of the First Five-Year Plan and it has now become indispensable, when there is all round demand to step up agricultural production. Efforts, such as the setting up of the community projects and National Extension Service, were initiated with the sole aim of winning the confidence of the farmers and



The Founder President with his workers

The Founder President with his lieutenants

securing their co-operation for success of the various schemes. It was at this juncture that the well-wishers of the farmers thought that an earlier and a fuller success in these efforts could be ensured if the official attempts were blended suitably with non-official efforts by the farmers themselves, so that the much needed two-way traffic could be established between the Government and the farmer. It was realized by every body that the one-way traffic which had been existing till recently from the Government to the farmer was not the correct approach and was not expected to achieve the goal within the desired period.

The decision to establish such an organization of farmers was, therefore, taken at a meeting of the State Ministers of Agriculture, Co-operation and Animal Husbandry held in July 1954, in Srinagar (Jammu & Kashmir).

Thus, the seed of the Bharat Krishak Samaj was first sown. The late Dr. Panjabrao S. Deshmukh, the Union Mimister of Agriculture, was unanimously requested to be its first Founder President. A Constitution for the Samaj was formed and the Samaj registered on February 7, 1955 under the Societies' Registration Act XXI of 1860 and on April 3, 1955, the first National Convention of Farmers was held in New Delhi, which was inaugurated by the late Prime Minister, Shri Jawaharlal Nehru. This is briefly the history of the origin of the Bharat Krishak Samaj.

A farmers' organization is a must in every country especially in democratic countries to safeguard the interests of the farming community, to voice their aspirations and to find solutions for their problems.

In India, where 80% of the population are concerned with farming and 50% of the national income is from agriculture, the need for such an organization was all the more necessary. Bharat Krishak Samaj filled this long felt need.

The State Ministers of Agriculture, Co-operation, Animal Husbandry, who met in Srinagar in 1954 decided its form and shape and Dr. P. S. Deshmukh, its First Founder President, built it up. It was registered on 7-2-55 under the Societies Registeration Act XXI of 1860 and held its first National Convention of Farmers in New Delhi on April 3, 1955, which was inaugurated by the late Pandit Jawaharlal Nehru.

The birth of Bharat Krishak Samaj has been hailed in all quarters in the country. It has created a very healthy enthusiasm among the farmers, who are eager to take an active part in the activities of the Samaj as they feel that it will help them to safeguard their interests and promote their economic welfare. Very encouraging reports are being received from all the States, where branches of the Samaj have been established and letters are constantly received in the central office from eager farmers who are keen to play an active role in promoting its activities.

Dr. Rajendra Prasad, the then President of the Indian Republic addressing the farmer delegates of the National Convention held in Talkatora Gardens, New Delhi

The late Jawaharlal Nehru addressing farmers during the first National Convention of Indian Farmers

Stability of the Samaj

At the beginning, the Union Ministry of Food and Agriculture liberally helped the Samaj monitarily and in other ways also for which the Samaj will ever remain grateful to them. This help, the Ministry gradually withdrew. For the last seven or eight years the Samaj has not even asked for any help from Government or anyone else. The financial position of the Samaj is sound. The two funds created by the Samaj in 1960, viz. Bharat Krishak Samaj Freedom From Hunger Fund of Rs. 5,83,137-40 being the balance of the gate money received by the World Agriculture Fair and the Bharat Krishak Samaj World Agriculture Fair Memorial Fund for Rs. 4 lakhs, have been combined into one to form a Trust Society called the World Agriculture Fair Memorial Farmers Welfare Trust Society. The Trust Society was registered in December 1963. Practically the whole amount has been invested in purchasing a building in New Delhi. Besides this building, the Samaj possesses three buildings, two in New Delhi, in one of which is located the central office of the Samaj. The third building is at Jalgaon in which is located the district Krishak Samaj office. The state branches are also making efforts to have their own buildings. Some of the State Branches get grant-in-aid from their respective State Governments.

Within less than three years of birth of the Samaj, branches of the Samaj were established in all the States including the Union territories of Delhi, Himachal pradesh, Tripura, Manipur and Goa. Steps are being taken to start branches in NEFA and Andaman and Nicobar Islands.

In most of the states the Samaj has branches even at district and taluka levels. Efforts are being made to open branches at block and village levels.

The membership of the Samaj is gradually increasing. The number of life members is over ten thousand and that of ordinary members about 4-5 lakhs. Statements of state-wise and year-wise enrolment of life members are given below. It will be seen from the former statement that the Maharashtra state Krishak Samaj has enrolled the highest nember of life members so far. Punjab stands second, Madhya Pradesh third, Haryana fourth and Tamil nadu fifth.

Statement of State-Wise Enrolment of Life Members Upto 31-12-1970

	Name of State	No. of life members enrolled
1.	Andhra Pradesh	224
2.	Assam	14
3.	Bihar	104
4.	Gujarat	302
5.	Jammu & Kashmir	25
6.	Kerala	216
7.	Madhya Pradesh	1,108
8.	Maharashtra	4,741
9.	Mysore	172
10.	Nagaland	1
11.	Orissa	452
12.	Punjab	1,405
13.	Haryana	1,007
14.	Himachal Pradesh	86
15.	Rajasthan	94
16.	Tamilnadu	608
17.	Uttar Pradesh	427
18.	West Bengal	56
19.	Chandigarh	4
20.	Delhi	70
21.	Goa	35
22.	Manipur	10
23.	Pondicherry	5
24.	Tripura	13
	Total	11,274

Statement of yearwise enrolment of life members

Year	No. of members enrolled
1954	2
1955	53
1956	412
1957	432
1958	677
1959	806
1960	3,361
1961	994
1962	488
1963	470
1964	396
1965	803
1966	533
1967—68	316
1968—69	723
1969—70	803
Total	11,274

Aims and Objects of the Samaj

The aims and objects of the Samaj are:

1. To study the problems facing the agricultural producers in India;

2. to protect, advance and promote the social, economic and cultural interests and activities of the agricultural producers, farm youth and farm women in this country;

3. to undertake propoganda, training and education of the farmers and co-operate with governmental and other agencies for the uplift and amelioration of the farming community and rapid progress of farming in India;

4. to assist in formulating and promoting national and international agricultural policies, in the interest of the agricultural producers and to collaborate and co-operate with similar organizations of agricultural producers in this country or abroad for the furtherence of the said objectives;

5. to take such steps for the fulfilment of the above as may be necessary from time to time, in particular collection and expenditure of funds, holding meeting, conferences, seminars and exhibitions, sending representations. deputations, memoranda etc., and exchanging delegations.

The Samaj is a non-political, non-sectarian association of the agricultural producers and all those who are interested in the promotion of their welfare.

Benefits of Becoming Life Member of the Bharat Krishak Samaj

For a small contribution of Rs. 110/- once in his/her life time, *the life member* of the Bharat Krishak Samaj gets the following concessions and facilities:

1. He/she is entitled to attend National Conventions of Farmers wherever they are held;

2. he/she can travel by rail to and from the place of Convention at half the cost;

3. once enrolled as a life member, he/she gets the monthly 'Krishak Samachar' as long as he/she lives without any payment, in English, Hindi, Marathi or Gurumukhi;

4. special facilities are provided for his/her benefits for visiting the National Agriculture Fairs which the Samaj has been holding in the different States every year;

5. for every group of 20 life members enrolled he/she is entitled to nominate one of them as a member of the All India Farmers Council of the Samaj;

6. a life member thus appointed on the Farmer's Council continues to function on that body for the Council's term of 3 years having the opportunity of attending the Council meetings twice a year in various parts of India without any travelling cost to himself/herself;

7. An enthusiastic, enlightened and active life member has

many opportunities of serving on various Councils and Committees of the Samaj or of the Government and other organizations;

8. he/she may be included amongst those selected for visiting different states in India and even foreign countries;

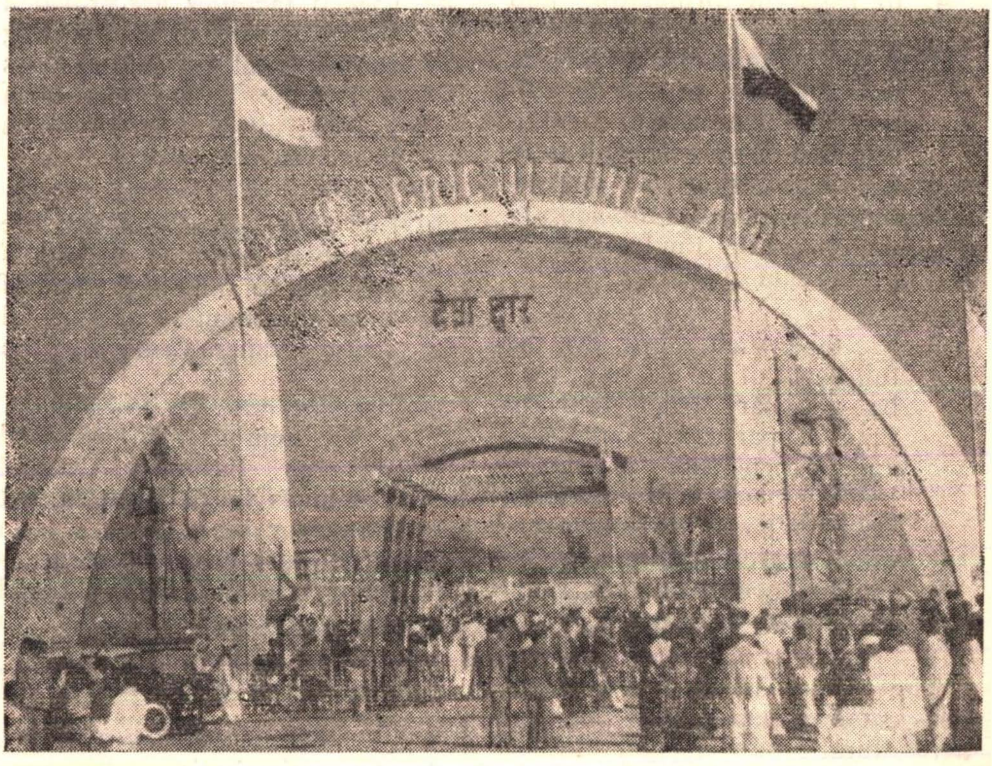
9. out of this small amount of Rs. 110/-, Rs. 25/-go to build up the State Organizations of the Samaj.

Governing Body

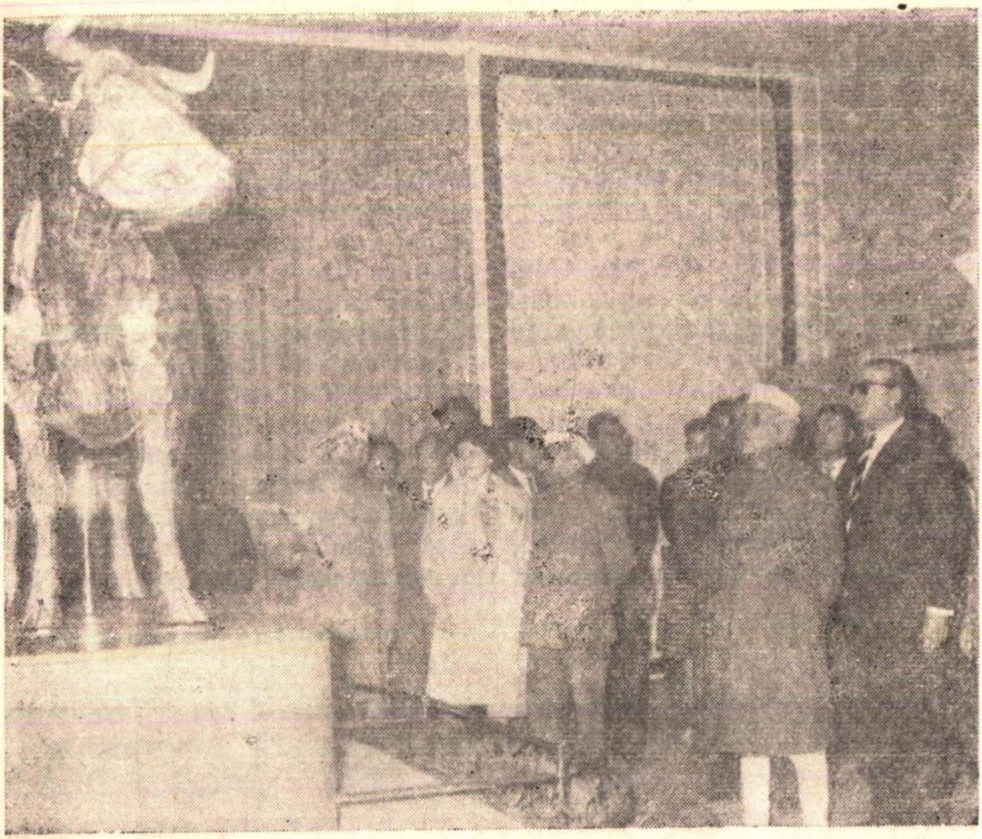
The Governing Body of the Samaj is the supreme administrative body and its decisions on all matters relating to the Samaj are final. The Governing Body is constituted by the President after his election by the All India Farmers' Council after every three years. It carries out the policies of the Samaj as directed by the All India Farmers' Council. Its strength is 51 including the President.

National Convention of Farmers

The National Convention of Farmers is a general meeting of farmers together with Government and other experts. The convention is held every year and farmer delegates from all over India participate in the function. The holding of



The impressive main gate of the first World Agriculture Fair



The late Prime Minister Shri Jawaharlal Nehru accompanied by our founder Prisident keenly interested in the glass cow in the Germen Democratic Republic pavilion in the World Agriculture Fair

such a Convention is authorised to the Samaj under Article 11 (Objects) - Object No. 4 of its Constitution. The main object of the Convention is to generate a general feeling of enthusiasm among farmers and to enable them to meet and discuss their problems and difficulties with their brothern from all over the country to make social and cultural contracts.

The Samaj has so far held Fourteen National Conventions of Farmers, seven having been held in Delhi, and one each in Mysore, Calcutta, Madras, Ahmedabad, Jaipur, Bombay and Gowhati.

The Conventions have been largely attended by farmers hailing from the remotest parts of India. This has been made possible mainly due to the generosity and thoughtfulness of the Railway Board in issuing railway concessions at single fare double journey rates. This enables the poorest of farmers to participate in the Conventions.

These Conventions have been inaugurated by eminent persons, like the President of India, the Prime Minister of India, Governors of States and Congress Presidents. The Conventions were also addressed by eminent authorities on agriculture, animal husbandry, co-operation, farm organization, etc.

In conjunctions with the Conventions, seminars on agricultural and allied subjects, acricultural and industrial exhibitions and trips to agriculturally important places have also been arranged. " The fifth National Agricultural Fair was held in April 1969 in Bombay" The sixth convention coincided with the World Agriculture Fair in 1960, and the 7th, 8th, 11th and 12th with the National Agriculture Fairs in Calcutta, Madras, Ahmedabad and Jaipur respectively.

All-India Farmers' Council

The All-India Farmers' Council is the policy making body of the Samaj and has a strength of 600 members drawn from life members of the Samaj, representatives of the states (one from each district), representatives of life members, representatives of other organizations (Boards, Commissions, etc.) agricultural experts, project and other officials etc. Its tenure is three years and it mee ts twice a year. The Council was constituted in pursuance of the resolution of

The late Dr. Punjabrao Deshmukh with the President, Dr. Radhakrishnan, the Prime Minister, the late Jawaharlal Nehru and Shri V. K. Krishna Menon, the then Union Minister for Defence at the World Agriculrure Fair the Governing Body of the Samaj adopted at its meeting held during the first National Convention of Farmers held in 1955. It was inaugutated by the late Prime Minister, Shri Jawaharlal Nehru. The present Council is the fourth one reconstituted in January, 1966.

The purpose of setting up the Couneil is to make available to the Governing Body of the Samaj from time to time the representative views of the farmers of India. Its meetings are business meetings and formal in nature. It helps in propogating the views and policies of the Samaj in all parts of the country and also to promote co-operation between the Samaj and the Government Departments.

The Council has so far held 24 meetings in the different parts of the country.

The Council meetings have been inaugarated and addressed by eminent persons. Exhibitions, Seminars, etc. were also held in conjunction with these meetings.

Standing Committee

The Standing Committee of the Samaj is a Committee of eleven members which is constituted by the President from among the members of the Governing body. It meets occasionally and looks after the day-to-day work of the Samaj.

The World Agriculture Fair

The idea of holding the first World Agriculture Fair was conceived of by the Samaj within a year or two of its birth, and the late Dr. Deshmnkh, president of the Samaj, mentioned it in his address requesting Shri A. P. Jain, then Union minister for Food and Agriculture, to open the Agricultural Exhibition which was organised on the occasion of the Second National Convention of Farmers in April 1956. Since then the Samaj had been working on lhe idea and it got the 'go ahead' signal when the All India Farmers' Council resolved in March, 1958, that the Fair should be held in New Delhi during the winter of 1959-60.

The world Agriculture Fair was inaugurated by the late Dr. Rajendra Prasad, then President of the Indian Union, on December 11, 1959, in the presence of Mr. Eisenhower, then president of the United States of America, and our revered late Prime Minister, Pandit Jawaharlal Nehru. The Fair remained open upto 29 February, 1960. Twelve foreign Governments participated in the Exhibition and had set up huge pavilions which were highly educative. The Foreign Sector comprised of the United States of America, Union of Soviet Socialist Republic, German Democratic Republic, People's Republic of Poland, Republic of Iraq, Iran, Afghanistan, Ceylon, Burma, Republic of Vietnam, People's Republic of China, Republic of Mangolia, Food and Agriculture Organization of the United Nations and the International Federarion of Agricultural Producers. The pavilions in the Foreign Sector told a tale of man's achievements in the laboratory and in the field.

The Indian participants in the Fair were the various divisions in the Union Ministry of Food and Agriculture, Animal Husbandry, Horticulture and Community Development of different States, the Central Commodity Committees, the Agriculture and Animal

Prize Distribution at the World Agriculture Fair

Husbandry Institutes, Commissions, Associations and business houses dealing in agricultural machinery, fertilizers, plant protection, chemicals equipment, etc. Their exhibits showed the latest developments in agriculture and allied sciences.

The Fair was essentially an exhibition of food and agriculture and brought home to Indian farmers through educative demonstrations how the battle on the food front was being waged and gradually won by farmers all over the world, and thus enabled them to equip themselves better to produce more of what are India's immediate needs of food and fibre.

The Fair, a pioneering venture seen by more than three million peopie from all parts of India and also by numerous people from several foreign countries, was adjudged as a remarkable achievement in the annals of the history of world agriculture. Amongst the dignitaries from foreign countries, besides the President of the Uuited States of America, who visited the Fair, were the President, the Prime Minister and the Minister for Agriculture of the German Democratic Republic, Prime Minister of Poland, Nepal, U. S. S. R., and Cambodia, Lady Mountbatten, Field Marshal Montgomery. They applauded the Bharat Krishak Samaj for conceiving and holding such a unique Fair for the first time in the history of world agriculture. The historic words of Eisenhower at the inauguration of the Fair are noteworthy :—

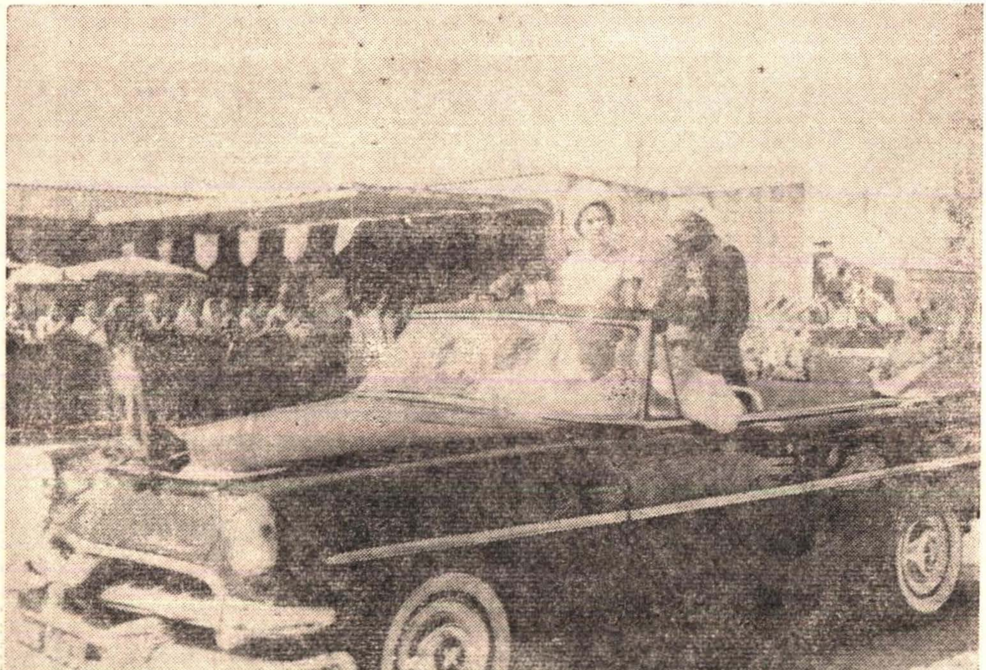
"I am singularly honoured by the invitation to join President Prasad at the opening of the World Agriculture Fair, the first such Fair ever held. And it is entirely right that it is held in India.

My couutry was quick to accept when invited to participate in this unique and historic event. And today, I am particularly honoured that India's Chief of the State will be with me when, in a few minutes, I officially open the United States Exhibit at the Fair."

National Agriculture Fairs

The success of the World Agriculture Fair also gave birth to the idea that it would be more useful if such exhibitions could be organised on a national level in various parts of the country. This idea was also stressed by the late Prime Minister Shri Nehru in his address to the conference of Ministers of Agriculture held in New Delhi in September, 1960. He felt that such exhibitions were so useful that they should be held even up to district level.

