

GREEN REVOLUTION IN PUNJAB

by

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DURING the last decade, some countries have achieved spectacular success in food production. Thickly populated Japan and Formosa achieved phenomenal increase in rice production. Out of wheat growing countries, Mexico is a striking example of a deficit country becoming self-supporting and even achieving a small exportable surplus. India, which has been facing a grave food shortage since World War II, on account of rising population, is also showing promise of solving its food problem. Progress achieved is uneven in the different States of India, but it is Punjab which has experienced a real green revolution in wheat production.

Observant foreigners, who happen to visit Punjab, often ask the question, "Why is it that Green Revolution is more evident in Punjab than in the rest of India". Green Revolution in Punjab is not a sudden development but culmination of a process which started in 1950, when land was allotted to the refugees from West Punjab and the modernization of agriculture was started. There is no other State in India in which the entire farming area has been consolidated into blocks of land, thus providing a sound base for land development. The Punjab Agricultural University which is the pivot of Green Revolution in Punjab is a model University in every respect. This is the only University which controls the entire research in the State and is also responsible for a good deal of extension. There is no other State in India which has such hard working and intelligent farming population.

Here it would be relevant to give some facts about Punjab. The total geographical area of Punjab is 5.03 million hectares of which 3.94 million

hectares is cropped. The total irrigated area is 2.65 million hectares, out of which 1.29 million hectares are irrigated by canals and 1.35 million hectares by tubewells. Tubewell-irrigated area exceeds the canal-irrigated area. It is 51% of the irrigated area while canal-irrigated area is 48.6%. Thus a good balance between surface and ground water irrigation has been achieved. The total population of the State is 13.47 millions (based on 1971 census). The rural population is 76.9 per cent of the total. The density of population per square kilometer is 268 against 148 of India. The literacy percentage is 33.39 as compared with 29.35 for the country as a whole.

THE HUMAN ELEMENT

A study on the Green Revolution in Punjab has indicated that apart from introduction of Mexican wheat material, which is the major factor, it is the human element which has played an important role in the Green Revolution. The Sikh farmer like the Reddies of Andhra Pradesh and Gounders of Coimbatore are efficient farmers. Their love for land is almost mystical. Education is widespread among them, and they easily understand the intricacies of balanced chemical fertilizers and plant protection chemicals. From among them are about half a million serving soldiers, ex-soldiers and pensioners who have aptitude and knowledge of machinery. Similarly, there are large numbers of police men, school teachers, and government servants of various categories who are sons of farmers. Most of these persons invest their savings in land development. The villagers who have migrated to foreign countries also invest their savings in agriculture. Recent development in this direction is the import of gift tractors in Punjab from foreign countries. In fact, Punjab is the only State in India in which the gap between the rural and urban areas is narrowest, and rural living is not equated with backwardness.

The most progressive among the farmers are the refugees from the canal colonies of West Punjab. On account of creation of Pakistan and consequent partition of Punjab, the Sikh and Hindu population had to migrate enmasse to India. The Punjabi land-owners lost an area of 67 lac acres in West Pakistan out of which 43 lac acres were irrigated. In East Punjab only 47 lac acres were available out of which only 13 lac acres were irrigated. This land was allotted to refugee land-owners. Due to gap in area of about 20 lac acres the refugee land-owner was subjected to a cut of 25% and in the case of large land-holders it was as much as 95%. These farmers had to pay a real price for freedom by losing their fertile irrigated lands but they met the challenge with courage. In fact, it is these refugee farmers who have played a conspicuous role in green revolution in the Punjab.

Apart from the farmers, the Sikh blacksmiths and carpenters called Ramgarhias played a vital role in regeneration of agro-industry in Punjab. By studying foreign designs they invented chaff-cutters, sprayers, threshers, and seed-cum-fertilizer drills to suit local conditions. No doubt, they were helped by the agricultural engineers of the Punjab Agricultural University in these efforts. The Ramgarhias have effectively supported the Green Revolution by supplying the tools of modern agriculture to the farmers.

LAND REFORMS

What land reform hopes to achieve in other States in India, has to a large extent been already achieved in Punjab. For this, there is a historical background. The first large-scale land reform was achieved by the Sikh revolutionary leader, Banda Bahadur during the reign of Mughal Emperor, Farukhsiyar. Banda distributed land to the tillers in the area east of the Ravi which came under his sway. The Sikh Missals derived their following from among the peasant cultivators. Partition of

Punjab in 1947 itself resulted in levelling of holdings. Then came the land reform measures of 1951-58, when the occupancy tenants were made the owners of land which they cultivated, absentee land-lordism was abolished, and ceiling on land-holdings was imposed at the level of 30 acres of irrigated-land.