Encouraged by the success of the World Agriculture Fair and by suggestions from the late Prime Minister Shri Nehru and several others, the Samaj ventured to shoulder the responsibility of following up the World Agriculture Fair by holding an annual National Agriculture Fair in the



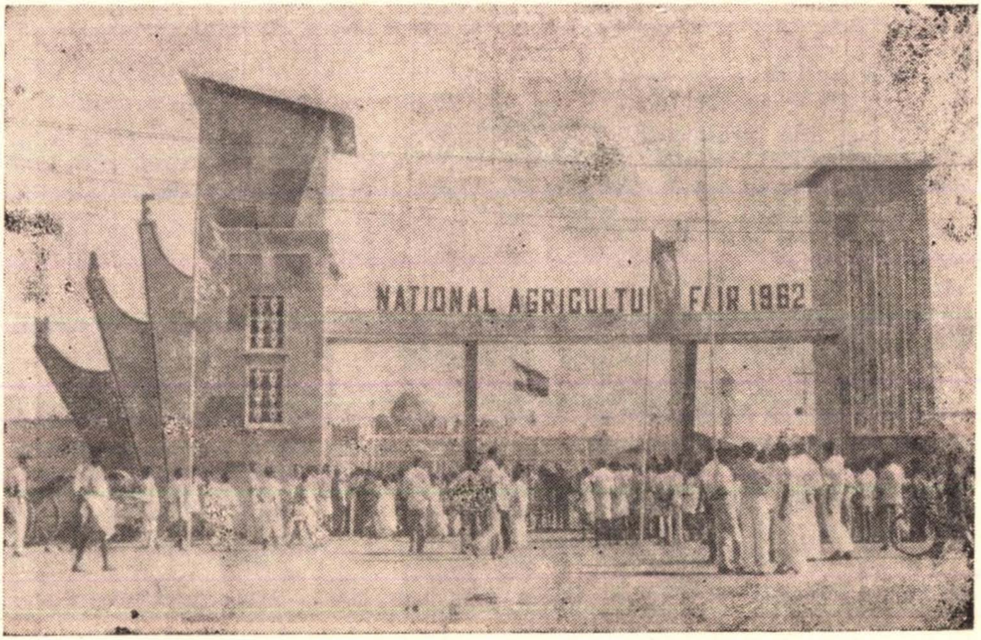
Her Majesty Queen Elizabeth and Dr. Punjabrao Deshmukh in the first National Agriculture Fair at Calcutta different parts of the country in rotation.

The First National Agriculture Fair

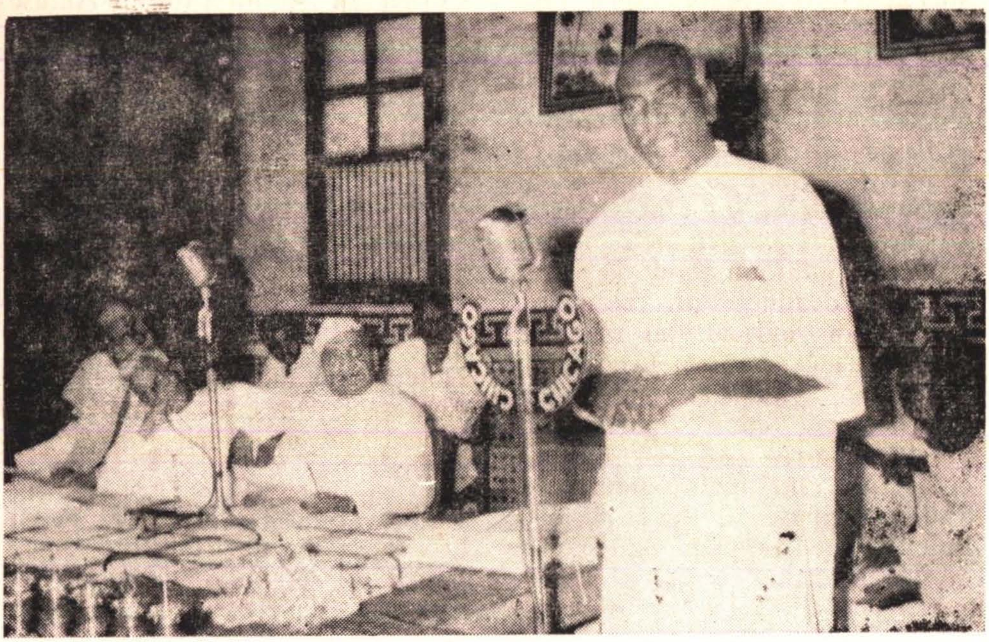
Thus, the First National Agriculture Fair was held in Calcutta in 1961 at the invitation of the Government of West Bengal. It was inaugurated by President Radhakrishnan, then Vice-President of India, on January 8, 1961. It closed on March 14, 1961. Nearly a million and a half of persons, including thousands of farmers from different parts of the country, visited the Fair. Covering an area of nearly 40 acres, the first National Agriculture Fair had the participation of three foreign countries, viz. the U. S. S. R., the Federal Republic of Germany and Japan, the Union Ministries of Food & Agriculture, Information and Broadcasting, Railways and Commerce and ten State Governments.

The Second National Agriculture Fair

The second National Agriculture Fair was organised at Madras. It was inaugurated by the then Governor of Madras, Shri Bishnuram Medi on January 14, 1962. It was a grand success. In many respects it was a greater success than the Calcutta Fair. Eleven States of the Indian Union, the Union Ministries of Food and Agriculture, Information and Broadcasting, Transport and Communication, Railways and Commerce participated in the Fair. This Fair also had the participation of two foreign Governments, viz. the United States of America and



The attractive main gate of the second National Agriculture Fair at Madras



Shri K. Kamaraj delivering his presidential address during the inauguration of the Second National Agriculture Fair

the Federal Republic of Germany. The Fair was praised by all sections of the public. The Press in Madras as well as in other parts of the country paid glowing tributes to the efforts of the Bharat Krishak Samaj. Nearly 16 lakhs of people, a considerable percentage of whom were farmers, visited the Fair. The Fair closed on March 11, 1962. The late Prime Minister Nehru was the patron of Fair.

The Third National Agriculture Lair

The Samaj had decided to hold the third National Agriculture Fair in Bombay in 1963 and had made all preliminary arrangements in that connection but due to the National Emergency the Samaj had to cancel the Fair.

The Third National Agriculture Fair was, however, held in Ahmedabad in January 1965. It was inaugurated by Shri Manubhai Shah, the then Union Minister of Commerce on 15 January, 1965 and closed on 15 March, 1965.

The Fourth National Agriculture Fair

The Fourth National Agriculture Fair was held in Jaipur in 1966. It was inaugurated by Shri Mohan Lal Sukhadia, the then Chief Minister of Rajasthan on November 14, 1966. The Fair closed on December 31, 1966.

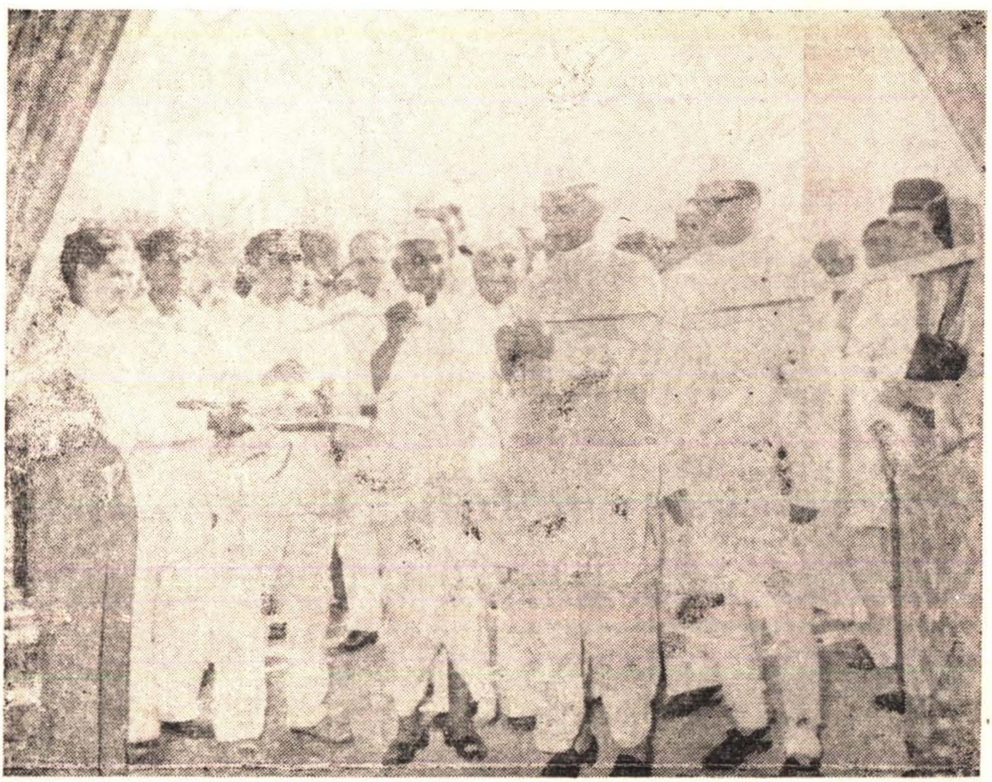
The Fifth National Agriculture Fair

The Samaj organised the 5th National Agriculture Fair at Bombay at the invitation of the Government of Maharashtra. The Fair was held during March-April 1969. It was expressed to be the biggest ever held fair in Bombay on a 90 acre plot of land in Mahim Creek area with an area of 4,50,000 sq. ft. as display area. Many State Governments and Ministries of the Central Government participated in the Fair. In addition about 60 private concerns dealing with the manufaeture of agricultural machineries, farm implements, plant protection chemicals, pesticides, insecticides etc., participated in the Fair. A few foreign embassies and high commissions also participated in the Fair. The Fair had a shopping and Eating Corner in addition to an Amusement Park.

The Samaj held the 13th National Convention and 22nd meeting of the All India Farmers Council at Bombay during the last week of April, 1969. The 14th National Convention of Farmers and the 24th All India Farmers Council was held at Gowhati, in April 1971.

Holding of the Eleventh General Conference of the International Federation of Agricultural Producers

The Bharat Krishak Samaj became a member of the Inter-



Chief guest of the evening Shri Morarji Desai opens the Agriculture Exhibition first before the inauguration of Council Meeting. The Exhibition was organized by Government of Gujarat

Fifth National Agricultural Fair at Bombay, inauguration by Shri Jagjivan Ram, the then Union Minister for food, Agriculture, Community Development and Co-operation

national Federation of Agricultural Producers in 1955, that is from the very first year of its existence. It made bold enough to invite the International Federation of Agricultural Producers to hold their Eleventh General Conference in New Delhi from 27 November to 5 December, 1959. The Conference was inaugurated on 27, November 1959 by the then President of India, late, Dr. Rajendra Prasad. He was welcomed on his arrival by Mr. James G. Patton, the then President of the International Federation of Agricultural Producers and President of the National Farmers' Union, U.S.A. The Conference was also addressed by the Prime Minister of India, late Shri Jawaharlal Nehru. Bharat Krishak Samaj was the host to the foreign delegates and it received great appreciation and praise from the delegates for conducting the conference efficiently and successfully.

National Agricultural Co-operative Marketing Federation

The National Agricultural Co-operative Marketing Federation was set up on 2nd October, 1958, the auspicious birthday of Mahatma Gandhi. The main objective of the Agricultural Co-operative

Marketing Federation are to co-ordinate and promote the marketing and trading activities of the members in agricultural and other commodities, to undertake to promote inter-state and international trade and commerce in agricultural and other commodities, to undertake supply of agricultural requisites, like seed, manures, agricultural implements, etc. The setting up of the Federation was the implementation of a resolution passed by the 5th meeting of the All India Farmers' Council of the Bharat Krishak Samaj in 1958.

Farmers Co-operative Bank of India Limited

Bharat Krishak Samaj had been anxious to establish a Farmer's Co-operative Bank in India since long. Apart from the reference to it by the late Dr. Panjabrao Deshmukh, President, Bharat Krishak Samaj, in the Srinagar Conference of Farmers and Ministers of Agriculture and Co-operation in July 1954, the National Convention of farmers as early as 1958 adopted a definite resolution to the effect that such a Bank be organised by the Bharat Krishak Samaj.

The Bank has started functioning and is making good progress. The Bank will, there is no doubt, solve to a great extent the long standing credit problem of the Indian farmers and their institutions.

First Afro-Asian Rural Reconstruction Conference

The Samaj has yet another great achievement to its credit. This is the holding of the First Afro-Asian Rural Reconstruction Conference in New Delhi in Jauuary, 1961, in which 23 Asian and African countries and five International Organisations participated. The late Dr· P. S. Deshmukh, President Bharat Krishak Samaj was elected the President of the Conference. The Conference was inaugurated by the late Dr. Rajendra Prasad, the then President of India. Shri K. D. Sharma, formerly Secretary of the Bharat Krishak Samaj, was its first Secretary General.

Freedom From Hunger Campaign Fund

The late Dr. Deshmukh, President, Bharat Krishak Samaj, in his address of welcome on the occasion of the inauguration of the World Agriculture Fair on 11th December, 1959, made the following announcement:

"The Bharat Krishak Samaj wishes to commemorate this great occasion by deciding to give concrete shape to this campaign envisaged by F. A O. We, therefore, propose to constitute a Freedom From Hunger Trust Fund of our own which would be devoted to fulfilling the first two aims of the campaign, viz. imparting information and education to the farmers of India and helping agricultural research. For this purpose all gate money received in the course of this Fair would be credited to this fund. The Samaj will also approach various Governments, religious and other organisations, private foundations, as well as individual donors to add to this fund. I have great pleasure in making this announcement at this moment so as to secure the blessings of His Excellency President Eisenhower who, I believe, has already associated himself with this campaign. We could not have chosen a better moment to make a move in this direction. I hope and trust we will enjoy the blessings and support of everyone present here as well as those outside."

Accordingly the Governing Body of the Bharat Krishak Samaj at its meeting held at Bhopal (Madhya Pradesh) in September, 1960, passed a resolution to the effect that a sum of Rs. 5,83, 137·40, the balance out of the gate money received by the World Agriculture Fair be constituted into the Bharat Krishak Samaj "Freedom From Hunger Fund" which may be used for project to help the farmers to increase agricultural production in the country and to finance any campaign which may be organized by the Samaj to support the Freedom From Hunger Campaign initiated by the F.A.O., W.A.F. Memorial Fund.

The Governing Body of the Bharat Krishak Samaj at the same meeting also decided that a sum of Rs. 4,00,000 be transferred from the receipts of the World Agriculture Fair and created into Bharat Krishak Samaj World Agriculture Fair Memorial Fund for granting scholarships to the sons and daughters of Indian farmers for study of agricultural science both in India and abroad or for any other suitable educational purpose which the Committee to be appointed for the administration of the fund might propose.

W.A.F. Memorial Farmers Walfare Trust Society

The Governing Body of the Bharat Krishak Samaj at its meeting held in Ahmedabad in November 1963 passed a resolution to the effect that the two funds viz. Bharat Krishak Samaj Freedom From Hunger Fund and Bharat Krishak Samaj World Agriculture Fair Memorial Fund consisting of Rs. 5,83,137·40 and Rs. 4,00,000 respectively may be combined into one to from a Trust Society under the Societies Registration Act to be called "World Agriculture Fair Memorial Farmers Welfare Trust Society." In pursuance of this resolution. the Trust was registered under the Societies Registeration Act in Delhi in December, 1963.

The Trust is giving scholarships to the students for higher studies in agriculture and allied subjects since its formation every year.

U. S. Government's Co-operation and Help to the Samaj

The Internatianal Co-operation Administration, U. S. A. (now U. S. A. I. D.) had placed at the disposal of the Samaj a Farm Organization Adviser, Mr. John H. Webb, for a period of three years, 1959-61 and had also made available to the Samaj a fully equipped publicity van with movie and public address system for use by the Samaj. The Samaj is grateful to U. S. A. I. D. for this generous help. The Samaj is also grateful to Mr. Webb for his valuable advice and help during the period of his tenure with the Samaj.

Foreign contacts and farmers exchange

BKS Bocomes A Member Of IFAP

The Samaj became a member of the International Federation of Agricultural producers in the very first year of its existence, i. e. 1955. The late Dr. P. S. Deshmukh, President, Bharat Krishak Samaj was elected as Vice-President of IFAP

Farm Leaders Training Programme
an Indian trainee working with his host farmer in U. S. A.

in 1963. Shri S. M. Wahi, a former Vice-President of the Samaj is a Vice-President of the IFAP now. He was a Vice-President of the IFAP before the late Dr. Deshmukh also.

The Samaj is an Honorary Member of the International Association of Fair and Expositions of U.S.A.

Farmers Exchange Project
(a) with U. S. A.

The Bharat Krishak Samaj has undertaken a project of farmer to farmer exchange in collaboration with Farmers and World Affairs, Inc., Philadelphia, U.S.A. The object of the project is briefly two-fold : (1) to study farming methods and problems, working of farm organization, co-operatives, credit system, extension methods, etc., and (2) to help build friendship and mutual understanding and co-operation between the people in general and the farmers in particular, of these two great democratic countries at the grassroots level.

Under this project eleven groups of American Farm Leaders have so far visited India. The groups consisted of both men and women totalling about one hundred and twenty. Six groups of Indian farm leaders (about sixty men and women) have also visited U.S.A. under the Programme.

(b) With G. D. R.

The Samaj has also undertaken an exchange programme with the Peasants Mutual Aid Association of the German Democratic Republic. About thirty Indian farm leaders have so for visited G.D.R, and about a dozen delegates from G.D.R. have visited India.

Both these programmes are at non-Governmental level.

Farm Leader Training Programme

The Bharat Krishak Samaj has undertaken a project called Farm Leader Training Programme in collaboration with Farmers and World Affairs, Inc., U.S.A., with which we are having Farmers Exchange Programme. Under this new training programme two Indian Farm leaders will be in U.S.A. with U. S. farm families under training as Trainees for about one year. The fiist group of traniees left for U.S.A. in March 1968. It proposed to send 3 young men, one each from Orissa, Mysore

Seminar on Agricultural Production-cum-Family Planning and Haryana to the U.S.A. under this plan for a period of about 6 months and the group reached the U.S.A. in the 1st week of April 1971.

Visit to Taiwan

Under the Afro-Asian Rural Reconstruction Organisation Programme sponsored with a Ford Foundation grant a group of 15 Indian Farmers visited Taiwan for 2 weeks from 24th August to 2nd September 1970. The members included Shri R. Srinivasan, President, Farmers Forum Madras, a member of the governing body and standing committee of the Samaj and others, all life members of the Bharat Krishak Samaj.

Family Planning and Agricultural Production Pilot Project

The Samaj has undertaken a "Co-operative Family Planning and Agricultural production Pilot Programme" in collaboration with and financial assistance of Farmers & World Affairs, Inc., U.S.A. Three Project Centres have already been started as Pilot Projects, one each in Madras (Chingleput Dist.), Maharashtra (Jalgaon Dist.) and in Mysore (Anakal taluka). The Samaj has appointed one Education Worker each for the Project. The worker is collecting necessary statistical datas etc, on family planning, and agricultural production. The workers have been provided with motor cycles.

The three centres are doing excellent work on both family planning and agricultural production.

Short duration Farmers Training Camps

The Samaj organised 12 short duration farmers training camps in the country with the help of the Government, one camp each by Uttar Pradesh Krishak Samaj; Mysore Krishak Samaj; two Training Camps each by farmers Forum, Madras and Jammu & Kashmir Krishak Samaj and three camps each by Madhya Pradesh Krishak Samaj and Maharashtra State Krishak Samaj. The Samaj intends to hold some camps this year also for which we have received necessary grants from the Government of India. The trainees have shown keen interest and appreciated the training opportunity.

Farmers Exchange Programme within the country

The Ministry of Food & Agriculture has started a scheme of Farmers Exchange Programme within the country. The Samaj intends to organise the programme and has received some grant from the Ministry.

National Food Congress

A National Food Congress was organised by the Government of India. Dr. Bholey was a Member of the Preparatory Committee of the National Food Gongress 1970. Mr. S. N. Mushran, Dr. D. A. Bholay and members of the Standing Committee of the Samaj attended the National Food Congress 1970 meeting held at Vigyan Bhavan, New Delhi from 11th to 14th May 1970. Further Mrs. Jaya Arunachalam Hon. Secreary of the Organiazation at Madras attended the Conference in the capacity of a special invitee. This Congress was in connection with the World Food Congress held at Hague from 16th to 30th June 1970. The N. F. Congress & the World Food Congress was a grand success. Considering as it does every item which concerns the farmer vitally it gives opportunity for members to express themselves frankly & forcefully in a constructive spirit, building men to take their place as effective producers, builders & contributors to the general productive welfare of the country as a whole.

World Agriculture Fair Memorial Shivaji College

The World Agriculture Fair Memorial Shivaji College was started in 1961, in the rural area of Delhi at Matiala, Najafgarh Road, in a temporary building. The Bharat Krishak Samaj donated Rs· 4,00,000 to the College Endowment Fund. The College is well established now and is making good progress. It has at present over 500 students both boys and girls. A new site for the college has been obtained where the college will be shifted shortly. The Delhi Administration has taken over the administration of the college.

Publications And Publicity

The Samaj has its own monthly journal called Krishak Samachar. The publication of this journal was taken up from December, 1956. It was being published both in English and Hindi upto July 1962, but since August 1962, it is also being published in Marathi from the District Krishak Samaj Office, Jalgaon. Since February 1964 the journal is being published in the Gurumukhi script also from the Punjab State Krishak Samaj Office, Chandigarh. The journal is sent free of cost to all life members in the languages of their choice.

The Samaj has also published several special publications, souvenirs, reports, etc. on the occasion of Conventions, Seminars, Fairs, etc. In 1964, the Samaj published the Bharat Krishak Samaj Year Book 1964. The Samaj has published its second Year Book 1968 in the year 1970. This book is also very highly commended upon and congratulated by experts and this was published by the Farmers Form Madras on behalf of the Bharat Krishak Samaj. Eminent scientists and experts in agriculture, animal husbandry, co-operation, etc. both from India and foreign countries have contributed very fine articles. This book is very highly commented upon by experts.

The Samaj intends to bring out Year Book every year.