CONSOLIDATION OF HOLDINGS

Another scheme which provided the base for the Green Revolution in Punjab is the scheme of Consolidation of Holdings. Everyone knows the disadvantages of fragmented and scattered holdings. It is a wasteful method of land utilization and many improved agricultural practices cannot be adopted. A good deal of land is wasted in embankments and field boundaries. Canal irrigation is practically an impossibility on tiny scattered plots. A tubewell cannot be economically sunk. It is only in the states of Punjab and Haryana that the entire cultivated area has been consolidated. Some progress has been made in Uttar Pradesh, Maharashtra and Madhya Pradesh but considering their total cultivated area it is not significant. The scheme has made least progress in Eastern India in the states of Bihar, Assam and West Bengal. These are the problem states of India in which the state of agriculture is deplorable. In Punjab, the scheme provided a unique opportunity of re-planning the countryside which includes the planning of roads, so that every field is accessible by a road. The most beneficent effect of the scheme of Consolidation of holdings was that the farmers were enabled to sink tubewells in their farms which were in one or two compact blocks. In 1950, Punjab had hardly any tubewell, and now it has 1,67,000 private tubewells.

The failure of monsoon in 1965 and 1966 and again in 1968 provided a great stimulus to the tapping of ground water. In fact, it was a blessing in disguise. It is the tubewells which not only saved the northern region from a great disaster

but also provided a food surplus in 1968, a year in which monsoon had calamitously failed. It was a year of the total failure of the winter monsoon and but for the tubewells and the high-yielding varieties of wheat, a famine would have prevailed. The high-yielding varieties of wheat require copious and frequent irrigation which the canals cannot provide. As such sinking of tubewells is necessary even in the canal-irrigated areas where irrigation intensity is low. Apart from supplementing irrigation, the tubewells also maintain water-level at an optimum depth thus saving the land from the evils of water-logging and salinity.

RURAL LINK ROADS

The scheme of rural link roads has also promoted the Green Revolution in Punjab. In fact, as soon as production of wheat mounted up in the villages, the need for transport of marketable surplus to the towns and rail-heads became an imperative necessity. The State Government launched a crash programme for construction of village link roads in 1968. Once a village is linked by a *pacca* road with a town its economy undergoes remarkable transformation. The farmers market their produce with facility and are also enabled to purchase inputs like fertilizers and agricultural implements from the market town with ease. This has led to rapid transformation in agriculture. Villagers who had no experience of growing commercial crops, like potatoes and vegetables, adopted them easily. The use of tractors and machinery also received an impetus. The benefits economic, social and cultural to all sections of the village community have been tremendous. In 1969-70 alone, 1,200 miles of link roads were constructed in the State which is more than the mileage added in the whole of the First Five-Year Plan period in undivided Punjab. The villagers provided land and in many cases labour for earth-work free of cost. The new roads have materially changed the road accessibility in the State. Two-thirds of villages and an equal proportion of the rural

population have either come on the metalled roads or are within one mile of the roads. The intensity is almost double in comparison with Andhra Pradesh, Maharashtra, Gujarat and Uttar Pradesh. With the provision of roads to the villages the number of vehicles has increased, higher education has become accessible to the villagers, health and family planning services have become more effective and the efficiency of farmers has greatly improved. No other development programme initiated so far in the villages got such a unanimous applause from the rural people as this road construction programme.

RURAL ELECTRIFICATION

Electric power is playing a vital role in the Green Revolution. It supplies the mechanical power to the tubewells, pumping-sets, threshers and chaff-cutters. The share of agriculture in power consumption rose from 15% in 1960 to 35% in 1970. In Punjab, the per capita consumption of electricity has gone up from 0.03 KWH in 1951 to 10.86 KWH in 1968. It is higher than the other states excepting Tamil Nadu, another progressive state, where it is 27.83 KWH per capita. About 80,000 private tubewells have been electrified and a similar number await electric connections. However, it is power shortage which is now standing in the way. In 1970-71, power availability is 230 MW against the power demand of 502 MW. Thus there is a deficit of 269 MW which has to be met if agriculture has to make further progress. Augmentation of power resources is the key to further agricultural progress not only in Punjab, but in other parts of India and particularly in the states with good ground water supplies.

MECHANIZATION OF AGRICULTURE

Mechanization of cultivation has played an important role in the agricultural revolution. Without tubewells which have placed water at the command of the cultivators, Agricultural Revolution would not have taken place. With tubewell irrigation

the intensity of cropping could even be more than 200%. The short period available between harvesting and threshing of one crop and the sowing of the next imposes a serious limitation on intensive cultivation. Bullocks are unable to meet this situation. The raising of two or more crops is practicable only through mechanization of these operations. Timeliness of sowing is most important. The Mexican wheats sown from the middle of November to the end of November give the highest yields and those which are sown late in December show a steep fall in production.

The total number of farms in the Punjab State is 7,24,365. Out of these, 69,365 farms fall in the size group of 12 hectares and above, 3,20,000 in the group 4 to 12 hectares and the rest are under 4 hectares. It is the owners of farms of first two categories which are viable who have significantly contributed to surplus production. The mechanization of small farms will depend greatly on the extent of development of custom operation. At a reasonable estimate, 2,50,000 farms will be operated with tractors. To meet the needs of the Punjab State alone, the production capacity of 13,000 tractors per year is necessary. The demand for tractors is mostly in the range from 15 to 30 h.p.

A study carried out by the Punjab Agricultural University has shown that the pattern of mechanization which has been followed in Punjab has resulted increased employment of human labour, due to increase in crop intensity and increased production per unit by time and area. It has not resulted in unemployment as was feared by some people. It has shown that labour and machinery are essentially complementary, and when they combine they can tackle vastly increased volume of work. There is more demand for human labour and less for bullock power which is a highly desirable development. It saves the land for food production

which was put under fodder production to feed the bullocks. The same land can sustain larger number of milch animals, thus leading to more milk production. Due to increased intensity of cropping, Punjab has experienced a labour shortage at peak periods which is being met to some extent by migration of labour from densely populated areas of Uttar Pradesh. Farm wage rates have risen fast, and landless farm workers have shared the new prosperity.

SYSTEM OF SERVICE TO SUPPORT AGRICULTURAL DEVELOPMENT

Here the system of services which has been developed in Punjab to support agricultural development deserves mention. The extension agency from the Development Commissioner to the Village Level Worker played a key role in new agriculture. The contacts made by the agricultural extension workers with the farmers, their educational effort and demonstrations arranged by them, made a deep impact on the farming community. The Co-operative Department, the Marketing Federation, and the Agro-Industries, Poultry and Dairy Development Corporations effectively supported the agricultural revolution. The crop loan system of the Co-operatives has proved to be of great benefit to the small farmers. In 1969-70, crop loans of the value of Rs. 61 crores were issued to the farmers, mostly for the supply of fertilizers and other agricultural inputs through the Marketing Federation. While 1965-66, the consumption of chemical fertilizers in Punjab was 2.3 lac tonnes of the value of Rs. 9.03 crores, in 1970-71, it was 11.30 lac tonnes of the value of Rs. 47.50 crores. Apart from this about 20,000 diesel engines were supplied to the farmers. The Marketing Federation also played an effective role in the purchase of wheat from the farmers. In 1968-69, it purchased 82 lac quintals of wheat at price of Rs. 64.83 crores. This was of great help to the farmers. The Agro-Industries Corporation supplied tractors to the farmers,

and saved them from illegal premium which the dealers charge.

MEXICAN WHEATS

The Wheat Revolution in India is the result of well-planned plant breeding research strategy and co-ordinated work approach of highly experienced agricultural scientists and bold administrative and policy decisions. However, the single major factor which helped start the Wheat Revolution in Punjab was the introduction of high-yielding, nitrogen responsive dwarf strains of wheat from Mexico. The simple fertilizer trials conducted in farmers' fields during 1959-61 had revealed that the tall varieties then cultivated in India do not respond well to nitrogen application. Hence, in 1962 the Indian Agricultural Research Institute, New Delhi, sent a proposal to the Government of India that Dr N.E. Borlaug of the International Maize and Wheat Research Centre, Mexico, may be invited to India and supply us with dwarf wheat material containing the "Norin" dwarfing genes in order to break the barrier to high yields in wheat. Dr Borlaug accepted the invitation and visited the major wheat growing areas of India in March 1963. This visit paved the way for our getting seeds of four commercial Mexican semi-dwarf wheats along with a few seeds of 613 different breeding lines. Seeds of this material were distributed by IARI in collaboration with the Rockefeller Foundation to the Punjab Agricultural University, Ludhiana, and to several other institutions. The performance of the Mexican varieties was very impressive even in the first year inspite of bad weather.