Seminars and Symposiums

The Samaj has organized several seminars on important subjects during Conventions, Conferences, World Agriculture Fair, National Agriculture Fairs, etc.

In these Seminars progressive farmers, Government and non-Government experts in agriculture and allied subjects participated. In the symposium on Radioisotopes, Fertilizers and Cowdung Gas Plant a large number of scientists from foreign countries also participated.

National Farmers Day

To Commemorate 3 April, 1955, on which day the first National Convention of Farmers was inaugurated by the late Prime Minister, Shri Jawaharlal Nehru, the Bharat Krishak Samaj decided to celebrate April 3, as the National Farmers Day.

Since then the Bharat Krishak Samaj has been celebrating this day-April 3, throughout India. The Krishak Samajs in the states at the state, district, taluk and village levels have been celebrating this day by arranging meetings, discussions, etc. in which both the farmers and agricultural experts have been participating. On this occasion the President has aiso been sending to the farmers in India a message of good wishes and encouragement.

Miscellaneous Activities of the Samaj

The Samaj has whole-heartedly co-operated with the Government in their Kharif (rainy season) and Rabi (winter) crop campaigns.

To meet the National Emergency, the Samaj immediately formulated a five point programme for National Defence and appealed to the Nation's peasantry to shoulder bravely its due share of the task of safeguarding the freedom of the motherland and helping to beat back the invader, and to step up agricultural production.

The central office and the state branches of the Samaj also liberally contributed to the National Defence Fund.

The Punjab State Farmers Forum has set up Farm Machinery and Implements (Production-cum-sale) Co-operative Industrial Society Ltd. They have also applied for license for manufacture of small tractors.

The Jalgaon District Krishak Samaj has taken an agency for the supply of tractors, spare parts and other agricultural machinery and implements and also has undertaken servicing of tractors and other agricultural machinery and implements.

The Mysore Farmer's Forum has undertaken supply of good quality seed potatoes of improved varieties to growers and has also applied for license to import seed potatoes from Burma and other countries.

The Mudhol Farmers' Forum (Bijapur, district Mysore State) with the full co-operation of the the technical personnel of U. S. A. I. D. and State Government has been able to successfully implement a new Mysore System of Soil and Water Conservation and Contour Bunding of fields on a large scale. The new methods have helped to a great extent to increase agricultural production. This is a very important line of work undertaken by the Mudhol Farmers' Forum. The success of this project has created enthusiasm in other state Krishak Samajs and work on similar lines is likely to be undertaken by them. The Mudhol Farmers Forum is also producing seeds of hybrid maize, jowar and bajra for supply to cultivators after getting the seeds certified by the National Seeds Corporation.

The Mudhol Farmers' Forum was the first to organize a Quintal Club.

The Punjab Krishak Samaj and Madhya Pradesh Krishak Samaj under the auspices of the Planning and Development Department have undertaken, training of the Panchayat Secretaries, Panchs, Sarpanchs, Upsarpanchs, etc., at Ferozepur and Bhopal respectively under the scheme of the Panchayat Raj Training Programme.

Many of our progressive farmers collaborate with the Central and State Governments for undertaking field trials on their own fields under the supervision of Government experts. Many of them have also been multiplying on a large scale improved certified seeds recommended by the Central Institutes, and the State Governments.

Some of our progressive farmers are also members of Government Committees, Planning Commission, etc.

Future Programme of work of the Samaj

The future programme of work of the Samaj includes:

1. Strengthening the organization in the States by appointing whole-time paid Secretaries or Assistant Secretaries, intensification of the effort to enrol life and ordinary members, holding farmers' conventions at state and district levels, Training Camps for Samaj workers, organizing Crop Competitions, Farmer's Days, Agricultural Museums, etc.

2. Promotion and organization of co-operatives; viz. formation of National Council of Farmers Co-operatives, Krishak Samaj Central Co-operatives, Seed Multiplication Associations, Agricultural and Machinery Co-operatives.

3. Popularisation of the main features of the Japanese method of paddy cultivation wherever suitable and popular, firstly, by studying the method and secondly by propagating it amongst other farmers. Wherever the Japanese Government farms are located, efforts to take advantage of these farms for the training of farmers, especially the younger generation, to be made. The knowledge gained is then to be practised by the trainees on their lands so as to become focus of radiation of the method.

4. Getting soils analysed and popularising fertilizer use and plant protection methods.

5. Grading agriculture produce.

6. Taking utmost possible advantage of warehouses constructed by Government.

7. Advising and undertaking co-operative farming on voluntary basis wherever possible.

8. Popularising Farmer's Co-operative Bank of India.

9. To get agency for the distribution of tractors, farm implements, spares, etc. through the State Krishak Samajs.

10. To give practical training to farm men and farm women in the increased agricultural production who are members of the Bharat Krishak Samaj in all the States and Union Territories with the help and guidance of the Directorate of Extension, Ministry of Food & Agriculture, Government of India.

The Samaj conducted 14 short duration farmers' training courses in the States, with the aid of grants from the Government of India for its members in its progressive members' farms.

11. **Expanded Family Planning And Agricultural Production Pilot Projects**

Inspired by the success of the three Pilot Projects already running one each in Jalgaon, Chingleput and Anakal, the Samaj and the Farmers & World Affairs, Inc., USA are considering the expansiou of the Project aid to have 14 such Pilot Projects in the country. The idea is that each state should have one such 'Family Planning and Agricultural Production Pilot Project' centres. The Samaj and the FWA are negotiating with the Ministry of Health and Family Planning and the USAID for necessary financial help to the Samaj for running the Projects in 14 centres.

The Samaj hopes that the Government will lend its helping hand to the Samaj for the Pilot Projects in the States.

This is in short the story of BKS, the leading farmer organisation representing the voice of our 6 million farm families. In the short span of its life it has made vigorous and sustained effort to organise itself in all the states of the country. It has tried to communicate the views of the farmers to the government and the members have made useful contribution to the deliberation of the various committees connected with Agriculture on which the Samaj has been given representation. There are many objectives which the Krishak Samaj has in view for the betterment of farming communities as a whole. The link that the Samaj has set out to forge between farming and farmers is getting stronger and stronger day by day.

CALENDAR OF IMPORTANT EVENTS

BHARAT KRISHAK SAMAJ

1954

1. July — The decision to establish an organisation of farmers was taken at a meeting of the Progressive Farmers and the State Ministers of Agriculture, Co-operation, and Animal Husbandry held in Srinagar under the Chairmanship of late Dr. P. S. Deshmukh, the then Minister of Agriculture, Government of India.

1955

2. February 7 — The Constitution for the Samaj was registered under the Societees Registration Act XXI of 1860, in the name of "Farmers' Forum, India" (Bharat Krishak Samaj).

3. February 13 — The first meeting of the Governing Body of the Samaj was held at 12, Janpath, New Delhi, the then residence of late Dr. Deshmukh.

4. April 3 — The first National Convention of Farmers was held in New Delhi and was inaugurated by late Shri Jawaharlal Nehru, the then Prime Minister of India.

1956

5. The first convention of Delhi State Krishak Samaj was held at Mehrauli and was inaugurated by Dr. P. S. Deshmukh, Union Minister of Agriculture and President, Farmers Forum, India.

6. April 2 — 2nd National Convention of Farmers was held in Delhi and was inaugurated by late Dr. Rajendra Prasad, the then President of India.

7.	April 3	1st All India Farmers Council meeting at Delhi was inaugurated by late Shri Jawaharlal Nehru, the then Prime Minister of India.
8.	September 10	2nd All India Farmers Council meeting at Delhi was inaugurated by late Dr. K. N. Katju. the then Union Minister of Defence.
9.	November 7	The first comference of the Young farmers of Mysore State was held in Shimoga and was inaugurated by Dr. P. S. Deshmukh, Union Minister of Agriculture and President, Young Farmers Association India.
10.	December	Started Publication of ' KRISHAK SAMACHAR ' in English and Hindi languages.
11.	December 28	The 4th conference of State Ministers of Agriculture was addressed by Dr. P. S. Deshmukh, Union Minister of Agriculture and President, Farmers Form, India.

1957

12.		Under the "Farm Leaders Study Programme" sponsored by the Technical Cooperation mission 20 Indian Farm Leaders went to U.S.A.
13.		Dr. P. S. Deshmukh Union Minister of Agriculture inaugurated the Western Regional-cum-All India Cattle and Poultry show at Indore.
14.	January 27	The Governing Body of the Farmers Forum, India meets at New Delhi under the Presidentship of Dr. P. S. Deshmukh.
15.	February	Shri Chester Bowles, former US Ambassador to India meets the members of the Governing body of the Farmers Forum and the young farmers Association of India at New Delhi.
16.	March 20	Shri A. P. Jain. Food and Agriculture Minister of Government of India inaugurates commodity committees formed by Farmers Forum, India.
17.	March 24	Shri U. N. Dhebar, the than President, Imdian National Congress in New Delhi inaugurates 3rd National Convention of Farmers.
18.	—Do—	Late Shri V. T. Krishnamachari the then Deputy Chairmen Planning Commission, in New Delhi inaugurates 3rd All India Farmers Council meeting.

19.	March 24	The Farmers Forum India organises an Agriculture and Rural Industries Exhibition along with the 3rd National Convention of Farmers in the Talkatora gardens at New Delhi.
20.		The All India Farmers Council holds its third meeting in Talkatora gardens, New Delhi.
21.		Dr. T. C. Ghosh, member of planning commision on the occasion of the 3rd National Convention of farmers inaugurates a training programme of the Young Farmers Association, India.
22.	July	Representatives of the Farmers Forum India were appointed as Members on the various Regional Committees of I. C. A. R.
23.	August 10	The local standing committee of the Farmers Forum India met in New Delhi under the Presidentship of Dr. P. S. Deshmukh, Union Minister for Co-operation and President, Farmers Forum, India.
24.	October	Dr. P. S. Deshmukh, Union Minister for Cooperation and President, Farmers Forum India meets ten American Young Farmers including 5 girls who were visiting India under the International Farm Youth Exchange Programme.
25.	—Do—	Farmers From sponsors a Kisan Special Train which started form Bulsar (Gujrat) on a round the country tour.
26.	October 8	8 Japanese Youth Leaders including two girls arrived in New Delhi on a good will mission.
27.	November 2	Shri Y. B. Chavan the then Chief Minister of Maharashtra inaugurates the 4th All India Farmers Council meeting held at Amaravati (Maharashtra).
28.	November	The Farmers Forum convened All India Conference of Cotton growers, Oil seeds growers, Millet growers and Fruit gorwers.
29.	November 15	Soviet Agricultural Delegation came to India on a good will mission and a reception was held by the Farmers Forum, India.
30.	December 11	The Bharat Krishak Samaj gave a reception to the Agriculture Study Team of FAO consisting of 21 persons.

31.	January 26	Rajmata Kamlendeemati Shah, Treasurer BKS and Dr. B. P. Pal, Director of I. A. R. I. New Delhi and a member of the governing body of the BKS were awarded the "Padma Bhushan" and "Padma Shri" respectively on the Republic Day.
32.	February 23	Dr. P. S. Deshmukh, President BKS inaugurates the first convention of Madhya Pradesh Krishak Samaj.
33.	March 14	Shri V. T. Krishnamachari, Deputy Chairman Planning Commission inaugurates the Seminar on "Krishak Samaj in Agriculture Extension".
34.	March 15	Prime Minister, Shri Jawaharlal Nehru inaugurates the 4th National Convention of farmers in New Delhi.
35.	March 19	Dr. Rajendra Prasad, President of the Republic of India was pleased to acept to be the Patron-in-Chief of the BKS.
36.	Marc 19	5th All India Farmers Council meeting was heid at New Delhi and was inaugurated by Shri A. P. Jain, the then Union Minister for Food and Agriculture.
37.	June 27	The announcement about the holding of the "World Agriculture Fair" in New Delhi from December 1959 to February 1960 was made by Shri A. P. Jain the then Union Minister of Food and Agriculture at a special function held at the Exhibition Ground, Mathura Road, New Delhi where the office of the World Agriculture Fair was opened.
38.	July 3	Dr. P. S. Deshmukh inaugurates the State Farmers Council of the Madras Krishak Samaj at Madras.
39.	August 5	20 Indian Farm Leaders left for the USA by air from New Delhi to take part in the "Farm Leaders study project" sponsored by the International Cooperation Administration of the Government of USA.
40.	October 2	The National Agricultural Co-operative Marketing Federation was registered ~~in connection~~ with effect to the resolution of the Bharat Krishak Samaj.
41.	November 22	6th All India Farmers Council meeting was held at Bhubaneswar and was inaugurated by Shri Harekrishna Mahtab, the then Chief Minister of Orissa.

42.	January	The 60th Birthday of Dr. P. S. Deshmukh, was celebrated at a reception held in the Central Office of the Bharat Krishak Samaj.
43.	February 4	Prime Minister Sri Nehru Inaugurated a rally of young farmers at Bangalore.
44.	March 12	Farmer-members of Thana Krishak Samaj (Bombay) meet Prime Minister Sri Jawaharlal Nehru in New Delhi.
45.	March 18	BKS gave a receptian to Shri B. R. Sen Director-General of the F & A Organisation.
46.	May 2	5th National Convention at Mysore was inaugurated by Mr. Mangaldas Pakvasa, the then Governor of Mysore.
47.	May	Dr. P. S. Deshmukh, President of BKS was elected President of the Samaj for the next term at the 7th meeting of All India Farmers Council held in Mysore,
4 .	August 1	The New International Wheat Agreement goes into effect.
49.	August 11	20 farm leaders left Delhi by plane to USA under the "Farm Leaders study project, 1959 programme" sponsored by the Technical Co-operation Mission of the USA.
50.	November 25	The first group of 12 American Farm Leaders arrived at Palam, India, under the farmers Exchange Programme of BKS with Farmers and World Affairs of U.S.A.
51.	November 27	The 11th General Conference of International Federation of Agricultural Producers was inaugurated in Vidyan Bhavan, New Delhi, by late Dr. Rajendra Prasad, the then President of India. The conference was held in Delhi at the invitation of the Samaj.
52.	November 29	8th All India Farmers Council meeting was held in New Delhi and was inaugurated by Shri S. K. Patil the then Union Minister for Food and Agriculture.

53. December 11 — World Agriculture Fair was inaugurated by Dr. Rajendra Prasad the then President of India in New Delhi, who was also the Chief Patron of BKS, *in the presence* of Mr. Dwight D. Eisenhower, the then President of U.S.A., late Shri Jawaharlal Nehru, late Dr. P. S. Deshmukh and many other distinguished guests.

1960

54. February 11 — 9th All India Farmers Council meeting was inaugurated by Shri Morarji Desai, the then Union Minister for Finance at Delhi.

55. February 12 — 6th National Convention of Farmers was inaugurated by late Dr. Rajendra Prasad, the then President of India, in New Delhi.

56. February 14 — Shri Jawaharlal Nehru, Prime minister of India addressed in the concluding function of the 6th National Convention of farmer at Talkatora gardens.

57. February 29 — Closing of the World Agriculture Fair. Dr. S. Radha-Krishnan, the then Vice-President of India gave away prizes and late Shri Jawaharlal Nehru, the then Prime Minister presided over the closing function.

58. August 14 — 20 progressive farm leaders from various States left for U. S. A. under "Farm leaders study project, 1960 Programme" sponsored by the Technical Cooperation mission of the U.S.A.

59. September 16 — The 10th All India Farmers Council was inaugurated by Shri H. P. Pataskar, the then Governor of Madhya Pradesh at Bhopal.

60. November 22 — Farmers Cooperative Bank of India Ltd., was established at Delhi.

1961

61. January 8 — Inauguration of the First National Agriculture Fair at Calcutta by Dr. S. Radha Krishnan, the then Vice-President of India.

62. January 18 — Dr. Rajendra Prasad, President of India inaugurates the Afro-Asian Rural Reconstruction Conference, Organised under the institute of BKS, at Vidhan Bhavan, New Delhi.

63. February 15 — 11th All India Farmers Council meeting at Calcutta was inaugurated by Shri Shriman Narayan, the then Member, Planning Commission.

64. February 16 — 7th National Convention of farmers was inaugurated at Calcutta by Shri Sanjiva Reddy, the then President, Indian National Congress.

65. February 18 — Her Majesty the Queen Elizabeth II and His Royal Highness Prince Philip, the Duke of Edinbrough visited the First National Agriculture Fair organised by the BKS at Calcutta.

66. March 14 — Closing of First National Agriculture fair at Calcutta. Shri Taran Kanti Ghosh, the then Minister for Agriculture and Food Production, Government of West Bengal, presided over the function.

67. May — A group of 12 Indian Farmers left for U. S. A. on an Agriculture study trip for about 3 months arranged in collaboration with "Farmers and World Affairs, Inc. Philadelphia U. S. A."

68. June 1 — The first group of 12 Indian farm leaders reached Washington D. C. under the farmers exchange programme.

69. July — Started World Agriculture Fair Memorial Shivaji College at Matiala, Delhi State.

70. October 18 — Shri Karan Singh, Sardar-i-Riyasat. Jammu and Kashmir inaugurates the 12th meeting of the All India Farmers Council at Tagore Memorial Hall Srinagar.

1962

71. January 7 — 3rd group of 15 American farm leaders arrived in India under the project of farmer exchange arranged by the BKS.

72. January 14 — Second National Agriculture Fair was inagurated at Madras by Shri Bishnuram Medhi, the then Governor of Madras.

73. March 8 — 13th All India Farmers Council meeting was inagurated at Madras by Shri C. Subramaniam the then Finance Minister of Madras.

74.	March 10	8th National Convention of Farmers was inagurated at Madras by Shri Bishnuram Medhi, the then Governor of Madras.
75.	March 11	Closing of the 2nd National Agriculture Fair at Madras. Shri K. Kamraj, the then Chief Minister of Madras presides over the closing function.
76.	March 19	2nd Afro-Asian Conference on Rural Recontruction was held in Cairo, the Capital of United Arab Republic.
77.	March 31	The Afro-Asian Rural Reconstruction was established and Shri K. D. Sharma became the 1st Secretary General of this International Organisation.
78.	April	Two farmer delegates from the GDR were the guests of BKS.
79.	May	2nd grup of Indian farm leaders left India for USA under Farmers Exchange Project sponsred by the BKS.
80.	May 10	The resignation of Shri K. D. Sharma as Secretary of the Samaj was accepted by the Governing body of the Samaj and Shri R. B. Deshpande was appointed to succeed Shri Sharma as Secretary of BKS.
81.	August	Dr. P. S. Deshmukh, President BKS was made an Honorary member of the National Farmers Union during his recent visit to Denver, Colorado, USA.
82.	August	Started Publication of "Krishak Samachar" in Marathi from Jalgaon (Maharashtra).
83.	October—November	BKS contributes a sum of Rs. 1,000/- to the National Defence Fund.
84.	October 17	14th All India Farmers Council Meeting was inaugurated at Chandigarh by late Sardar Pratap Singh Kairon, the then Chief Minister of Punjab.

1963

85.	January 26	Shri Bishan Mansingh, member governing body of BKS was awarded "Padma Shri" on the 1963 Republic Day awards.

86.	February 5	Dr. P. S. Deshmukh founder President of the BKS was elected President of the National Agriculture Co-operative Marketing Fedaration.
87.	February 10	4th group of 10 farm leaders from the USA arrived in India under farmer to farmer exchange programme sponsored jointly by the Samaj and Farmers and World Affairs Inc., Philadelphia, USA.
88.	February 28	First Patron-in-Chief of the Samaj, Dr. Rajendra Prasad, Ex-President of India passes away at Patna.
89.	May 16	Dr. P. S. Deshmukh, President BKS was elected as one of the Vice Presidents of the International Federation of Agriculture Producers during its 13th General Conference held at Bray, Ireland.
90.	June 25	Dr, P. S. Deshmukh, President of BKS and Secretary Shri R. B. Deshpande visits GDR at the invitation of the Farmers Mutual Aid Association of the GDR.
91.	November 5	Inauguration of the 15th All India Farmers Council meeting at Ahmedabad by late Shri Balwantrai Mehta, the then Chief Minister of Gujarat.
92.	November 5	Shri A. M. Thomas Vice-President of the BKS and Deputy Minister for Food was made Minister of State for Food in the Union Ministry of Food and Agriculture.

1964

93.	January 1	The World Agricultural Fair Memorial Farmers Welfare Trust Society was registered under the Societies Registration Act XXI of 1860 as per a resolution passed by the Governing Body at its meeting held at Ahmedabad on November 5th 1963.
94.	January 17	5th group of 14 farm leaders from the U. S. A. arrived in India under the farmer to farmer exchange programme, sponsored jointly by the Farmer and World Affairs USA & BKS.
95.	February	Farmers' Forum, Punjab startes publication of "Krishak Samachar" in Gurumukhi script also from Chandigarh.

96.	March 19	The 16th All India Farmers Council meeting was inaugurated at Delhi by Shri Asoka Mehta, the then Deputy Chairman, Planning Commission.
97.	March 20	The 9th—10th combined National Convention of farmers was inaugurated at Delhi by Shri Swaran Singh, then Union Minister for Food and Agriculture.
98.	March 20	A delegation from GDR at the invitation of Dr. P. S. Deshmukh, President, BKS attends the 9th & 10th National Convention of Farmers, at New Delhi.
99.	May	BKS Vice-President Maharani Mohinder Kaur of Patiala was nominated to the Rajya Sabha.
100.	May 27	Shri Jawaharlal Nehru, Prime Minister of India and Chief Patron, Agriculture Fair passes away in Delhi.
101.	July 19	A delegation of 9 members of BKS left for GDR at the invitation of the Farmers Mutual Aid Association of GDR.
102.	August 26	A delegation of 9 Indian Farm Leaders leaves for USA under the farmers exchange programme and one more member on 5th September.
103.	September 15	A delegation on behalf of BKS meets the "Jha Committee".
104.	October 2	The BKS Year Book 1964 was brought out on 2nd October (Mahatma Gandhi Birthday) and the publication was inaugurated at the hands of late Shri Lal Bahadur Shastri, the then Prime Minister of India.
105.	October 24	17th All India Farmers Council meeting was inaugurated at Bhubaneswar by Shri S. P. Mohanty, the then Minister for Agriculture and Education, Government of Orissa.
106.	November 15	Dr. P. S. Deshmukh, M. P., President BKS leaves Delhi for Sydney by air to attend the Executive Committee Meeting of the IFAP.
107.	December 2	Dr. P. S. Deshmukh was re-elected Vice-President of IFAP.
108.	December 27	The 66th birthday of the President of BKS., Dr. P. S. Deshmukh was celebrated.

1965

109.	January 15	3rd National Agriculture Fair at Ahmedabad was inaugurated by Mr. Manubhai Shah, the then Union Minister for Commerce.
110.	January 16	The sixth group of six American Couples - farmers - arrived in New Delhi under the farmer to farmer exchange programme of BKS.
111.	March 8	Inauguration of the 18th meeting of the All India Farmers Council at Ahmedabad by Shri Shah Nawaz Khan, the then Union Minister for Agriculture.
112.	March 9	Inauguration of the 11th National Convention of farmers at Ahmedabad by Shri Utsavbhai Parikh, the then Minister for Agriculture, Government of Gujarat.
113.	March 11	Closing of the 11th National Convention of farmers and the 3rd National Agriculture Fair at Ahmedabad by Padma Vibhusan Nawab Mehdi Nawaz Jang, the then Governor of Gujarat.
114.	April 3	BKS completes its 10 years of existance.
115.	April 10	Dr. P. S. Deshmukh, Founder-President of the Samaj passes away.
116.	May	Mrs. Vimalabai Deshmukh B.A., LLB., wife of late Founder-President of BKS was elected to the Parliament.
117.	May 31	A delegation of BKS meets the Agricultural prices commission.
118.	June 4	The Governing Body of the Samaj unanimously decides that Shri A. M. Thomas should carry out the duties of the President of BKS.
119.	June 4	The Governing Body decides to have a suitable memorial for Dr. Deshmukh.
120.	July 14	A group of 10 Indian farm leaders leaves for USA under the exchange programme.
121.	September 17	A delegation of 6 members of the BKS leaves for GDR at the invitation of the Farmers Mutual Aid Association of GDR.

122.	October 22	Shri Mohan Wahi, Vice-President, BKS appointed as a Director of the Fertiliser Corporation of India Limited.
123.	December 8	Padma Shri Bishan Mansingh, member of the All India Farmers Council and member of the governing body and the standing committee of the Samaj passes away.

1966

124.	January 11	Shri Lal Bahadur Shastri, Prime Minister of India, suddenly passes away at Tashkend.
125.	January 15	The 7th group of American farm leaders consisting of 5 couples arrive in New Delhi under the farmer to farmer exchange programme of BKS.
126.	January 28	Shri C. Subramauiam, the then Union Minister for Food & Agriculture was elected as President of BKS at the 10th All India Farmers' Council meeting held at Lucknow.
127.	January 28	The 19th All India farmers council meeting was inaugurated at Lucknow by Smt. Sucheta Kriplani, the then Chief Minister of U.P.
128.	January 28	Inauguration of the 1st State Agriculture fair at Lucknow was done by Smt. Kriplani, the Chief Minister of U.P.
129.	January 30	Concluding day session of the Council was addressed by Shri Bishwanath Das, the then Governor of U.P.
130.	May	Shri S. M. Wahi, Vice-President, BKS was elected as Vice-President of the International Federation of Agricultural Producers by the 15th conference held in London.
131.	August 13	The Governing Body agreed that Family Planning and Agricultural Production Pilot Project centres be started one each at Jalgaon and Madras.
132.	October	Honorary membership of International Association of Fairs and Expositions, USA was conferred to BKS.
133.	November 12	The 4th National Agriculture Fair at Jaipur was inaugurated by Shri Mohanlal Sukhadia, the Cheif Minister of Rajasthan.

134.	December 28	The 20th meeting of the All India Farmers Council elected Shri A. M. Thomas as the President of the Samaj.
135.	December 28	The 20th meeting of the All India Famers Council was inaugurated by Shri Ram Niwas Mirdha, the then Speaker, Legislative Assembly of Rajasthan.
136.	December 29	The 12th National Convention of farmers was inaugurated at Jaipur by Shri Ram Niwas Mirdha, the then Speaker, Legislative Assembly Rajasthan.
137.	December 30	Late Dr. Sampurnanad, the then Governor of Rajasthan delivered address at the closing function of the 4th National Agriculture Fair and 12th convention of farmers.

1967

138.	February 25	A group (3 couples) of U. S. Farm Leaders arrives India under the Exchange Project with farmers and World Affair Inc. U.S.A.
139.	April 3	The 13th National Farmers Day was Celebrated.
140.	July 9	The Governing body ratifies the decision of the President Shri A. M. Thomas, to handover duties to Shri Ram Niwas Mirdha as Acting President of the Samaj on the eve of his Departure as the Indian High Commissioner to Australia.
141.	July 7	A delegation of Indian Farm leaders make a tour of East Germany from 7th to 20th.
143.	August 18	A group of Indian Farm leaders left India on a 7 week tour of USA under the Exchange Programme of BKS and Farmers and World Affairs Inc. USA.
144.	September 1	Dr. Bholay takes over the Secretaryship of the Samaj from Shri R. B. Deshpande.
145.	October 14	The 2nd State Agriculture Fair at Delhi was inaugurated by Shri A. P. Shinde, the Union Minister for Food.
146.	November 19	Prime Minister Smt. Indira Gandhi completes 40 years of her devoted life.
147.	November 29	The Arbitrator communicated that the proceedings of the Agriculture Fair Arbitration case has been finally closed.

1968

148.	February 2	The International Fedaration of Agriculture Producers nominates Shri Wahi, and Dr. D. A. Bholay as delegates for the United Nations Conference of

		Trade & Development held at Vigyan Bhavan, New Delhi.
149.	February 2	Shri Radhanath Rath, life member and governing body member of BKS is awarded the title of "Padma Bhushan" on the Republic Day of 1968,
150.	February 2	Shri H. G. Patil, the life member of BKS and the Honorable member of the Governing Body of BKS is nominated as Vice-Chancellor of the Proposed first Agriculture University of Maharashtra.
151.	March 22	Three young Indian farmers, one each from Punjab, Maharashtra and Haryana left for USA as the 1st batch of trainees under the Farm Leaders Training Programme with USA.
152.	April 3	National Farmers Day celebrated.
153.	May 6	Inauguration of the 21st meeting of the All India Farmers Council by Shri Nakul Sen, late Governor of Goa, Daman and Diu. at Panaji.
154.	May 7	Shri S. N. Mushran, M. L. A., was elected as the President ~~of BKS.~~ and the first Chairman of BKS according to new Ammended Constitution of Samaj.
155.	May 8	Closing function of the Council meeting was addressed by Mr. Anthony J. D'Souza, Minister for Agriculture of Goa, Daman and Diu at Panjim.
156.	May 21	Shri S. N. Mushran, the newly elected President of the Samaj assumes charge of his office at Delhi.
157.	August 5 (ammended)	A reception was held at Vithalbhai Patel House, in New Delhi to welcome Shri Jagajivan Ram, Union Minister for Food, Agriculture, Community Development and Co-operation as the President of the Samaj as per the new constitution of the Samaj, Shri S. N. Mushran as the Chairman of BKS.
158.	November 24	Mr. Ray Newton, Ex-~~Deputy~~ Director of the American friends committee and Executive Secretary, Farmers and World Affairs Inc., USA breathed his last.

1969

159.	January 18	The 9th group of nine U. S. Farm Leaders arrived India under the Farmers Exchange Programme with USA.
160.	April	The Fifth National Agriculture Fair organised by the Bharat Krishak Samaj was declared open by the Union Food and Agriculture Minister Shri Jagajivan Ram, in Bombay.
161.	April	The President of Young Farmer's Association India nominates Dr. D. A. Bholay as one of the Vice-Presidents of YoungFarmers Association, India.

162. April — The meeting of the 13th National Convention of Farmers and 22nd National Council of farmers of the Bharat Krishak Samaj was held in Bombay.

163. April — In the 22nd National Council of Farmers at Bombay, Dr. D. A. Bholay, Secretary General of the Bharat Krishak Samaj inaugurated the Seminar on Farm Revolution.

164. May 7 — Shri S. N. Mushran, Chairman of the Samaj addresses the delegates of the 22nd Meeting of the All India Farmers Council, Bombay.

165. May 8 — Shri B. Rachaiah, Minister of Agriculture, Mysore President over the celebrations of the 13th National Convention of Farmer.

166. September 22 — Shri S. N. Mushran, Chairman of the Samaj and Dr. D. A. Bholay, Secretary leave India on 22-9-69 by air on an invitation from the Farmers Mutual Aid Association of German Democratic Republic.

1970

167. January 16 — The Tenth group of American Farm Leaders delegation consisting of 10 members (Five families) arrived in New Delhi ~~on 16th January 1970~~ under the farm Leaders exchange programme of BKS.

168. March 13 — 23rd meeting of All India Farmers Council of the Bharat Krishak Samaj was held in the Jawaharlal Nehru Agricultural University, Jabalpur.

169. May — Shri R, Srinivasan, Chairman of the Farmers Forum, Madras was nominated as the President of Tamil Nadu Farmers Forum and in his place Shri G. Karuppiah Moopanar was nominated as the Chairman of Farmers Forum, Madras.

170. June 16 to 20 — The Second World Food Congress was held in Hague.

171. July 28 to August 8 — A World Conference on Agricultural Education and training jointly organised by the FAO, ILO, and UNESCO was held in Copenhagen.

172. December — Dr. Norman, E. Borlaug an eminent agriculture scientist was awarded the 1970 Noble peace price for his pioneering ventures like the development of Hybrid Wheat and triticale.

1971

173. January — A group of 6 farmer leaders arrive (11th group) in New Delhi, Under Farmers Exchange Programme run by Bharat Krishak Samaj and Farmers and World Affaris inc. Philadelphia, USA.

174. April 5 to 8 — 14th National Convention of farmers and 24th All India Farmers Council was held at Grama Sevak Training Centre, Khanapara, Gauhati.

Seminar *Subject*	*Time & Place*	*Occasion & who inaugurated*
Fixation of remunerative and incentive prices for agricultural produce, and State trading in food-grains through the Foodgrains Trading Corporation proposed to be set up by Government.	October 1964 Bhubaneshwar.	17th All India Farmers Council meeting. Chief Guest was Dr. P. K. Parija, Vice-Chancellor of Utkal University, who inaugurated the Seminar at Bhubaneswar.
Seminar on Self Sufficiency in Food Grains.	January 1966 Lucknow.	19th All India Farmers Council meeting. Mr. A. M. Thomas, President Bharat Krishak Samaj and the then Minister for Defence Production, Government of India, who inaugurated the Seminar at Lucknow.
Seminar on Farm Management	December 1966 Jaipur.	12th National Convention of Farmers. The Seminar was organised by the National Productivity Council and Rajasthan Productivity Council in collaboration with BKS. Shri Nathu Ram Mirdha, the then Minister of Agriculture, Govt. of Rajasthan inaugurated the Seminar at Jaipur.
Seminar on Agricultural Revolution	May 1968 Panaji.	21st meeting of the All India Farmers Council at Panaji. Shri. Nakul Sen, Lt. Governor of Goa, Damnn & Diu inaugurated the Seminar. at Panaji.

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PART II

AGRICULTURAL STATISTICS

INFORMATION ON CEREALS PERTAINING TO ANDHRA PRADESH STATE
STATEMENT SHOWING THE TARGETS FINALISED FOR KHARIF & RABI 1970-71
(in acres)

	District	Paddy		Hybrid Jowar & Swarna		Hybrid Bajra		Hybrid Maize		Wheat
		KHARIF	RABI	KHARIF	RABI	KHARIF	RABI	KHARIF	RABI	
1	Srikakulam	70,000	5,000	—	1,000	3,000	—	800	—	1,000
2	Visakhapatnam	50,000	5,000	10,000	1,000	30,000	1,000	8,000	2,000	8,000
3	East Godavari	75,000	70,000	4,000	4,000	10,000	—	1,500	—	1,000
4	West Godavari	75,000	1,45,000	4,000	1,000	950	—	600	1,500	2,000
5	Krishna	75,000	1,10,000	6,000	3,000	1,000	—	600	1,000	1,000
6	Guntur	70,000	60,000	12,000	20,000	15,000	500	1,500	—	2,000
7	Nellore	40,000	61,500	1,000	8,000	25,000	25,000	—	—	500
8	Kurnool	50,000	12,500	18,000	22,000	7,500	2,000	—	—	4,500
9	Ananthapur	17,000	7,000	5,000	4,000	6,000	3,000	2,500	—	2,500
10	Cuddapah	25,000	12,500	7,300	3,000	7,000	10,000	100	—	500
11	Chittoor	50,000	70,000	—	1,000	15,000	5,000	—	1,000	2,000
12	Hyderabad	10,000	6,000	1,000	1,000	800	200	1,000	200	14,000
13	Nizamabad	30,000	10,000	2,000	500	—	—	6,000	1,000	3,000
14	Medak	10,000	5,000	2,000	2,000	200	—	5,000	500	9,000
15	Mahbubnagar	40,000	20,000	15,000	15,000	1,500	1,500	—	500	30,000
16	Nalgonda	40,000	20,000	1,000	500	5,000	250	500	500	3,000
17	Warangal	40,000	30,000	2,500	1,500	500	—	12,000	12,000	5,000
18	Khammam	23,000	3,000	500	10,000	3,000	—	1,500	400	1,000
19	Karimnagar	13,000	18,000	6,000	700	—	—	15,000	32,000	4,000
20	Adilabad	5,000	1,500	3,000	500	50	50	1,000	1,500	6,000
	Total	8,08,000	6,72,000	1,00,300	99,700	1,31,500	48,500	57,500	54,100	1,00,000

YIELD PER ACRE ON AN AVERAGE UNDER HIGH YIELDING AS WELL AS OTHER VARIETIES

ANDHRA PRADESH

HIGHEST YIELDS RECORDED

(Crop Competition Data)

Year	Crop	Variety	Highest yield Recorded
1953-54	Paddy	M.T.U. 19	9,900 lbs/acre
1954-55	,,	,,	10,061 ,, ,,
1955-56	,,	,,	10,290 ,, ,,
1956-57	,,	,,	9,000 ,, ,,
1957-58	,,	,,	10,380 ,, ,,
1958-59	,,	M.T.U. 9	9,840 ,, ,,
1959-60	,,	M.T.U. 19	11,220 ,, ,,
1960-61	,,	G.E.B. 24	4,850 kgs/acre
1961-62	,,	,,	4,722 ,, ,,
1962-63	,,	,,	4,236 ,, ,,
1963-64	,,	,,	5,240 ,, ,,
1964-65	,,	C.O. 20	5,209 ,, ,,
1965-66	,,	Not given	5,820 ,, ,,
1966-67	,,	I.R. 8	5.600 ,, ,,
1967-68	,,	,,	5,670 ,, ,,
	Jowar		
1953-54	(Rainfed)	Not given	3,480 lbs/acre
1954-55	,,	,,	5,168 ,, ,,
1955-56	,,	,,	5,963 ,, ,,
1956-57	,,	,,	4,480 ,, ,,
1957-58	,,	,,	2,925 ,, ,,
1956-57	,, (Rabi)	,,	1,000 ,, ,,
1957-58	,,	,,	4,380 ,, ,,
1958-59	,,	,,	5,375 ,, ,,
1959-60	,,	,,	5,460 ,, ,,
1960-61	,,	,,	2,245 kgs/acre
1961-62	,,	,,	1,820 ,, ,,
1962-63	,,	,,	1,261 ,, ,,
1963-64	,,	,,	840 ,, ,,
1964-65	,,	,,	1,934 ,, ,,
1965-66	,,	,,	2,732 ,, ,,
1966-67	,,	,,	2,230 ,, ,,
1967-68	,,	,,	920 ,, ,,

IRRIGATED AREA DURING 1968-69 IN ANDHRA PRADESH FOR FOODGRAINS

	Area in acres	Area in Hectares
CEREALS		
1. Rice	65,96,947	26,69,692
2. Wheat	11,209	4,536
3. Jowar	1,52,853	61,857
4. Bajra	1,80,839	73,183
5. Ragi	3,20,443	1,29,678
6. Maize	1,34,139	54,264
7. Korra	37,213	15,061
8. Varagu	74,804	30,272
9. Samai	891	360
10. Other small millets	11,349	4,592
PULSES		
11. Bengalgram	1,550	627
12. Redgram	3,169	1,282
13. Greengram	28,545	11,551
14. Blackgram	752	304
15. Horsegram	3,405	1,378
16. Other Pulses	747	302
17. Total Pulses	38,168	15,444
Total foodgrains	75,58,860	50,58,959

STATEMENT SHOWING THE QUARTER-WISE BREAK-UP OF AMMONIUM SULPHATE FOR THE YEAR 1970—71

ANDHRA PRADESH

Sl. No.	District	Ist Quarter	IInd quarter	IIIrd quarter	IVth quarter	Total
1.	Srikakulam	6,000	3,300	—	2,450	11,750
2.	Visahapatnam	5,000	3,000	—	2,500	10,500
3.	East Godavari	12,500	6,800	—	4,700	24,000
4.	West Godavari	16,000	9,200	—	7,800	33,000
5.	Krishna	12500	6800	—	4700	24,000
6.	Guntur	15000	8000	—	6500	29,500
7.	Nellore	6000	3300	—	2450	11,750
8.	Chittoor	4500	2500	—	2250	9250
9.	Cuddapah	3000	1600	—	1150	5750
10.	Kurnool	6000	3375	—	1875	11250
11.	Anantapur	4000	2125	—	1875	8000
12.	Hyderabad	1500	—	1160	590	3250
13.	Medak	3000	—	2080	670	5750
14.	Mahaboobnagar	5000	—	3200	1800	10,000
15.	Warangal	4000	—	3100	2150	9250
16.	Khammam	2000	—	1600	900	4500
17.	Nalgonda	3000	—	2080	670	5750
18.	Karimnagar	5000	—	3500	2000	10500
19.	Nizamabad	10000	—	7280	2470	19750
20.	Adilabad	1000	—	1000	500	2500
	Total:	125000	50000	25000	50000	250000

Statement showing the Fertiliser-wise break-up of the quantities programmed to be distributed in A. P. during 1970-71 (M. Tonnes)

Sl. No.	District	A S	Urea	A.S.N.	C.A.N.	A.P.	Di-AP	Total in terms of AS
1.	Srikakulam	11,750	14,100	2,350	8,460	9,400	2,350	65,800
2.	Visakhapatnam	10,500	12,600	2,100	7,560	8,400	2,100	58,800
3.	East Vodavari	24,000	28,800	4,800	17,280	19,200	4,800	1,34,400
4.	West Godavari	33,000	39,600	6,600	23,760	26,400	6,600	1,84,800
5.	Krishna	24,000	28,800	4,800	17,280	19,200	4,800	1,34,400
6.	Guntur	29,500	35,400	5,900	21,240	23,600	3,900	1,65,200
7.	Nellore	11,750	14,100	2,350	8.460	9,400	2 350	65,800
8.	Chitoor	9,250	11,100	1,850	6,660	7,400	1 850	51,800
9.	Guddapah	5,750	6,900	1,150	4,140	4,600	1 150	32,200
10.	Kurnool	11,250	13,500	2,250	8,100	9,000	2 250	63,000
11.	Anantapur	8,000	9,600	1,600	5,760	6,400	1 600	44,800
12.	Hyderabad	3,250	3,900	650	2,340	2,600	650	18,200
13.	Medak	5,750	6,900	1,150	4,140	4,600	1 150	32,200
14.	Mahaboobnagar	10,000	12,000	2,000	7,200	8,000	2,000	56,000
15.	Warangal	9,250	11,100	1,850	6,660	7,400	1,850	51,800
16.	Khammam	4,500	5,400	900	3,240	3,600	900	25,200
17.	Nalgonda	5,750	6,900	1,150	4,140	4,600	1,150	32,200
18.	Karimanagar	10,500	12,600	2,100	7,560	8,400	2,100	58,800
19.	Nizamabad	19,750	23,700	3,950	14,220	15,800	3,950	1,10,600
20.	Adilabad	2,500	3,000	500	1,800	2,000	500	14,000
	Total:	2,50,000	3,00,000	50,000	1,80,000	2,00,000	50,000	14,00,000

STATEMENT SHOWING THE TARGETS UNDER MULTIPLE CROPPING. (A.P)

		Target for 1970-71
1.	Srikakulam	1,12,380
2.	Visakhapatnam	1,03,142
3.	East Godavari	1,12,380
4.	West Godavari	1,12,380
5.	Krishna	1,40,094
6.	Guntur	1,86,284
7.	Nellore	1,67,808
8.	Kurnool	1,95,552
9.	Anantapur	1,86,284
10.	Cuddapah	93,904
11.	Chittoor	93,904
12.	Hyderabad	66,190
13.	Nizamabad	84,666
14.	Medak	1,12,380
15.	Mahboobnagar	1,95,552
16.	Nalgonda	1,67,808
17.	Warangal	1,12,303
18.	Khammam	93,904
19.	Karimnagar	1,12,380
20.	Adilabad	1,03,142
	Total:	25,52,437

THE AREA AND PRODUCTION OF EACH OF THE FOOD GRAINS IN ANDHRA PRADESH FOR THE YEARS 1968—69 and 1969—70

Sl. No.	Name of the crop.	1968—69 Area in Hectares.	1968—69 Production in tonnes.	1968—69 Average yield in Tonnes/Hectare.	1969--70 Area in Hectares.	1969--70 Production in tonnes-	1969--70 Average yield in Tonnes/ Hectares
1.	Rice	28,49,218	35,08,438	1.23	33,00,100	40,44,800	1.23
2.	Wheat	14,211	2,936	0.21	1,16,100	4,000	0.25
	MAJOR MILLETS						
3.	Jowar	24,73,663	12,77,460	0.52	25,67,700	12,09,800	0.47
4.	Bajra	5,87,478	2,45,509	0.42	5,83,800	2,88,800	0.49
5.	Ragi	3,26,005	2,19,837	0.67	3,08,200	2,33,300	0.76
6.	Maize	2,36,812	2,47,375	1.05	2,28,300	2,91,500	1.28
	SMALL MILLETS						
7.	Korra	4,46,762	80,967	0.18	4,68,800	92,500	0.20
8.	Varagu	1,79,340	48,970	0.27	1,74,100	48,800	0.28
9.	Samai	82,415	13,596	0.16	73,500	14,900	0.20
10.	OTHER SMALL MILLETS	1,33,715	23,577	0.18	1,34,100	28,600	0.21
	PULSES						
11.	Bengalgram	82,676	19,642	0.24	77,600	20,600	0.27
12.	Redgram	1,75,599	84.859	0.48	1,89,200	48,800	0,26
13.	Blackgram	2,33,203	46,815	0.20	1,93,900	33,900	0.18
14.	Horsegram	4,37,871	58,532	0.13	3,83,600	54,500	0.14
15.	Greengram	5,01,082	56,775	0.11	4,77,900	59,100	0.12
16.	Other pulses	59,063	8,490	0.14	53,200	8,800	0.17
17.	Total pulses	14,89,494	2,75,113	0.18	13,75,400	2,25,700	0.16
18.	Total foodgrains	91,09,699	59,43,778	0.65	92,30,100	64,82,700	0.70

Source: Bureau of Economics and Statistics, A.P., Hyderabad.