At that time, I was Director-General of the Intensive Agricultural Programme with the Ministry of Food and Agriculture of the Government of India, with the responsibility of organizing production of food-crops in irrigated districts. I then suggested that we should import more seeds of these varieties as soon as possible. In 1965, at the All-India

Wheat Workshop held at Ludhiana a decision was taken to import 250 tonnes of seeds of the varieties Sonora 64 and Lerma Rojo. These seeds were distributed to farmers all over the country by IARI. Their performance was so impressive that at the Chief Ministers' Conference held at New Delhi in April 1966, a decision to import 18,000 tonnes of seeds of Mexican varieties was taken. At that time, this was the biggest seed import made by any country from another. The seeds were purchased from Mexico by a team of experts, led by the late Dr S. M. Sikka and including Dr S.P. Kohli, which was specially sent to Mexico for this purpose. For this bold step, credit goes to Mr C. Subramaniam, the then Minister for Food & Agriculture of the Government of India.

Out of the seed obtained from Dr Borlaug which was segregating, selections were made by the Indian plant breeders, Dr D. S. Athwal, of the Punjab Agricultural University, Ludhiana, named his selection as Kalyan after his native village, Kalyanpur, and a similar selection made at the Indian Agricultural Research Institute was called Sona. These two re-selections were derived from the same parental S-227 line and were found to be similar in performance. In 1967, these lots were merged into a single variety called Kalyan Sona-227. A year after the release of this variety, Pakistan released the same variety under the name Mexi-Pak. As compared with the red grained Lerma-Rojo, Kalyan-Sona-227 was amber-grained, a colour liked by Indians.

The high-yielding Mexican varieties require much more care in cultivation, as compared with the old Indian wheat varieties. Here we may mention the work done by the agronomists who standardised cultural practices to enable the new varieties to reach their full yield potential. The cultivation of Mexican wheats promoted the use of seed-cum-fertilizer drills for proper placement of seed

and fertilizers, as well as harvesting and threshing machinery. The farmers learned the use of fertilizers and agricultural machinery for the first time on a large scale and what they learned for use in wheat cultivation, they could also apply to other crops. Now the Indian breeders at the Punjab Agricultural University, Ludhiana, U.P. Agricultural University, Pantnagar, and Indian Agricultural Research Institute are selecting new lines and by hybridization are producing wheats which have good grain quality as well as superior yield and rust resistance. The greatest danger to these wheats is the possibility of their resistance to rust breaking down, and once it happens there is a real danger of a famine on a continental scale.

The yield potential of Mexican wheats is as high as 60 quintals per hectare as against 30 quintals of the best indigenous tall wheats. This is mainly due to the fact that they are short-stemmed and can absorb large quantities of fertilizers without lodging as compared with the traditional varieties which grow too high, become top heavy and fall down. They are much more responsive to fertilizers at all levels of applications. A given amount of fertilizer produces a much greater increase in yield in the new varieties than in the old varieties. Besides, they are adapted to a broad range of latitudes. A number of them can also be sown late and this has proved to be a boon when there is not sufficient moisture in the soil for preparing the seedbed and large areas are irrigated by tubewells for almost two months, from November to the end of December. However, the best yields are obtained when sowing is done between 15th and 30th November.

IMPACT ON WHEAT PRODUCTION

The improved varieties which were available before the Green revolution were only marginally superior to the varieties cultivated by the farmers whereas the new wheats provide a sharp contrast by doubling or even trebling the crop yield. The

impact which these Mexican varieties have made on wheat production is starting. In 1961-62, the production of wheat in the Punjab was 1,763,000 metric tonnes valued at Rs. 630 millions while in 1967-68, the production was 3,335,000 metric tonnes valued at Rs. 1,200 millions. In 1968-69, the drought year, the production was 3,950,000 metric tonnes valued at Rs. 1,415.3 millions at constant prices of the year 1950-51. In 1970-71, the yield was about 4,800,000 metric tonnes. This is a real technological breakthrough for it is for the first time that man has acquired control over the vagaries of rainfall in this region.