AREA AVERAGE YIELD AND PRODUCTION IN MAHARASHTRA STATE

(1969-70)

Crop	Area	Av. Yied	Production
Rice	13,281	993	13,183
Wheat	8,394	492	4,131
Kharif Jowar	25,316	733	18,559
Rabi Jowar	33,537	417	13,976
Bajri	20,344	314	6,387
Maize	450	682	307
Ragi	2,127	847	1,801
Other Cereals	2,024	389	788
Total Cereals -	1.05,473	561	59,132

1. Area in 'oo' hectares
2. Av. Yield in ka/hectares
3. Production in 'oo' tonnes.

ESTIMATES OF AREA AND PRODUCTION OF PRINCIPAL CROPS IN NAGALAND

YEAR 1969--70

Crops	Area in Hectares	Yield per hect. (in kg.)		Total Production	
Cereals	90,000	—		68130	M/T
Autumn Rice					
(including Jhum Rice)	41,300	820		33,870	,,
Winter Rice	18,900	1,020		19,280	,,
Maize	9,200	613		5,640	,,
Other cereals &					
Small millets	20,600	453		9,340	,,
Pulses	3,250	500		1,330	,,
Gram	40	500		20	,,
Tur	60	660		40	,,
Rabi Pulses	1,450	400		580	,,
Beans	1,700	425		720	,,
Oil Seeds	1,912	—		806	,,
Sesamum	600	470		282	,,
Rape & Mustard	1,300	400		520	,,
Linseed	12	320		4	,,
Fibres	210	—	**Bales**	584	,,
Cotton	100	95	,,	53	,,
Jute	100	900	,,	500	,,
Mesta	10	560	,,	31	,,
Other Crops	5,818	—		51,345	,,
Sugarcane	1,350	28,000		37,800	,,
Tobacco	28	600		17	,,
Potato	3,050	4,000		12,200	,,
Sweet Potato	240	2,800		6,72	,,
Chillies	1,150	570		656	,,

Note:-1. The estimates of area and production are not based on any land records as the area in Nagaland is not cadastrally surveyed and there is no primary reporting agency in the State.

ESTIMATED AREA UNDER AND PRODUCTION OF PRINCIPAL CROPS IN TRIPURA DURING 1969—70

Crops.	Area in acres	Production in M.T. Bales.	Average yield in Kgs. per acre.
1. Rice -Aman	3,26,365	1,16,000 M.T.	355
Aus (including Jhum)	3,07,350	1,07,680 M.T.	350
Boro	24,580	11,000 M.T.	448
Total	6,58,295	2,34,680 M.T.	356
2. Pulses	7,790	1,242 M.T.	159
3. Sugarcane (Gur)	6,970	10,250 M.T.	1470
4. Potato	6,900	18,620 M.T.	2700
5. Oilseeds	15,350	2,542 M.T.	166
6. Jute	18,250	56,910 Bales	562
7. Mesta	19,550	49,440 Bales	455
8. Wheat (Ad-hoe)	743	641 M.T.	863

ALL-INDIA FINAL ESTIMATE OF RICE 1969–70

(DETAILS)

STATE	Area (Thousand hectares)			Production (Thousand Tonnes)		
	1969–70	1968–69 %	Inc. (+) or dec. (–) in col. (2) over col. (3)	1969–70	1968–69 %	Inc. (+) or dec. (–) in col. (4) over col. (6)
1	2	3	4	5	6	7
Andhra Pradesh						
Autumn	1217.7	1150.0 (E)	(+) 67.7	1850.0	1800.0 (E)	(+) 50.0
Winter	1283.7	1200.0 (E)	(+) 84.7	1700.0	1550.0 (E)	(+) 150.0
Summer	797.7	703.4 (+)	(+) 94.4	1150.0	990.5	(+) 159.5
Total	3300.1	3053.4	(+) 246.7	4700.0 (E)*	4340.5*	(+) 359.5
Assam						
Autumn	565.8 @	560.8	(+) 5.0	404.5 @*	413.2*	(—) 8.7
Winter	1517.5 @	1488.4	(+) 29.1	1488.0 @*	1687.6*	(—) 199.6
Summer (E)	160.0	150.0	(+) 10.0	165.0	150.0	(+) 15.0
Total	2243.3	2199.2	(+) 44.1	2057.5	2250.8	(—) 193.3
Bihar						
Autumn	501.5	459.0	(+) 42.5	289.0 *	227.4	(+) 61.6
Winter	4871.4	4858.8	(+) 12.6	3500.0 (E)	4770.0*	(—) 1270.0
Summer (E)	120.0	110.0	(+) 10.0	220.0	200.0	(+) 20.0
Total	2243.3	5427.8	(+) 65.1	4009.0	5197:4	(—) 1188,4

1	2	3	4	5	6	7
Gujarat						
Autumn	499.1@	489.4	(+) 9.7	447.4@*	230.0*	(+) 217.4
Haryana						
Autumn	241.0	223.0	(+) 18.0 (+)	371.0	265.0*	(+) 106.4
Jammu & Kashmir						
Winter	241.3	239.2	(+) 2.1	482.1*	487.3*	(—) 5.2
Kerala						
Autumn	393.7	394.9	(—) 1.2	521.4	521.3	(+) 0.1
Winter	382.2	380.6	(+) 1.6	537.5	571.7	(—) 34.2
Summer	96.7	150.0 (E)	(—) 53.3	156.0	307.0 (E)	(—) 151.0
Total	872.6	925.5	(—) 52.9	1214.9*	1400.0*	(—) 185.1
Madhya Pradesh						
Autumn	4319.3	4391.2	(—) 71.9	3201.6*	3004.6*	(+) 197.0
Maharashtra						
Autumn	1383.0@	1362.7	(+) 20.3	1424.7@*	1362.2*	(+) 62.5
Summer	9.3	9.3	—	6.6	6.6	—
Total	1392.3	1372.0	(+ 20.3	1431.3	1368.8	(+) 62.5

1	2	3	4	5	6	7
Mysore						
Autumn	646.3	741.0	(—) 94.7	1230.0	1111.6	(+) 118.4
Winter	360.0	383.3	(—) 23.3	850.0	739.5	(+) 110.5
Summer	100.0 (E)	68.3 (E)	(+) 31.7	210.0	150.0 (E)	(+) 60.0
Total	1106.3	1192.6	(—) 86.3	2290.0*(E)	2001.1*	(+) 288.9
Nagaland						
Autumn	41.2	40.9	(+) 0.3	31.6	32.7	(—) 1.1
Winter	19.0	18.8	(+) 0.2	18.2	20.2	(—) 2.0
Total	60.2	59.7	(+) 0.5	49.8	52.9	(—) 3.1
Orissa						
Autumn	230.9@	222.0	(+) 8.9	115.7@*	105.0*	(+) 10.7
Winter	4075.3@	3928.0	(+) 147.3	3780.9@*	4200.0*(E)	(+) 419.1
Summer	200.0(E)	149.0	(+) 51.0	420.0(E)	393.6	(+) 26.4
Toal	4506.2	4299.0	(+) 207.0	4316.6	4698.6	(—) 382.0
Punjab						
Autumn	384.4	338.0	(+) 46.4	572.9@*	460.0*	(+) 112.9
Rajastan						
Autumn	115.0	129.0	(—) 14.4	98.9	57.0	(+) 41.9
Tamil Nadu						
Autumn (I Crop)	2073.6	1889.7	(+) 183.9	3440.5	2871.1	(+) 569.4
Winter (II Crop)	574.9	617.2	(—) 42.3	1015.1	968.9	(+) 46.2
Summer (III Crop)	46.7	65.0(E)	(—) 18.3	76.6	100.0 (E)	(—) 23.4
Total	2695.2	2571.9	(+) 123.3	4532.2*	3940.0*	(+) 592.2

1	2	3	4	5	6	7
Uttar Pradesh						
Autumn	2499.1@	2470.3	(+) 28.8	1919.5@*	1532.7*	(+) 386.8
Winter	1884.8@	1900.3	(—) 16.0	1513.4@*	1289.4*	(+) 224.0
Summer (E)	150.0	150.0	—	100.0	100.0	—
Total	4533.9	4521.1	(+) 12.8	3532.9	2922.1	(—) 610.8
West Bengal						
Autumn	760.0(E)	860.9	(—) 100.9	630.0*	728.1*	(+) 98.1
Winter	4095.5(P)	3887.0	(+) 208.5	5400.0*	5300.0(E)*	(+) 100.0
Summer*	160.0(F)	90.9	(+) 69.1	320.0	221.9	(+) 98.1
Total	5015.5	4838.8	(+) 176.7	6350.0(E)	6250.0	(+) 100.0
Andaman Nicobar Islands						
Autumn	8.0	7.9	(+) 0.1	9.6	10.7	(—) 1.1
Dadra Nagarhaveli						
Winter	9·1	7.2	(+) 1.9	10.8 (+)	5.4	(+) 5.4
Delhi						
Autumn	2.8	3.1	(—) 0.3	4.1 (+)	2.3	(+) 1.8
Goa, Daman & Diu						
Autumn	44.2	44.2	(—)	57.5	51.9	(+) 5.6
Winter	6.1	6.0	(+) 0.1	8.8	9.6	(—) 0.8
Total	50.3	50.2	(+) 0.1	66.3	61.6	(+) 4.8
Himachal Pradesh						
Autumn	97.1	96.0	(+) 1.1	113.8*	98.5*	(+) 15.3
Manipur						
Autumn	144.0	167.0	(—) 23.0	232.0*	300.0 (E)	(—) 68.0

1	2	3	4	5	6	7
Nefa						
Autumn	54.6	70.0 (E)	(—) 15.4	45.2	100.0 (E)	(--) 54.8
Pondicherry						
Autumn	6.0	7.0	(—) 1.0	11.3	11.9	(—) 0.6
Winter	21.3	22.0	(—) 0.7	39.8	35 2	(+) 4.6
Summer	2.1	3.0	(—) 0.9	4.0	4.5	(—) 0.5
Total	29.4	32.0	(—) 2.6	55.1	51.6	(+) 3.5
Tripura						
Autumn	124.4	130.8	(—) 6.4	107.7	93.0	(+) 14.7
Winter	132.1	119.6	(+) 12.5	116.0	102.7	(+) 13.3
Summer	9.9	11.3	(—) 1.4	11.0	9.4	(+) 1.6
Total	266.4	261.7	(+) 4.7	234.7	205.1	(+) 29.6
All India						
Autumn	16352.7	16249.2	(+) 103.5	17129.9	15390.2	(+) 1739.7
Winter	19475.7	19056.9	(+) 418.3	20460.6	21737.5	(—) 1276.9
Summer	1852.4	1660.2	(+) 192.2	2839.2	2633.5	(+) 205.7
Total	37680.3	36966.3	(+) 714.0	40429.7	39761.2	(+) 668.5

ø — Adopted from the All-India Final Estimate, 1968-69. Partially Revised Estimates received from the States are under surutiny.

(E) — Estimated

* — Based on the results of Crop Cutting surveys.

@ — Figures for 1969-70 have been adjusted on the basis of the relationship between the Final and Fully Partially. Revised Estimates during the triennium ending 1967-68.

£ — Includes figures (area 28,200 hectares and production 5,600 tonnes during 1969-70) for the crop grown in nonreporting (forest) areas of the State.

— — Nil or Negligible.

†† — Includes an ares of 149.5 thousand hectares and production 146,4 thousand tonnes in respect of the hilly areas of Kumaun and Uttar Khand Divisions for which seeson-wise classification is not available. Production estimates for these hilly areas are based on eye-estimates

Estimates for three hilly areas are based on eye-estimatos.

(P) — Preliminary estimates based on Sub Sample A.

Notee :-

1. In Tamil Nadu Statistics of rice are actually collected by I, II & III crops, which, for purposes of All-India Estimates, are broadly classified into Autumn, Winter and Summer crops respectiʌely.
2. Territories not mentioned above do not grow rice to any appreciable extent.

ALL-INDIA FINAL ESTIMATE OF JOWAR 1969-70

(DETAILS)

STATE	Area (Thousand hectares)			Production (Thousand tonnes)		
	1969–70	1968–69 ø	Inc. (+) or Dec. (-) in Col. (2) over Col. (3)	1969–70	1968–69 ø	Inc. (+) or Dec. (-) in Col. (5) over Col. (6)
1	2	3	4	5	6	7
Andhra Pradesh						
Kharif	1309.7	1260.4	(+) 49.3	716.5	565.5	(+) 151.0
Rabi	1414.6	1420.5	(—) 5.9	634.8	754.9	(—) 120.1
Total	2724.3@	2680.9	(+) 43.4	1351.3*@	1320.4*	(+) 30.9
Bihar						
Kharif	9.4	12.1	(—) 2.7	5.1	3.0	(+) 2.1
Gujarat						
Kharif	1125.6	1124.8	(+) 0.8	240.1	201.3	(+) 38.8
Rabi	189.4	171.5	(+) 17.9	146.5	115.3	(+) 31.2
Total	1315.0	1296.3	(+) 18.7	386.6*	316.6*	(+) 70.0
Haryana						
Kharif	234.0	209.0	(+) 25.0	55.0*	26.0*	(+) 29.0
Jammu & Kashmir						
Kharif	0.1	0.2	(—) 0.1	0.1	0.1	

1	2	3	4	5	6	7
Kerala						
Kharif	1.5	1.2	(+) 0·3	0.6	0.5	(+) 0.1
Madhya Pradesh						
Kharif	2401.0 P	2690.6	(—) 289.6	1452.2	1800.0(P)	(—) 347.8
Rabi	25.3	17.3	(+) 8.0	15.3	12.4	(+) 2.9
Total	2426.3@	2707.9	(—) 281.6	1467.5*@	1812.4*	(—) 344.9
Maharashtra						
Kharif	2638.3	2712.1	(—) 73.8	1752.5	2018.6	(—) 266.1
Rabi	3452.5	3578.0	(—) 125.5	1461.7	1530.3	(—) 68.6
Total	6090.8	6290.1	(—) 199.3	3214.2*	3548.9*	(—) 344.7
Mysore						
Kharif	1303.9	1149.0	(+) 154.9	900.0	624.3	(+) 275.7
Rabi	1850.0 (E)	1922.3	(—) 72.3	900.0	1012.7	(—) 112.7
Total	3153.9	3071.3	(+) 82.6	1800.0* (E)	1637.0*	(+) 163.0
Orissa						
Kharif	16.9	14.3	(+) 2.6	13.5	12.0	(+) 1.5
Punjab						
Kharif	3.0	3.0	—	3.0	3.0	—
Rajasthan						
Kharif	1167.1 @	945.8	(+) 221.3	413.9@	199.3*	(+) 214.6

Tamil Nadu								
Kharif	559.0	422.0	(+)	137.0	437.6	296.4	(+)	141.2
Rabi	172.5	244.1	(—)	71.6	137.5	171.7	(—)	34.2
Total	731.5	666.1	(+)	65.4	575.1*	468.1*	(+)	107.0
Uttar pradesh								
Kharif	722.1	823.6	(—)	101.5	431.4*	452.7*	(—)	21.3
West Bengal								
Kharif	0.5	1.4	(—)	0.9	0.3	0.9	(—)	0.6
Rabi	—	—		—	—	—		—
Total	0.5	1.4	(—)	0.9	0.3	0.9	(—)	0:6
Delhi								
Kharif	7.9	8.0	(—)	0.1	3.1	2.7	(+)	0.4
Himachal Pradesh								
Kharif	0.5	—	(+)	0.5	0.2	—	(+)	0.2
Pondicherry								
Kharif	0.1	—	(+)	0.1	0.1	—	(+)	0.1
Total India								
Kharif	11500.6	11377.5	(+)	123.1	6425.2	6206.3	(+)	218.9
Rabi	7104.3	7353.7	(—)	249.4	3295.8	3597.3	(—)	301.5
Total	18,604.2	18,731.2	(—)	126.3	9,721.0	9,803.6	(—)	32.6

ø Adopted from the All India Final Etimate 1968-69. Partially Revised Estimates received from the states are under scrutiny

@ Figures for 1969–70 have been adjusted on the basis of the relationship between the Final and Fully/Partially Revised Estimate during the trennium ending 1967–68.

* Based on the results of crop cutting surveys.

– Nil or Negligible.

† Includes the following data in respect of crop growing in non-reporting (forest) areas of Madhya Pradesh for 1969-70.

	Area (Hectares)	Production (Tennes)
Kharif	9538	4100
Rabi	Neg	Neg
Total	9538	4100

(E) Estimated·

(P) Provisional.

Note :— States and Territories not mentioned above do not grow jowar to any apperciable extent.

ALL INDIA FINAL ESTIMATE OF BAJRA, 1969-70

(DETAILS)

STATE	Area (Thousand hectares)			Production (Thousand tonnes)		
	1969–70	1968–69 ø	Inc. (+) or Dec. (–) in Col. (2) over Col. (3)	1969–70	1968–69 ø	Inc. (+) or Dec. (–) in Col. (5) over Col. (6)
1	2	3	4	5	6	7
Andhra Pradesh	601.9@	572.3	(+) 29.6	320.0*@	232.4*	(+) 87.6
Bihar	15.0	16.4	(—) 1.4	7.5	7.3	(+) 0.2
Gujarat	1784.2@	1640.2	(+) 144.0	1204.4*@	800.0* (E)	(+) 404.4
Haryana	928.0	872.0	(+) 56.0	516.0*	500.0 (E)	(+) 215.0
Jammu & Kashmir	11.4	17.2	(—) 5.8	7.0	5.9	(+) 0.1
Madhya Pradesh *	275.5@	299.8	(—) 24.3	167.8*@	147.8*	(+) 20.0
Maharashtra	2257.2@	1890.5	(+) 366.7	762.9*@	597.8*	(+) 165.1
Mysore	566 7@	512.9	(+) 53.8	226.6*@	150.4*	(+) 66.2
Orissa	2.6	2.1	(+) 0.5	2.5	1.9	(+) 0.6
Punjab	201.3@	192.0	(+) 9.3	221.9* @	201.0*	(+) 20.9
Rajasthan	4346.4	4563.7	(—) 217.3	807.8*	500.0 (E)	(+) 307.8
amil Nadu	459.3	401.9	(+) 57.4	309.9*	253.0*	(+) 56.9
Uttar Pradesh **	1020.2	1049.9	(—) 29.7	752.7*	577.7*	(+) 175.0
West Bengal	0.2	0.2	—	0.1	0.1	—
Delhi	20.8	19.1	(+) 1.7	17.6*	14.0*	(+) 3.6
Himachal Pradesh	0.1	0.1	—	—	—	—
Pondicherry	2.0	1.5	(+) 0.5	2.1	1.5	(+) 0.6
TOTAL INDIA	12492.8	12051.8	(+) 441.0	5326.8	3801.8	(+) 1525.0

ø — Adopted from the All-India Final Estimate, 1968-69. Partially revised estimates received from the states are under Scrutiny.

@ — Figures for 1969-70 have been adjusted on the basis of the relationship between the Final and Fully/Partially Revised Estimates during the triennium ending 1967-68.

* — Based on the results of Crop Cutting surveys

(E) — Estimated

† — Includes area 1'450 hectares and production 190 tonnes during 1969-70 for the crop grown in non-reporting (forest) area of Madhya Pradesh.

†† — Includes a provisional area of 164 hectares and a production of 73 tonnes for the crop grown in the hilly districts of Kumaun and Uttar khand Divisions for which yield data are based on eye estimates.

— — Nil or Negligible.

STATEMENT II

ALL-INDIA FINAL ESTIMATE OF MAIZE, 1969-70

(DETAILS)

STATE	Area (Thousand hectares)			Production (Thousand tonnes)		
	1969–70	1968–69 ø	Inc. (+) or Dec. (–) in Col. (2) over Col. (3)	1969–70	1968–69 ø	Inc. (+) or Dec. (–) in Col. (5) over Col. (6)
1	2	3	4	5	6	7
Andhra Pradesh	242.5@	241.9	(+) 0.6	309.6*@	265.0*	(+) 44.6
Assam	26 9	26.2	(+) 0.7	14.5	14.0	(+) 0.5
Bihar	953.3@	957.5	(—) 4.2	865.6*@	1109.0*	(—)153.4
Gujarat	290.8@	275.7	(+) 15.1	289.1@	149.1*	(+)140.0
Haryana	109.0	99.0	(+) 10.0	138.0*	73.0*	(+) 65.0
Jammu & Kashmir	256.3	244.6	(+) 11.7	363.0*	325.6*	(+) 37.4
Madhya Pradesh †	623.3@	618.9	(+) 4.4	417.7*@	350.9*	(+) 66.8
Maharashtra	54.3@	37.3	(+) 17.0	57.5@	51 5	(+) 6.0
Mysore	55.9	56.0	(—) 0.1	104.9	120.0	(—) 15.1
Orissa	72.0@	65.2	(+) 6.8	60.8@	54.0	(+) 6.8
Punjab	562.9@	481.0	(+) 81.9	826.8*@	720.0* (E)	(+) 76.8
Rajasthan	782.9	794 9	(—) 12.0	518.0*	62.6* (E)	(—)104.6
Tamil Nadu	12.9	9.0	(+) 3.9	13.9	9.4	(+) 4.5
Uttar Pradesh ††	1505.3	1502.1	(+) 3.2	1192.2*	1338.2*	(—)146.0
West Bengal	50.4	45.5	(+) 4.9	45.5	39.2	(+) 6.3
Delhi	1.3	1.4	(—) 0.1	0.9	0.9	—
Himachal Pradesh	255.9	252.1	(+) 3.8	443.5*	500.0* (E)	(—) 56.5
Manipur	6.3	7.5	(—) 1.2	12.8*	18.7*	(—) 5.9
TOTAL INDIA	5862.2	5715.8	(+)146.4	5674.3	5701.1	(—) 26.8

F. No. 41

ø — Adopted from the All-India Final Estimate, 1968-69. Partially revised estimates received from the states are under scrutiny.

@ — Figures for 1969-70 have been adjusted on the basis of the relationship between the Final and Fully/Partially Revised Estimates during the triennium ending 1967-68.

* — Based on the results of Crop Cutting surveys.

† — Includes figures of area 7,876 hectares and production 1,343 tonnes during 1969-70 for the crop grown in non-reporting (forest) area of the State.

†† — Includes 9,837 hectares and 10,601 tonnes during 1969-70 in respect of the hilly regions of Kumaun and Uttarkhand divisions estimated on the basis of random sample surveys. The yield data are based on eye estimates.

(E) — Estimated.

NOTE :- States and Territories not mentioned above do not grow maize to any appreciable extent.

ALL INDIA FINAL ESTIMATE OF RAGI 1969-70

DETAILS

STATE	Area (Thousand hectares)			Production (Thousand tonnes)		
	1969-70	1968-69 ø	Inc (+) or Dec (-) in Col. (2) over Col (3)	1969-70	1968-69 ø	Inc. (+) or Dec. (-) in Col. (5) over Col. (6)
1	2	3	4	5	6	7
Andhra Pradesh	339.3@	314.1	(+) 25.2	267.4*@	255.5*	(+) 11.9
Bihar	175.9	183.4	(—) 4.5	80.8	99.1	(—) 18.3
Gujarat	57.8@	55.1	(+) 2.7	55.4*@	27.9*	(+) 27.5
Kerala	5.0	5.0	—	7.6	7.1	(+) 0.5
Madhya Pradesh †	19.7	17.9	(+) 1.8	5.4	4.7	(+) 0.7
Maharashtra‡	221 0	223.0	(—) 2.0	130.0*	192.8*	(—) 62.8
Mysore	1200.0@	780.6	(+)419 4	866.0* @	469.1*	(+)385.9
Orissa	154.6@	127.6	(+) 27.0	159.2 @	145.5	(+) 13.7
Punjab	—	0.2	(—) 0.2	—	—	—
Tamil Nadu	336.1	294.5	(+) 41.6	336.7*	286.0*	(+) 50.7
Uttar Pradesh @@	245.2	212.2	(+) 33.0	195.4*	136.2*	(+) 59.2
West Bengal	8.9	9.5	(—) 0.6	7.3	7.5	(—) 0.2
Dadra and Nagar Haveli	2.4	2.6	(—) 0.2	1.5*	3.9*	(—) 2.4
Himachal Pradesh	14.0	13.9	(+) 0.1	10.6	10.5	(+) 0.1
Pondicherry	3.5	1.6	(+) 1.9	4.9	2.2	(+) 2.7
ALL-INDIA	2783.4	2238.2	(+)545.2	2117.2	1648.0	(+)469.2

ø — Adopted from the All-India Final Estimate of Ragi 1968-69. Partially Revised Estimates received from the states are under scrutiny.

@ — Figures for 1969-70 have been adujsted on the basis of the relationship between the Final and Fully/Partially Revised Estimates during the triennium ending 1967-68.

* — Based on the results of Crop Cutting surveys.

† — Includes Figures of area 184 hectares and production 21 tonnes for 1969-70 in respect of the crop grown in non-reporting (forest) area of the State.

† — In the case of Maharashtra, production figures of Thana, Poona, Ratnagiri, Satara, Kolaba, Nasik, Dhulia, Ahmednagar and Kolhapur districts only are based on the results of crop cutting surveys.

— Nil or Negligible

@@ — Data relating to Uttar Pradesh include area figure of 212,510 hectares and production figure of 174711 tonnes for 1969-70 in respect of the hilly regions of Kumaun and Uttar khand Divisions where production figures are based on the results of crop cutting surveys.

Note :- States and Territories not mentioned above do not grow ragi to any appreciable extent.

ALL-INDIA FINAL ESTIMATE OF SMALL MILLETS 1969-70

DETAILS

STATE CROP	Area (Thousand hectares)			Production (Thousand tonnes)		
	1969–70	1968–69 ø	Inc (+) or Dec. (–) in Col (2) over Col. (3)	1969–70	1968–69 ø	Inc. (+) or Dec. (–) in Col. (5) over Col. (6)
1	2	3	4	5	6	7
Andhra Pradesh						
Kharif						
Korra		423.3				
Varagu		28.8				
Samai		69.5				
Others		105.0				
Total		626.6				
Rabi						
Korra		33.6				
Varagu		122.6				
Samai		2.9				
Others		18.3				
Total		177.4				
State Total	850.5**	804.0	(+) 46.5	184.7**	180.0 (E)**	(+) 4.7
Assam**						
Kharif	6.3	6.0	(+) 0.3	3.1	3.0	(+) 0.1
Bihar**						
Kharif	224.5	239.1	(–) 14.6	102.5	95.9	(+) 6.6

1	2	3	4	5	6	7
GUJARAT						
Kharif						
Kodra	89.5	88.9	(+) 0.6	75.8*	40 7*	(+) 35.1
Others	55.4	56.5	(—) 1.1	37.6	32.8	(+) 4.8
Total	144.9	145.4	(—) 0.5	113.4	73.5	(+) 39.9
Rabi	1.9	5.5	(—) 3.6	1.3	2.6	(—) 1.3
STATE TOTAL Kharif & Rabi)	146.8	150.9	(—) 4.1	114.7	76.1	(+) 38.6
HARYANA						
Kharif**	0.2	0.1	(+) 0.1	0.1	—	(+) 0.1
Jammu & Kashmir						
Kharif						
Trumba	2.7			1.0		
Kangani	1.0			0.6		
Kodra & Mandal	1.0			0.2		
Sewal	0.1			—		
Salan (Ganhar)	—			—		
Cheena	2.1			1.0		
Total	6.9			2.8		
Rabi						
Grim	7.2 (a)			5.5 (a)		
State Total	14.1	30.0** (E)	(—) 15.9	8.3	25.0 (E)**	(—) 16.7
Kerala						
Kharif**	6.7	6.6	(+) 0.1	3.5	3.1	(+) 0.4

1	2	3	4	5	6	7
MADHYA PRADESH						
Kharif						
Kodon-Kutki	1360.8	1380.5	(—) 19.7	285.9*	279.8*	(+) 6.1
Sawa	149.4	157.6	(—) 8.2	46.9	44.9	(+) 2.0
Rala	6.8	8.1	(—) 1.3	1.6	1.5	(+) 0.1
Kakum	2.4	2.7	(—) 0.3	0.5	0.6	(—) 0.1
Basara	21.3	21 8	(—) 0.5	4.6	5.1	(—) 0.5
Others	96.5	89.2	(+) 7.3	29.1	25.8	(+) 3.3
Total	1637.2	1659.9	(—) 22.7	368.6	357.7	(+) 10.9
Rabi (Rajgira)	4.5	4.2	(+) 0.3	1.2	1.1	(+) 0.1
STATE TOTAL (Kharif & Rabi)	1641.7	1664.1	(—) 22.4	369.8	358.8	(+) 11.0
MAHARASHTRA						
Kharif						
Kodra	43.4	42.4	(+) 1.0	24.2	23.8	(+) 0.4
Italian Millets	14.8			5.6		
Vari	79.2			32.0		
Banti-Bhadli	21.3	167.7	(+) 4.6	4.3	68.8**	(—) 7.8
Sawa	27.0			11.1		
Kodon-Kutki little millets	16.4			4.8		
Others	13.6			3.2		
Total	215.7	210.1	(+) 5.6	85.2	92.6	(—) 7.4
Rabi	1.9	1.6	(+) 0.3	0.4	0.4	—
STATE TOTAL (Kharif & Rabi)	217.6	211.7	(+) 5.9	85.6	93.0	(—) 7.4
MYSORE						
Kharif						
Navane	171.7	193.1	(—) 21.4	33.3		
Haraka	30.5	48.7	(—) 18.2	8.6		

1	2	3	4	5	6	7
Save	83.4	70.3	(+) 13.1	25.2		
Baragu	10.3	5.6	(+) 4.7	3.4		
Badli Vari	2.3	2.3	—	0.4		
Others	8.9	19.0	(—) 10.1	2.5		
Total	307.1	339.0	(—) 31.9	75.4	113.0**	(—) 39.6
ORISSA						
Kharif**	166.7	149.7	(+) 17.0	62.3	100.0 (E)	(—) 37.7
PUNJAB						
Kharif**	0.3 (a)	0.3	—	0.2 (a)	0.2	—
RAJASTHAN						
Kharif	74.4	60.6	(+) 13.8	17.8	13.0 (E)	(+) 4.8
Rabi	3.2 (a)	3.2	—	1.5 (a)	1.5	—
Total**	77.6	63.8	(+) 13.8	19.3	14.5	(+) 4.8
TAMIL NADU						
Kharif						
Korra	14.5	13.5	(+) 1.0	11.3	10.2	(+) 1.1
Varagu	196.9	192.5	(+) 4.4	209.3	200.4	(+) 8.9
Samai	149.7	137.0	(+) 12.7	64.3	63.6	(+) 0.7
Others	44.7	30.7	(+) 14.0	24.1	16.6	(+) 7.5
Total	405.8	373.7	(+) 32.1	309.0	290.8	(+) 18.2
Rabi						
Korra	5.4	4.9	(+) 0.5	3.9	3.7	(+) 0.2
Varagu	26.9	46.6	(—) 19.7	24.8	47.2	(—) 22.4
Samai	36.6	36.3	(+) 0.3	17.3	17.9	(—) 0.6
Others	11.7	12.7	(—) 1.0	6.3	6.7	(—) 0.4
Total	80.6	100.5	(—) 19.9	52.3	75.5	(—) 23.2

1	2	3	4	5	6	7
STATE TOTAL (Kharif & Rabi)	486.4	474.2	(+) 12.2	361.3	366.3	(—) 5.0
UTTAR PRADESH						
Kharif						
Kodon	316.7	316.7	—	194.2	199.3	(—) 5.1
Kutki	4.4	2.4	(+) 2,0	1.6	0.6	(+) 1.0
Kakun	9.7	14.0	(—) 4.3	4.1	6.1	(—) 2.0
Sawan	182.1	202.9	(—) 20.8	83.5	108.8	(—) 25.3
Total	512.9	536.0	(—) 23.1	283.4	314.8	(—) 31.4
Rabi						
Chena	32.4 (a)	32.4	—	34.0 (a)	34.0	—
STATE TOTAL (Kharif & Rabi)	545.3	568.4	(—) 23.1	317.4	348.8	(—) 31.4
WEST BENGAL**						
Kharif	11.5	10.0	(+) 1.5	6.7	5.4	(+) 1.3
Rabi	1.4 (a)	1.4	—	1.1 (a)	1.1	—
Total	12.6	11.4	(+) 1.5	7.8	6.5	(+) 1.3
HIMACHAL PRADESH						
Chalai	8.8			7.4		
Cheena	2.7			1.8		
Kangni	2.8			1.7		
Ogla	2.6			1.6		
Others	11.1			5.5		
STATE TOTAL	28.0	26.9**	(+) 1.1	18.0	19.5**	(—) 1.5
ALL-INDIA**						
(Kharif & Rabi)	4732.7	4746 2	(—) 13.5	1732.0	1803.7	(—) 71.7

ø — Adopted from the All India Final Estimate, 1968-69. Partially Revised Estimates received from the States are under scrutiny.

** — Millet-wise break-up not available.

* — Based on the results of Crop Cutting Surveys.

(E) — Estimated.

(a) — In the absence of information for the current year, last years data has been repeated.

† — Data relating to Kodon Kutki in respect of Madhya Pradesh State include 12.8 thousand hectares and 2.4 thousand tonnes for the Crop grown In non-reporting (forest) area during 1969-70.

— — Nil or Negligible.

Note :- States and Territories not mentioned above do not grow small millets to any appreciable extent.

STATEMENT II

ALL-INDIA FINAL ESTIMATE OF WHEAT, 1969-70

STATE	Area (Thousand hectares)			Production (Thousand tonnes)		
	1969-70	1968-69 ø	Inc. (+) or Dec. (-) in Col. (2) over Col. (3)	1969-70	1968-69 ø	Inc. (+) or Dec. (-) in Col. (5) over Col. (6)
1	2	3	4	5	6	7
Andhra Pradesh	16.1	12.7	(+) 3.4	4.0	3.0	(+) 1.0
Assam	11.8	7.5	(+) 4.3	7.1	4.7	(+) 2.4
Bihar	1145.0	1095.3	(+) 49.7	1200.0*(E)	1259.0*	(—) 59.0
Gujarat	432.6	502.5	(—) 69.9	591.6*	620.5*	(—) 28.9
Haryana	1017.1@	895.0	(+)122.1	2110.5*@	1522.0*	(+)597.5
Jammu & Kashmir	210.0(E)	200.0(E)	(+) 10.0	250.0(E)	210.0(E)	(+) 40.0
Madhya Pradesh	3175.7@	3055.6	(+)120.1	2210.0*@	2007.5*	(+)208.5
Maharashtra	865.1	873.1	(—) 8.0	390.5*	428.1*	(—) 37.6
Mysore	327.3@	309.5	(+) 17.8	136.3*@	160.0*	(—) 23.7
Orissa	14.9	14.1	(+) 0.8	18.9	17.4	(+) 1.5
Punjab	2162 0(E)	2086.0	(+) 76.0	4800.0*(E)	4520.0*	(+)280.0
Rajasthan	1253.6@	1162.3	(+) 91.3	1275.3*@	1178.1*	(+) 97.2
Tamil Nadu	1.1	1.1	—	0.4	0.4	—
Uttar Pradesh	5378.4	5239.1	(+)139.3	6314.3*	6086.8	(+,227.5
West Bengal	240.0(E)	150.0(E)	(+) 90.0	400.0*(E)	300.0*(E)	(+)100.0
Delhi	44.8	41.8	(+) 3.0	69.4*	75.0*(E)	(—) 5.6
Himachal Pradesh	330.0(E)	312.5	(+) 17.5	308.0*(E)	259.1*	(+) 40.9
Total	16625.5	15958.1	(+)667.4	20093.3	18651.6	(+)1441.7

ø — Adopted from the All-India Final Estimate, 1968–69.

Partially Revised Estimates received from the States are under scrutiny.

* — Based on the results of crop eutting surveys.

@ — Figures for 1969-70 have been adjusted on the basis of the relationship between the Final and Fully / Partially Ravised Estimates during the triennium ending 1967-68.

(E) — *Estimated.* — — Nil or Negligible.

† — Includes an Area of 2800 hectares and production of 900 tonnes during 1969-70 for the Crop grown in non-reporting (forest) area of Madhya Pradesh.

Note:— States and Territories not mentioned above do not grow wheat to any appreciable extent.

STATEMENT II

ALL-INDIA FINAL ESTIMATE OF BARLEY, 1969-70.

DETAILS

STATE	Area (Thousand hectares)			Production (Thousand tonnes)		
	1969–70	1968–69 ø	Inc (+) or Dec. (-) in Col. (2) over Col. (3)	1969–70	1968–69 ø	Inc. (+) or Dec. (-) in Col. (5) over Col. (6)
1	2	3	4	5	6	7
Bihar	264.0	293.6	(—) 29.6	167.0*	183.0	(—) 16.0
Gujarat	6.7	5.5	(+) 1.2	2.2	1.9	(+) 0.3
Haryana	141.0	166.0	(—) 25.0	180.0*	195.0*	(—) 15.0
Jammu & Kashmir	19.5(E)	19.5 (E)	—	10.0(E)	10.0(E)	—
Madhya Pradesh	176.0	170.2	(+) 5.8	165.7*	126.8*	(+) 38.9
Maharashtra	3.5	3.5	—	2.5	2.7	(—) 0.2
Mysore	4.3	4.8	(—) 0.5	2.9	3.2	(—) 0.3
Punjab	80.0(E)	82.0	(—) 2.0	80.0*(E)	70.0*	(+) 10.0
Rajasthan	473.4	500.5	(—) 27.1	511.7*	378.7*	(—) 67.0
Uttar Pradesh	1484.9	1411.2	(+) 73.7	1467.0*	1149.5	(+)317.5
West Bengal	63.9(a)	63.9	—	49.8(a)*	49.8*	—
Delhi	2.7	2.5	(+) 0.2	2.5*	2.0*	(+) 0.5
Himachal Pradesh	45.0(E)	35.0	(+) 10.0	75.0*(E)	51.2*	(+) 23.8
TOTAL INDIA	2764.9	2758.2	(+) 6.7	2716.3	2423.8	(+)292. 5

ø — Adopted from the All India Final Estimate of Barley 1968-69. Partially revised estimates received from the States are under scrutiny.

* — Based on the results of crop cutting surveys.

(a) — Last year's data repeated for want of information for the current year.

(E) — Estimated.

— — Nil or Negligible.

† — Includes figures (area 365 hectares and production 119 tonnes) during 1969-70 for the crop grown in non-reporting (forest) area of the State.

† — Includes 39296 hectares & 42493 tonnes for the crop grown in hilly regions of Kumaon & Uttar Khand in Uttar Pradesh during 1969-70 for which production figures are based on eye estimates.

Note :— States and territories not mentioned above do not grow barley to any appreciable extent.

MILLETS - WORLD AREA.

	Cholam (Sorghum)		Other millets.		Maize	
	Area in 00' hectares.	Production in kg/ha.	Area in 00' hectares.	Production in kg/ha.	Area in 00' hectares.	Production in kg/na.
India	1,80,120	540	2,13.690	450	45,910	990
Africa	53,100	—	46,100	—	1,38,300	1,080
U. S. A.	48,470	2,580	—	—	3,34,000	3,070
South America	10,200	1,160	—	—	1,40,100	1,360
Pakistan	5,860	500	9,110	420	—	—
Australia	1,400	1,390	220	1,110	860	2,010
France	240	2,550	4	1,070	8,860	2,350
Spain	220	2,360	40	1,720	5,140	2,340
Hungary	800	1,730	30	620	12,090	2,900
Japan	80	980	—	—	—	—
Italy	60	4,040	—	—	10,720	3,660
Yugoslavia	60	5,550	5	960	24,300	2,860
Czekoslovakia	20	630	10	1,200	1,750	2,650
Ceylon	10	690	—	—	—	—
Bulgaria	—	—	30	680	6,580	3,130
Austria	—	—	10	1,920	500	4,420
Poland	—	—	220	1,230	80	2,250
U. S. S. R.	—	—	35,000	990	—	—
China	—	—	50	1,120	—	—
Total :	3,00,640	—	2,77,519	—	7,34,190	—

AREA AND PRODUCTION OF FOOD CROPS

Year ended June:	1955-56	1960-61	1966-67	1967-68	1968-69
Area Mn. hectare					
Rice	31.5	34.1	35.3	36.4	37.0
Wheat	12.4	12.9	12.8	15.0	16.0
Jowar	17.4	18.4	18.1	18.4	18.7
Bajra	11.3	11.5	12.2	12.8	12.1
Maize	3.7	4.4	5.1	5.6	5.7
Ragi	2.3	2.5	2.3	2.3	2.2
Barley	3.4	3.2	2.8	3.4	2.8
Small millets	5.3	5.0	4.6	4.9	4.7
Gram	9.8	9.3	8.0	8.3	7.1
Other pulses	13.4	14.3	14.1	14.4	14.2
Total foodgrains	**110.6**	**115.6**	**115·3**	**121.4**	**120.4**
Production Mn. tonnes					
Rice	27.6	34.6	30.4	37.6	39.8
Wheat	8.8	11.0	11.4	16.5	18.7
Jowar	6.7	9.8	9.2	10.0	9.8
Bajra	3.4	3.3	4.5	5.2	3.8
Maize	2.6	4.1	4.9	6.3	5.7
Ragi	1.8	1.8	1.6	1.9	1.6
Barley	2.8	2.8	2.3	3.5	2.4
Small millets	2.1	1.9	1.5	1.9	1.8
Gram	5.4	6.3	3.6	6.0	4.3
Other pulses	5.6	6.5	4.7	6.1	6.1
Total foodgrains	**66.9***	**82.0**	**74.2**	**95.1**	**94.0†**

Note: Figures for 1968-69 are subject to revision. Also see Table 123.

* Including non-reporting areas, production was 69.2 mn. tonnes.

† Foodgrains production in 1966-70 is 99.5 mn. tonnes.

IMPORTS OF FOODGRAINS : QUANTITY & VALUE*

	Quantity				Value of foodgrains imports
	Rice	Wheat†	Others	Total	
	'000 tonnes				Rs. crores
1956	330	1,113	—	1,443	56
1961	384	3,092	19	3,495	130
1965	783	6,583	96	7,462	290
1966	787	7,833	1,739	10,358	523
1967	453	6,400	1,819	8,672	532
1968	446	4,765	482	5,694	361
1969	487	3,090	295	3,872	253

* Including imports from U. S. A under P. L. 480.

† Including flour.

AVAILABILITY OF FOODGRAINS

	Net quantity available*				
	Annual total (Mn. tonnes)		Per capita per day (Grams)		
	Cereals	Pulses	Cereals	Pulses	Total
1956	52.3	10.2	359	70	430
1961	64.3	11.1	398	69	467
1965	73.7	10.9	415	61	476
1966	64.7	8.6	355	47	402
1967	66.6	7.3	357	39	396
1968	76.3	10.6	398	55	453
1969	76.8	9.1	392	47	438

* Total domestic production (*less* quantity provided for seed requirements etc.) *plus* imports, *minus* exports and adjustments for changes in Government stocks.

	1960-61	1966-67	1967-68	1968-69
	'000 tonnes of nutrients			
Nitrogenous fertilisers (N)				
Production	101	308	354	541
Consumption	210	840	1,040	1,208
Phosphntic fertilisers (P_2O_5)				
Production	53	145	191	210
Consumption	70	250	340	382
Potassic fertilisers* (K_2O)	26	115	170	170

* consumption estimates: there is no indigenous production.

CROPPED AREA AND IRRIGATED AREA

	Net area sown	Total Cropped area*	Net area irrigated	Gross area irrigated*	Gross irrigated as% of cropped area
	Mn. hectares				
1955-56	129.2	147.3	22.8	25.6	17.4
1960-61	133.2	152.7	24.6	27.9	18.3
1961-62	135.4	156.1	24.9	28.5	18.3
1962-63	136.3	156.8	25.7	29.5	18.8
1963-64	136.4	156.8	25.9	29.7	18.9
1964-65†	137.9	158.1	26.1	31.2	19.7
1965-66†	136.1	155.3	26.7	31.2	20.1
1966-67†	137.0	156.6	27.5	32.7	20.9

* Sum of net area sown / irrigated and area sown / irrigated more than once during the year.

† Provisional

AREA IRRIGATED BY SOURCES AND CROPS

	1955.56	1960-61	1964-65	1965-66
	Mn. hectares			
Source wise				
Government canals	8.0 (35.3)	9.2 (37.2)	9.9 (37.7)	9.8 (37.2)
Private canals	1.4 (6.0)	1.2 (4.9)	1.1 (4.4)	1.1 (4.3)
Tanks	4.4 (19.4)	4.6 (18.5)	4.8 (18.4)	4.4 (16.8)
Wells	6.7 (29.6)	7.3 (29.6)	7.8 (29.9)	8.4 (31.9)
Others	2.2 (9.7)	2.4 (9.8)	2.5 (9.6)	2.6 (9.8)
Total net irrigated area	22.8 (100.0)	24.6 (100.0)	26.1 (100.0)	26.7* (100.0)
Crop wise				
Rice	11.0 (43.0)	12.5 (44.7)	13.4 (44.4)	13.1 (42.4)
Wheat	4.2 (16.2)	4.2 (15.2)	4.9 (16.1)	5.2 (16.9)
Sugarcane	1.3 (5.0)	1.7 (6.0)	1.7 (5.4)	2.0 (6.5)
Oilseeds	0.3 (1.1)	0.4 (1.5)	0.5 (1.5)	0.5 (1.8)
Cotton	0.8 (3.3)	1.0 (3.5)	1.3 (4.0)	1.3 (4.1)
Total gross irrigated area†	25.6 (100.0)	27.9 (100.0)	31.2 (100.0)	31.2 (100.0)

Note : Figures in brackets show percentages to total irrigated area.

* Including some areas for which details are not available.

† Including irrigated area under other crops.

AREA UNDER HIGH-YIELDING VARIETIES PROGRAMME

	Area under HYV* ('000 hectares)	HYV area as % of total cropped area	Average yield (kg. per hectare)	
			All-India	HYV area†
1967-68				
Wheat	2,942	19.6	1,103	2,655
Paddy	1,785	4.9	1,546	2,434
Jowar	603	3.3	545	788
Bajra	419	3.3	405	1,092
Maize	287	5.1	1,123	2,044
Total	6,036	6.8	....	...
1968-69				
Wheat	4,793	30.0	1,169	2,463
Paddy	2,629	7.1	1,613	3.990
Jowar	690	3.7	523	1,063
Bajra	745	6 2	316	870
Maize	388	6.8	997	2,503
Total	9,245	10.3		

* Cumulative figures.

† Based on sample studies mede by the Programme Evaluation Organisation of the Planning Commission. Yield estimates of wheat are for the Rabi season and the others for Kharif season.

NUMBER OF TRACTORS, ELECTRIC PUMPS AND OIL ENGINES IN USE (STATE-WISE)

As of April :	Tractors*		Electric pumps†		Oil engines†	
	1961	1966	1961	1966	1961	1966
	000s					
Andhra Pradesh	1.8	2.9	17.0	57.2	33.9	46.7
Assam	0.5	0.8	—	—	—	0.4
Bihar	1.5	2.1	1.9	6.9	3.2	3.7
Gujarat	2.0	3.2	6.2	14.7	45.0	112.4
Kerala	0.3	0.4	2.6	4.9	3.4	6.8
Madhya Pradesh	2.0	2.5	2.2	6.1	9.7	16.5
Maharashtra	1.4	3.3	6.5	38.0	63.7	146.8
Mysore	1.0	2.6	12.4	27.1	10.1	24.6
Orissa	0.2	0.7	0.1	0.2	1.2	0.7
Punjab‡	7.9	15.5	8.8	32.5	8.2	29.3
Rajasthan	3.2	4.2	0.5	5.0	2.5	7.3
Tamil Nadu	1.4	3.3	98.5	208.5	36.8	42.9
Uttar Pradesh	7.1	10.1	3.0	10.2	8.4	28.1
W. Bengal	0.3	1.5	0.3	0.6	3.6	4.2
Total (incl. other areas)	31.0	54.0	160.2	414.6	230.0	471.0

* For agricultural purposes.

† For irrigation purposes.

‡ Figures relate to the erstwhile State of Punjab.

OUTPUT & YIELD OF SELECTED AGRICULTURAL CROPS IN MAJOR PRODUCING COUNTRIES, 1966

N.B. Figures under the 'Output' columns show the percentage share of each country in the total world production of Rice (253.1 mn. tonnes), Wheat (308.3 mn. tonnes). Cotton (10.7 mn. tonnes) and Groundnut (16.0 mn. tonnes) respectively. Yield figures are expressed in 100 kg per hectare.

	Rice (Paddy)			Wheat	
	Output	Yield		Output	Yield
India	18.0	12.8	India	3.4	8.2
Brazil	2.3	14.5	Argentina	2.0	12.0
Burma	2.6	14.7	Australia	4.1	15.3
Indonesia	5·6	18.4	Canada	7.3	18.7
Japan	6.5	50.9	France	3.7	28.3
Pakistan	6.5	15.7	Turkey	3.2	12.0
Philippines	1.6	13.5	U.S.A.	11.6	17.7
Thailand	4.7	17.2	U.S.S.R.	32.6	14.4

	Cotton (Lint)			Groundnut*	
	Output	Yield		Output	Yield
India	8.3	1.1	India	28.1	6.2
Brazil	5.8	1.6	Argentina	2.6	12.3
Mexico	5.8	7.9	Brazil	5.6	13.9
Pakistan	4.4	2.8	China†	14.8	11.9
Turkey	3.6	5.4	Indonesia	3.1	12.7
U.A.R.	4.3	5.9	Nigeria	11.2	12.8
U.S.A.	19.5	5·4	Senegal	5.4	7.7
U.S.S.R.	19.1	8.3	U.S.A.	6.8	19.0

* In shell.

† Mainland China.

Production and Import of Cereals : All-India 1950 to 1969

(Million tonnes)

Year	Production				Net Imports			
	Rice	Wheat	Other Cereals	Total Cereals	Rice	Wheat	Other Cereals	Total Cereals
1	2	3	4	5	6	7	8	9
1950	25.1	6.8	18.7	50.6	0.36	1.43	0 37	2.16
1951	22.1	6.8	16.8	45.7	0.76	3.06	0.98	4.80
1952	22.6	6.3	17.5	46.4	0.74	2.55	0.64	3.93
1953	24.3	7.6	20.0	51.9	0.18	1.71	0.15	2.04
1954	29.8	8.1	23.2	61.1	0.63	0.20	0.01	0.84
1955	26.6	9.1	23.3	59.0	0.17	0.44	( ) 0.01	0.60
1956	28.7	8.9	19.9	57.5	0.29	1.10	—	1.39
1957	30.2	9.5	20.5	60.2	0.75	2.88	—	3.63
1958	26.5	8.0	21.9	56.4	0.40	2.71	0.11	3.22
1959	32.0	10.0	23.5	65.5	0.30	3.54	0.02	3.86
1960	31.7	10.3	22.9	64.9	0.70	4.38	0.05	5.13
1961	34.6	11.0	23.7	69.3	0.38	3.09	0.02	3.49
1962	35.7	12.1	23.2	71.0	0.39	3.25	—	3.64
1963	33.2	10 8	24.6	68.6	0.48	4.07	—	4.55
1964	37.0	9.9	23.7	70.6	0.64	5.62	—	6.26
1965(a)	39.3	12.3	25.4	77.0	0.78	6.57	0.10	7.45
1966(a)	30.7	10.4	21.1	62.2	0.78	7.83	1.73	10.34
1967(a)	30.4	11.4	24.1	65.9	0.45	6.40	1.82	8.67
1968(a)	37.6	16.5	28.9	83.0	0.44	4.77	0.48	5.69
1969(b)	39.8	18.7	25.1	83.6	0.48	3.09	0.28	3.85

(a) Partially Revised Estimates

(b) Final Estimates (subject to revision)

Per Capita Availability of Cereals—State-wise (1961-63 and 1968-1969 Averages)

(kg. per annum)

States	Average per capita availability of Cereals during	
	1961-63	1968 and 1969*
1	2	3
Andhra Pradesh	140.7	140.0
Assam (NEFA & Nagaland)	131.4	143.3
Bihar	122.1	128.5
Gujarat	116.9	107.9
Haryana	(*b*)	(*b*)
Jammu and Kashmir	154.2	213.1
Kerala	105.5	103.9
Madhya Pradesh	181.1	178.6
Maharashtra	157.3	137.4
Mysore	142.8	145.9
Orissa	171.8	196.5
Punjab	155.2	192.0**
Rajasthan	159.4	146.3
Tamil Nadu	141.8	133.6
Uttar Pradesh	127.3	131.6
West Bengal	155.2	162.1
All-India	142.8	144.0

(*b*) Included under Punjab.

* Provisional and subject to revision

** Relates to Punjab, Haryana, Chandigarh Delhi and Himachal Pradesh

Total fertilizer requirements

(in miilion tonnes,

Estimated plant food consumption in 1969-70	Fertiliser requirements for production of additional 67 million tonnes of foodgrains	Total additional requirements of plant nutrients for the entire agricultural programme	Total fertiliser requirements by 1981	Breakup of total requirements of plant nutrients		
				N	P_2O_2	K_5O
(a)	(b)	(c)	(a+c)			
1.70	6.70	8.26	9.96	5.70	2.84	1.42
					or, say	
				6.0	3.00	1.50

Production, imprts and distribution of fertilisers 1952-53 to 1968-69 and 1969-70 (estimated)

(tonnes)

Year[1]	Nitrogen (N)			Phosphate (P_2O_5)			Potash (K.O.)	
	Production	Imported[2]	Distributed[3]	Production	Imported	Distributed[5]	Imported[5]	Distributed[4]
1952-53	53,067	44,294	57,822	7,445	—	4,552	3,311	3,311
1953-54	52,905	19,346	89,287	13,831	—	8,261	7,490	7,490
1954-55	68,478	19,984	94,810	14,345	—	15,027	11,097	11,097
1955-56	76,859	53,370	107,495	12,365	—	13,018	10,295	10,295
1956-57	78,788	56,768	123,054	17,585	—	15,874	14,791	14,791
1957-58	81,144	110,100	149,019	25,785	—	21,922	12,786	12,786
1958-59	80,766	97,540	171,988	30,987	—	29,490	22,366	22,366
1959-60	83,694	142,335	229,326	51,407	3,819	53,930	33,103	21,342
1960-61	111,987	171,926	211,685	53,722	128	53,134	24,845	29,052
1961-62	154,326	142,920	291,536	65,360	645	63,932	30,381	27,982
1962-63	194,194	229,462	360,033	88,300	7,959	81,385	44,276	36,503
1963-64	219,072	197.691	425,872	107,836	12,267	120,847	64,060	51,860
1964-65	243,230	259,517	492,249	131,021	12,293	148,530	57,176	71,640
1965-66	237,889	376,270	582,588	118,779	21,766	134,075	93,641	89,631
1966-67	308,993	574,628	830,171	145,678	129,158	274,601	143,337	133666
1967-68	402,648	975,897	1,135,655	207,142	370,776	438,168	276,465	205,750
1968-69	562,981	780,052	1,222,398	213,229	90,828	296,140	165,183	164,077
1969-70 (Estimated)	810,724	670,000	9,243,870	239,970	57,000	314,965	63,000	936,500

1. Figures are on July-June basis, unless otherwise stated.
2. Figures from 1952-53 to 1957-58 are on April-March basis.
3. Figures from 1952-53 to 1956-57 relate to calendar years while from 1957-58 to 1962-63 they are on April-March basis.
4. In the case of K_2O from 1952-53 to 1958-59, in the absence of distribution figures, thc quantity imported is taken as distributed.
5. Figures from 1952-53 to 1957-58 refer to calendar year while from 1958-59 to 1962-63 they are on April-March basis.

Land Utilisation in India 1969-71

Land Categories	Area in thousand Hectares	Percentage of reporting area
1	2	3
1. Geographical area	327,000	—
2. Reporting area	305,947	100.0
3. Forests	60,500	19.7
4. (A) Non-agri. uses	15,571	5.1
(B) Barren non-culturable	35,037	11.4
(C) Total not available for cultivation	50,608	16.5
5. (A) Permanent pastures and grazing land	14,066	4.6
(B) Culturable waste land	17,046	5.6
(C) Tree crops	4,085	1.3
(D) Total uncultivated land other than fallow	35,197	11.5
6. (A) Fallow other than current fallows	9,404	5.5
(B) Current fallows	13,208	11.5
(C) Total fallows	22,612	17.0
7. (A) Net sown area	13,730	44.8
(B) Area sown more than once	19,608	6.4
(C) Total cropped area	156,638	51.2
8. Net irrigated area	27,514	20.1

Statement showing total area, percent irrigated area and yield (Kg/ha.) under important Crops in India

Crop	Cropped area 1968-69 (thousand hectares)	Percentage of irrigated area (1966-67)	Yield Kg./ha. (1968–1969)
1	2	3	4
Foodgrain	120,430	22.5	781
Rice	36,967	38.2	1,076
Wheat	15,958	48.0	1,169
Jowar	18,731	4.1	523
Bajra	12,052	3.1	318
Total pulses	21,264	11.1	490
Groundnut	7,091	4.8	631
Total Oilseeds	14,585	5.1	475
Cotton (lint)	7,685	15.5	123
Gram	7,105	18.9	607
Maize	5,716	15.6	997
Sugarcane (cane)	2,461	71.6	47,780
Small millets	4,746	1.9	380
Total cereals	99,166	24.9	843
Total cropped area 1966–67	156,567	20.9	—

Aree Utilised for Food Grain Production

Country/Region	Area per person	Food grain cultivation (percent)
1	2	3
U.S.A.	2.35	34.1
Africa	2.00	22.1
Latin America	1.04	41.4
India	0.83	71.3
Asia, excluding China and Iapan	0.79	61.6
Japan	0.16	72.8

Source : Report of the President's Panel on World Food Supply.

Statement showing percentage of area under irrigation and average yields of rice in various States of India

Percentage categories (Percent irrigated Rice)	Name of the State	Percent Irrigated area	Average yield in Kg/ha.
1	2	3	4
A. 85% or above	1. Tamil Nadu	92.5	1551
	2. Andhra Pradesh	92.1	1460
	3. Jammu & Kashmir	92.9	1148
	4. Punjab	85.6	1186
	5. Delhi	110.0	1000
B. 50 to 85%	1. Kerala	53.0	1356
	2. Haryana	71.9	1161
	3. Mysore	60.7	1456
	4. Himachal Pradesh	54.6	854
C. 25 to 50%	1. Assam	28.8	890
	2. Bihar	29.5	858*
	3. West Bengal	28.2	1038
	4. Nagaland	26.6	645
D. Less than 25%	1. Gujarat	17.9	1161
	2. Madhya Pradtsh	13.7	454
	3. Maharashtra	18.4	791
	4. Orissa	23.0	868
	5. Rajasthan	24.0	276
	6. Uttar Pradcsh	18.0	453

* 1968-69 yield data.

Rough Rice: Area, yield per hectare, and production in some selected rice growing countries, 1968 (FAO, 13th Session of the Rice Study Group, March, 1969).

COUNTRY	AREA (1,000 Has)	AVERAGE YIELD Tons/Ha*	PRODUCTION 1,000 metric tons)
Brazil	4,291**	1.583	6,792**
Burma	4,516***	1.469	6.636***
Cambodia	2,376	1.482	3,521
Ceylon	572	2.378	1,360
China (Taiwan)	837	3.913	3,275
Dominican Republic	89**	1.651	147**
El Salvador	20***	2.500	50***
India	36,722**	1.547	56,787**
Indonesia	7,760	1,965	15,249
Italy	154	5.260	810
Japan	3,280	5.713	18,740
Laos	960**	.817	784**
Malaysia (West)	456	2.377	1,084
Mexico	167	2.724	455
Nepal	1,119**	1.981	2,217**
Nicaragua	27	2.407	65
Pakistan	11,513	1.650	18,994
Panama	130**	1.162	151**
Peru	63	3.063	193
Philippines	3,199	1.250	4,000
Portugal	33	4.636	153
Republic of Korea	1,246**	3.908	4,869**
Spain	63	6.349	400
Thailand	6,799	1.618	11,000
UAR	506	4.644	2,350
USA	952	5.018	4,777
Vietnam (South)	2,300	1.956	4,500

*Note: Yield information (kg/ha) computed by IRRI bassed on figures in *published table (except Burma, Dominican Republic and El Salvador).*

**Area and production figures are for 1967.

***Area and production figures are for 1966.*

Conversion of pure nutrients to quantity of various nitrogen fertillizers

Rate of N Application (kg/ha)	Nitrogenous fertilizers Ammonium sulfate (20% N)	Urea (45% N)	Ammonium chloride (26% N) (kg/ha)	Aqua ammonia (25% N)	Anhydrous ammonia
10	50	22	38	40	12
20	100	44	76	80	24
30	150	66	114	120	36
40	200	88	152	160	48
50	250	110	190	200	60
60	300	132	228	240	72
70	350	154	266	280	84
80	400	176	304	320	96
90	450	198	342	360	108
100	500	220	380	400	120
110	550	242	418	440	132
120	600	264	456	480	144
130	650	286	494	520	156
140	700	308	532	560	168
150	750	330	570	600	180

Production of Foodgrains: 1964-65—1968-69*

(*Million Tonnes*)

	1964-65	1965-66	1966-67	1967-68	1968-69
1. Cereals of which :	76.9	62.2	65.9	83.0	83.6
Rice	39.3	30.7	30.4	37.6	39.8
Wheat	12.3	10.4	11.4	16.5	18.7
Coarse grains	25.4	21.2	24.1	28.8	25.2
2. Pulses of which :	12.4	9.8	8.3	12.1	10.4
Gram	5.8	4.2	3.6	6.0	4.3
3. TOTAL FOODGRAIN	89.4	72.0	74.2	95.1	94.0

*Source: *Economic Survey*, 1969-70, Government of India, New Delhi, 1970, p, 5. (Table 2).

Conversion of pure nutrients to quantity of various phosphorus fertilizers

	Phosphatic fertilizers	
Rate of P_2O_5 application	Ordinary super-phosphate (20% P_2O_5)	Triple super-phosphate (45% P_2O_5)
	(kg/ha)	
10	50	22
20	100	44
30	150	66
40	200	88
50	250	110
60	300	132
70	350	154
80	400	176
90	450	198
100	500	220
110	550	242
120	600	264
130	650	286
140	700	308
150	750	330

The P_2O_5 (phosphorus) figures should be multiplied by:

5.0 for ordinary superphosphate

2.2 for triple superphosphate

Conversion of pure nutrients to quantity of various potassium fertilizers

Rate of K_2O application	Muriate of potash (60% K_2O)	Sulphate of potash (50% K_2O)
(kg/ha)	(kg/ha)	
10	17	20
20	34	40
30	51	60
40	68	80
50	85	100
60	102	120
70	119	140
80	136	160
90	153	180
100	170	200
110	187	220
120	204	240
130	221	260
140	238	280
150	255	300

The K_2O (potassium) figures should be multiplied by:
1.7 for muriate of potash
2.0 for sulphate of potash

Liming materials

Name	Chemical formula	$CaCO_3$ equivalent	Sources
Limestone	$CaCO_3$	95%	Natural limestone deposit
Hydrated lime	$Ca(OH)_2$	120%	Limestone burned with steam
Dolomite	$CaCO_3MgCO_3$	110%	With natural mineral deposit

[1]Source: Western Fertilizer Handbook. 1961 (Third Edition). Sacramento, Sacramento, California.

Amounts of insecticidal formulation required for preparing a 5-gal spray containing different percentages of the active material

Commercial formulation available	Concentration desired in the final spray (%)								
	.01	.02	.03	.04	.05	.06	.09	.10	.15
	Quantity requirrd (ml)								
20% E.C.	9.5	19.0	28.5	38.0	47.5	57.0	85.5	95.0	142.5
25% E.C.	7.6	15.2	22.8	30.4	38.0	45.6	68.4	76.0	114.0
50% E.C.	3.8	7.6	11.4	15.2	19.0	22.8	34.2	38.0	57.0
57% E.C.	3.33	6.6	10.0	13.3	16.65	20.0	30.0	33.3	50.0
	Quantity required (g)								
25% W.P.	7.6	15.2	22.8	30.4	38.0	45.6	68.4	76.0	114.0
50% W.P.	3.8	7.6	11.4	15.2	19.0	22.8	34.2	38.0	57.0
85% W.P.	2.23	44.6	6.69	8.92	11.15	13.38	20.07	22.3	33.45

Common rodenticides and some of their characteristics

Poison	Lethal dose (mg/kg)	Bait concentration	Relative Effectiveness	Acceptance of bait	Odor	Taste	Deterioration of bait	Mode of Action	Hazard	Antidote
Warfarin	1	.025	Excellent	Good	None	Slight	None	Internal bleeding	Slight	Vitamin K blood transfusion
Sodium fluoroacetate (1080)	5	loz/28 lb	Good	Good	None	Slight	Slight	Paralysis of heart and central nervous sys tem	Extreme	None
Zinc phosphide	40	1.0	Good	Good	Strong	Strong	Strong	Heart paralysis, liver damage	Moderate	Copper sulfatc before emetic
Thallium sulfate	25	1.5	Good	Good	None	Slight	None	Gastro-intestinal kidney endocrine, respiratory damage	Extreme	None reliable
Antu	8	1.5	Good	Good	Slight	Moderate	None	Pleural effusion	Moderate	None
Arsenic	100	3	Fair	Fair	None	Moderate	None	Affect kidney alimentary tract, nervous system	Moderate	Milk of Magnesia Milk or water
Red Squill	500	10	Fair	Fair	Moderate	Strong	Moderate	Heart paralysis	Slight	Vomiting
Strychnine	6	0.6	Fair	Fair	None	Strong	None	Convulsion asphyxis	Moderate	Charcoal in water and sedative

A FEW SELECTED TARGETS OF PRODUCTION FOR FOOD GRAMS AND MAJOR COMMERCIAL CORPS :-

S.No.	Commodity	Unit	1968-69 production	1973-74 targete
1.	Foodgrains	million tonnes	98	129
	Rice	million tonnes	39.0	52.0
	Wheat	million tonnes	18.0	24.0
	Maize	million tonnes	6.2	8.0
	Jowar	million tonnes	10.0	15.0
	Bajra	million tonnes	5.1	7.0
	Other cereals	million tonnes	7.2	8.0
	Pulses	million toones	12.5	15.0
2.	Sugarcane (gur)	million tonnes	12	15
3.	Oilseeds	million tonnes	8.5	10.5
4.	Cotton	million bales	6	8
5.	Jute	million bales	6.2	7.4
6.	Tabacco	million kgs.	350	450
7.	Coconut	million nuts	5,600	6,600
8.	Arecanut	thousand tonnes	126	154
9.	Cashewnut	thousand tonnes	131	207
10.	Pepper	thousand tonnes	23	42
11.	Lac	thousand tonnes	35	52

PLAN OUTLAY FOR AGRICULTURE AND ALLIED PROGRAMMES

(Rs. crores)

S.No.	Head of development	Third Plan	Annual Plans (1966-69)	Fourth Plan
1.	Agricultural production	203	252	420b
2.	Development of small farmers and agricultural labour	....	....	115
3.	Research and education	a	a	85
4.	Minor irrigation	270	314	516
5.	Soil conservation	77	88	159
6.	Area development	2	13	38
7.	Animal husbandry	43	34	94
8.	Dairying and milk supyly	34	26	139c
9.	Fisheries	23	37	83
10.	Forests	46	44	93
11.	Warehousing, storage and marketing	27	15	94
12.	Food processing and subsidiary food	a	a	19
13.	Central support to financial institutions	....	40	324
14.	Buffer stocks of agricultural commodities	....	140	255
15.	Cooperation	76	64	179
16. 17.	Community development } Panchayats	288	99	115
	Total	1,089	1,166	2,728

a. Included under Agricultural production.

b. Includes provision for Research and education and development of small farmers made in the State Plans.

c. Includes outlay of Rs. 95 crores for Indian Dairy Corporation.

MANUFACTURERS AND INSTALLED CAPACITY OF NITROGENOUS FERTILISERS (as on 30th September 1969)

Name of factory	Installed capcity (tonnes)		Likely date of production
	Material	Nutrient (N)	
(i) IN PRODUCTION			
(a) Ammonium sulphate			
Assam			
1. Fertilizer Corporation of India Ltd., Unit: Namrup	100,000	20,600	
Bihar			
2. Bararee Coke Co. Ltd., Loyabadı	600	120	
3. Burrakur Coal Co. Ltd., Bansjora₁	1.320	270	
4. Fertilizer Corporation of Inda Ltd.. Unit: Sindri†	355,000*	74,550	
5. Tata Iron and Steel Co. Ltd., Jamshedpur.	23,100	4,760	
Gujarat			
6. Gujarat State Fertilizers Co. Ltd. Baroda	148,000	30,490	
Kerala			
7. Fertilisers And Chemicals, Travancore Ltd., Alwaye	200, 000*	42.000	
Madhya Pradesh			
8. Hindustan Steel Ltd., Bhilai¹	32,600	6,720	
Mysore			
9. Mysore Chemicals & Fertilisers Ltd., Belagula	6,710	1,380	
Orissa			
10. Hindustan Steel Ltd., Rourkela₁	28,000	5,770	
Tamil Nadu			
11. E.I.D.—Parry Ltd., Madras	38,610	7,950	
West Bengal			
12. Hindustan Steel Ltd., Durgapurı	21,200	4,370	
13. Indlan Iron and Steel Co. Ltd., Burnpur-Kultiı	23,000	4,740	
Total	978,140	203,720	

(Continued)

MANUFACTURERS AND INSTALLED CAPACITY OF NITROGENOUS FERTILISERS (as on 30th September 1969)

(Continued)

Name of factory	Installed capacity (tonnes)		Likely date of production
	Material	Nutrient (N)	
(b) Ammonium sulphate nitrate			
Bihar			
1. Fertillzer Corporation of India Ltd., Unit: Sindri†	121,920	31,700	
Total	121,920	31,700	
(c) Calcium ammonium nitrate			
Orissa			
1. Hindustan Stecl Ltd., Rourkela (25%N)	480,000	120,000††	
Punjab			
2. Fertilizer Corporaion of India Ltd., Unit: Nangal (25%N)[2]	320,000**	80,000	
Total	800,000	200,000	
(d) Urea			
Andhra pradesh			
1. Coromandel Fertilisers Ltd., Visakhapatnam[2]	16,500	7,260	
Assam			
2. Fertiliz Corporation of India Ltd., Unit: Namrup[2]	55,000	24,200	
Bihar			
3. Fertilizer Corporation of India Ltd., Unit: Sindri†	23'470*	10,750	
Gujarat			
4. Gujarat State Fertilizers Co. Ltd., Baroda[5]	364,000*	166,200	
Maharashtra			
5. Fertilizer Corporation of India Ltd., Unit: Trombay[2]	99'000*	45,000	

(Continued)

MANUFACTURERS AND INSTALLED CAPACITY OF NITROGENOUS FERTILISERS (as on 30th September 1969) (Continued)

Name of factory	Installed capacity (tonnes)		Likely date of production
	Material	Nutrient (N)	
Rajasthan			
6. Shriram Fertilisers and Chemicals, Kota	240,000	111,700	
Tamil Nadu			
7. Neyveli Lignite Corporation Ltd., Neyveli	154,000*	70,000	
Uttar Pradesh			
8. Fertilizer Corporation of India Ltd., Unit: Gorakhpur	179,320*	80,000	
Total	1,131,290	515,110	
(e) Ammonium chloride			
Kerala			
1. Fertilisers And Chemicals, Travancoce Ltd., Alwaye[3]	25,000	6,250	
Uttar Pradesh			
2. New Central Jute Mills Co. Ltd., Varanasi	40,640	10,160	
Total	65,640	16,410	
Grand Total for (i)	—	966,940	
(ii) UNDER IMPLEMENTATION			
(a) Urea			
Assam			
1. Fertilizer Corporation of India Ltd., Unit: Namrup[4]	330,000*	152,000	1970–71
Bihar			
2. Fertilizer Corporation of India Ltd. Unit: Barauni	330,000*	152,000	1971–72

(Continued)

MANUFACTURERS AND INSTALLED CAPACITY OF NITROGENOUS FERTILISERS (as on 30th September 1969) (Continued)

Gujarat			
3. Indian Farmers Fertiliser Coop. Ltd., Kandla	382,000	168,000	1972–73
Kerala			
4. Cochin Fertiliser Project, Cochin[7]	330,000*	152,000	1969-70
Maharashtra			
5. Fertilizer Corporation of India Ltd., Unit: Trombay[4,6]	392,000*	180,320	1972-73
Tamil Nadu			
6. Madras Fertilizers Ltd., Madras+	210,000*	96,600	1970-71
Uttar Pradesh			
7. Indian Explosives Ltd., Kanpur	450,000*	200,000	1969-70
West Bengal			
8. Fertilizer Corporation of India Ltd., Unit: Durgapur[8]	330,000*	152,000	1969-70
Total	2,754,000	1,252,920	
Grand Total for (ii)	—	1,252,920	

(iii) APPROVED IN PRINCIPLE

(a) Urea

Andhra Pradesh			
1. Coromandel Fertilisers Ltd., Visakhapatnam[4]++	73,500+	79,810	1972-73
2. Fertilizer Corporation of India Ltd., Unit: Ramagundam	495,000+	229,000	1973-74
Madhya Pradesh			
3. Fertilizer Corporation of India Ltd., Unit: Korba	495,000+	229,000	1973-74
Maharashtra			
4. Kamptee Project, Kamptee	495,000+	229,000	1973-73

(Continued)

MANUFACTURERS AND INSTALLED CAPACITY OF NITROGENOUS FERTILISERS (as on 30th September 1969) (Continued)

Name of factory	Installed capacity (tonnes)		Likely date of prodc-tion
	Material	Nutrient (N)	
Mysore			
5. Mangalore Project, Mangalore	340,000*	160,000	1972-73
Orissa			
6. Fertilizer Corporation of India Ltd., Unit: Talcher	495,000+	229,000	1973-74
Punjab			
7. Fertilizer Corporation of India Ltd., Unit: Nangal•	330,000+	152,000	1973-75
Goa			
8. Zuari Agro-Industries, Goa	340,000+	160,000	1972-73
Total	3,163,500	1,467,810	
(b) Ammonium chloride			
Maharashtra			
1. Maharashtra Coop. Fertilisers & Chemicals, Thana	66,000	16,500	1971-72
Rajasthan			
2. Shriram Fertilisers and Chemicals, Kota	30,000	7,500	1971-72
Total	96,000	24,000	
Grand Total for (iii)	—	1,491,810	
Grand Total for (i), (ii) & (iii)	—	3,711,670	
(iv) PROPOSED FOR IMPLEMNTATION			
(a) Urea			
Uttar Pradesh			
1. Pilani Investment Corporation Ltd., Mirzapur	340,000*	160,000	1972-73
Total	340,000	160,000	
Grand Total for (iv)	340,000	160,000	
Grand Total for (i), (ii), (iii), & (iv)	—	3,871,670@	

(Continued)

MANUFACTURERS AND INSTALLED CAPACITY OF NITROGENOUS FERTILISERS (as on 30th September 1969) (Concluded)

1 By-product from steel plants.

2 Also for expansion, the programme of which is furnished separately.

3 The entire production is not for agricultural purposes,

4 Expansion.

5 In addition, it produces 3,500 tonne of technical gradc urea containing 46.5% N.

6 In addition, it will produce 2,500 tonnes of technical grade urea.

7 It will produce urea during first phase beginning 1969-70. During second phase diammonium phosphate of different grade is to be manufactured.

8 A programme is proposed for FCI Ltd., Durgapur, similas to the "Rationalisationi Schcme" envisaged for FCI Ltd., Sindri (†).

† With the proposed renovation and technological alterations at F.C.I. Ltd., Sindri under "Rationalisation Scheme"–naphtha as feedstock, by-product gypsum for ammonium sulphate and pyrites for snlphuric acid–triple superphate to the tune of 156,450 tonnes of P_2O_5 envisaged for psoduction. Likely date of commissioning is 1970-71.

†† Since December 1968, the entire production of calcium ammonium nitrate is of grade 25% N. Occasionally, they manufacture 20.5% N grade also.

\+ Total capacity of the project is 190,000 tonnes of N, while urea (vide–ii) and ammonium phosphate (ii), taken together account for 168.600 tonnes of N. it is understood that the balance N will be available as ammonia (NH_3).

++ Expansion is proposed in two phases; first phase having a capacity of 20,000 tonnes of N and the second phase 135, 000 tonnes of N. First phase is expected to be compledted by 1970-71.

* The analyses of the fertilisers given in Table 9.06 have been used to calculate the capacities in terms of the nutrient except those marked with an asterisk.

** With effect from 20th August 1967, calcium ammonium nitrate produced at F.C.I Ltd., Nangal, carries 25 per cent N as against 20.5 per cent.

@ Besides the above proposals, Paradeep Project is under active consideration of the Government which would carry a capacity of 229,000 tonnes of N. End-product pattern is not yet decided.

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Uttar Pradesh

CONSOLIDATED STATE—WISE STATEMENT OF

Name of State	1954	1955	1956	1957	1958	1959	1960
1. Andhra Pradesh	—	2	16	14	21	8	33
2. Assam	—	—	2	3	2	1	—
3. Bihar	—	3	3	10	12	22	17
4. Gujerat	—	4	9	18	14	8	12
5. Jammu & Kashmir	—	—	—	1	57	—	10
6. Kerala	—	6	1	4	1	43	130
7. Madhya Pradesh	—	1	18	6	103	121	57
8. Maharashtra	—	14	164	266	191	372	1,563
9. Mysore	—	4	20	34	40	6	5
10. Nagaland	—	—	—	—	—	1	—
11. Orissa	—	—	9	2	10	26	16
12. Punjab	—	1	114	12	74	48	677
13. Haryana	—	2	14	1	20	80	644
14. Himachal Pradesh	—	—	1	3	1	1	33
15. Rajasthan	—	—	—	5	8	4	5
16. Tamil Nadu	—	3	12	33	162	47	30
17. Uttar Pradesh	1	12	22	12	15	6	12
18. West Bengal	—	1	5	2	1	3	6
19. Chandigarh	—	—	—	—	—	—	—
20. Delhi	1	—	2	4	2	6	2
21. Goa	—	—	—	—	—	—	—
22. Manipur	—	—	=	—	—	1	6
23. Pondicherry	—	—	—	1	—	—	3
24. Tripura	—	—	—	1	—	2	1
Total For Each Year	2	53	412	432	677	806	3,361

Grand Total 11,274

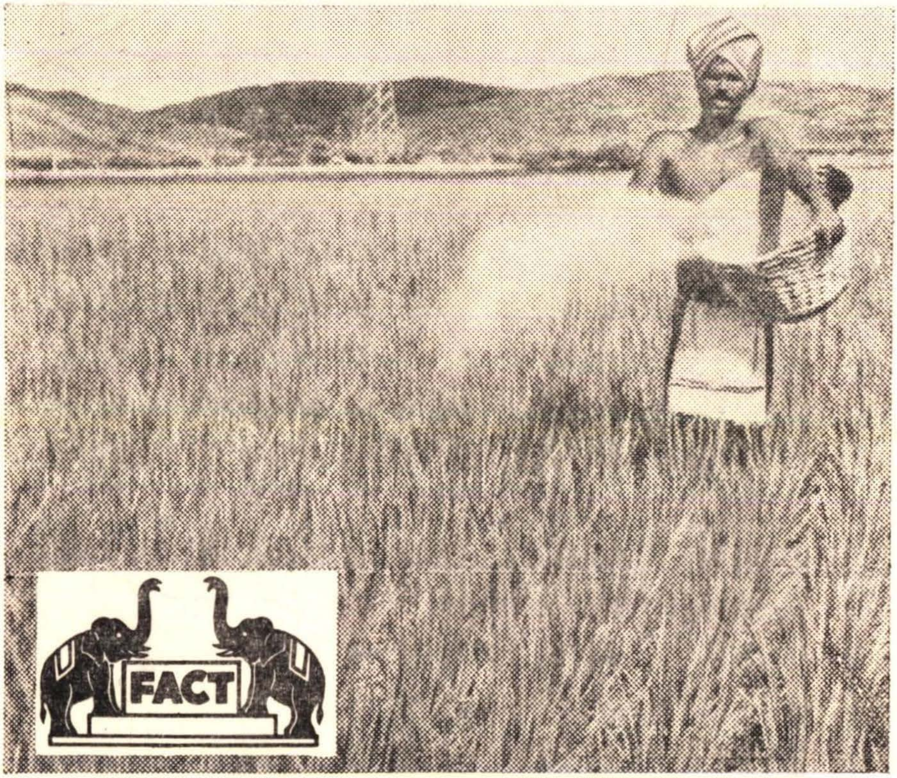
KRISHAK SAMAJ

LIFE MEMBERS FROM 1954 to December 1970

1961	*1962*	*1963*	*1964*	*1965*	*1966*	1967 1968	1968 *1969*	1969 *1970*	Grand Total
24	19	1	27	5	30	5	16	3	224
—	—	1	—	—	1	—	1	3	14
3	5	—	1	3	1	10	6	8	104
12	—	48	11	136	5	5	18	92	392
2	—	—	—	—	4	3	2	3	25
4	3	2	2	5	3	5	6	1	216
118	97	74	101	81	22	12	51	146	1,108
400	259	162	96	383	189	160	318	204	4,741
1	8	—	11	3	5	10	12	13	172
—	—	—	—	—	—	—	—	—	1
13	10	63	60	36	51	1	86	69	452
238	33	59	27	15	14	17	63	13	1,405
71	19	19	2	18	32	10	70	5	1,007
3	1	—	1	4	2	18	6	2	86
1	1	2	4	5	3	29	27	—	94
79	15	25	35	64	27	12	4	60	608
5	4	5	7	17	130	11	4	164	427
3	3	5	3	15	7	1	—	1	56
—	—	—	—	—	—	2	2	—	4
4	11	4	4	8	4	5	10	3	70
—	—	—	0	1	1	—	26	7	35
3	—	—	—	—	—	—	—	—	10
—	—	—	—	—	—	—	—	1	5
—	—	—	4	4	2	—	—	—	13
994	488	470	396	803	533	316	728	798	11,274

Dr. D. A. BHOLAY,
Secretary General

TWO EARS OF CORN WHERE ONLY ONE GREW BEFORE !



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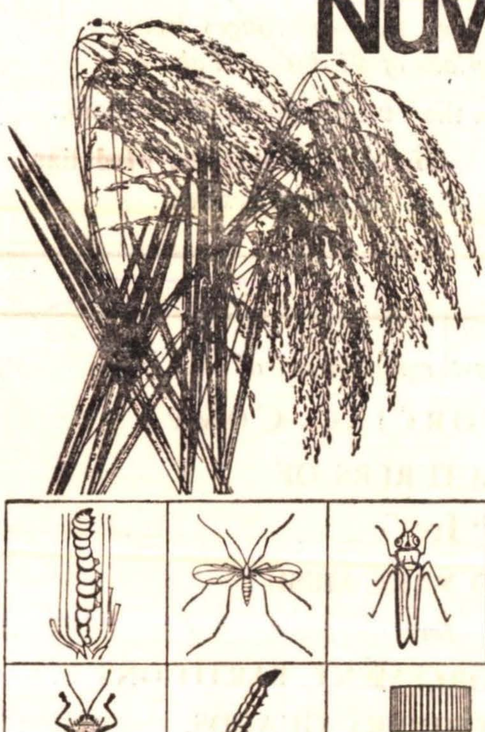

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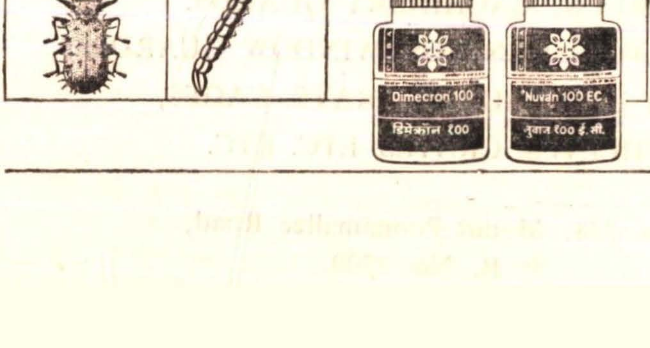

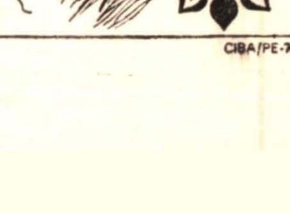

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Issued by the State Family Planning Bureau,

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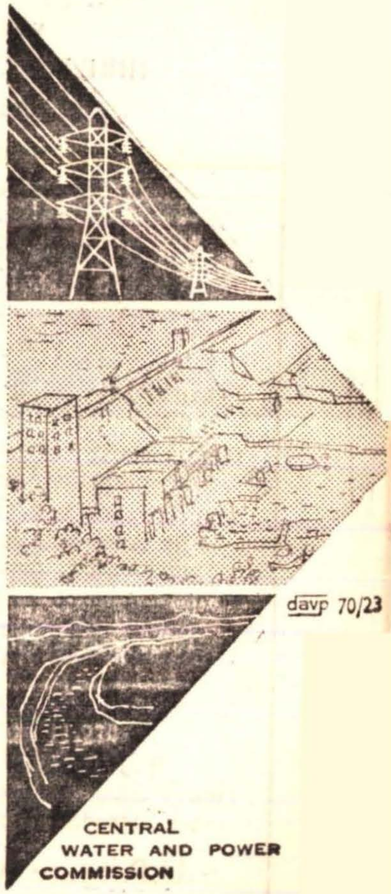
GREEN REVOLUTION AND US



When you talk of GREEN REVOLUTION, you are talking of more assured irrigation, better flood control measures, more power to the villages to run the tube-wells and energise the pump-sets — the necessary aids to make GREEN REVOLUTION a reality. Today, we are grateful that our efforts over the years have paved the way for the country to march ahead nearer its goal of GREEN REVOLUTION.

davp 70/23

SILVER JUBILEE CELEBRATIONS

SERVICE TO THE NATION
1945 - 1970

CENTRAL WATER AND POWER COMMISSION