BENEFIT TO FARMERS

The green revolution in Punjab has benefited all farmers, big, medium and small. A cliché, often repeated by the oroticians is that only big farmers have benefited from the green revolution. This is untrue. The success of a farmer in adopting new technology depends upon his luck in finding adequate ground water. Even small farmers with holdings of two to five hectares who have been able to bore successful tubewells have adopted the new technology. The green revolution has benefited not only the farmers, but also farm labourers who command high wages in cash and are also fed by the farmers.

STIMULUS TO ECONOMY

The phenomenal increase in production of foodgrains has not only saved the country from a grave political crisis but also provided 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, watches, transistors and textiles have benefited a great deal from the agricultural revolution. The stagnant economy of towns has received stimulus. Many new markets for sale of foodgrains have developed. The shops are brighter

and have more goods to sell. The number of shops selling agricultural chemicals, machinery and implements, textiles, and country liquor have noticeably increased. Repair shops for tractors, diesel engines and pump-sets have multiplied. The requirements of new agriculture, in the terms of fertilizers, plant protection chemicals, pump-sets, electric-motors, pipe sprayers and dusters are tremendous.

TIME ACQUIRES VALUE

It is for the first time that time has acquired value for the Indian farmer. With the ready availability of water all the year round from tubewells, double or even triple cropping has become a common practice.

Small threshers powered by electricity or diesel are now a familiar sight in the countryside of the Punjab. Farmers no longer want to waste their time on harvesting and threshing wheat with traditional bullock-power. The number of power-driven threshers in the year 1962 was negligible and has suddenly increased to 80,000 in the year 1968-69. The need to prepare seedbed quickly and to plant the next crop has generated a great demand for tractors. In 1961, the Punjab had only 4,997 tractors and in 1970 there were about 25,000 tractors with the Punjab farmers. The total demand envisaged is about one-hundred thousand. The farmers use the tractors not only for ploughing their land and threshing their grain but also use them for custom hiring to their neighbours. Tractor cultivation, due to deep tillage, has also contributed to higher production. A study carried out in Ferozepur District has shown that yield per acre of Mexican wheat was 24.70 quintals per hectare in tractor-operated farms irrigated by tubewells, while in similar bullock operated farms it was noticeably less, viz., 19.81 quintals per hectare.

Intensive farming with the new technology has generated demand for more farm labour. As a result, acute labour shortage has arisen. Another contributory cause is that the sons of Harijans who are landless labourers after receiving education are going into professions and skilled jobs and are no longer interested in working on farms as unskilled labourers. The gap in labour supply is being partially filled by migrant labour from over-populated eastern Uttar Pradesh and dry areas of Rajasthan.

Here it would be relevant to refer to the work done by the College of Agricultural Engineering of the Punjab Agricultural University. Besides training agricultural engineers and providing technical guidance to industry, this college has done research to develop agricultural machinery, in the design of irrigation systems, to reclaim water-logged land, and on storage bins for wheat. The pieces of equipment developed by the College such as fertilizer-cum-seed drill, bullock and tractor-operated reapers, potato-harvesting machines, groundnut digger, and storage bins have already been taken up by private industry for manufacture.

EXTENSION EDUCATION

The present programme of extension education in agricultural engineering consists of short-term courses for progressive farmers, young farmers, personnel from agricultural and extension departments, participation in *Rabi* and *Kharif* campaigns and supply of technical advice to the farmers of the Punjab on different aspects of tubewell construction and operation, water management, tractors and farm machinery, farm structures and storage. Farmers are turning up in increasing numbers to learn tractor driving and management of pumping-sets and electric-motors, and poultry farming.

PRICE SUPPORT POLICY, THE PIVOT OF THE GREEN REVOLUTION

Agriculture has remained stagnant in countries like India as the producers never got remunerative prices for their crops as the Government policies were consumer-oriented. Another tragedy of these countries is that the administrative services are overloaded with officials who have no experience of agriculture and rural life. Most of them are from urban castes and classes who were the traditional exploiters of the agriculturists. Hence, it is too much to expect that they would view their problems with sympathy. This has been the bane of Indian agriculture. A radical departure came in 1966 on account of the compulsion of food shortages when the Government of India adopted the policy of giving remunerative price for foodgrains. It paid rich dividends in increased food production as well as the stimulus it provided to the economy.

The price support policy for wheat adopted by the Government of India is a key factor which has assured the success of the Wheat Revolution. Not only the price offered is remunerative but arrangements are also made to purchase the foodgrains through the Food Corporation of India and the State Marketing Departments. Thus the strategy of grain dealers who used to join together to depress the price at the time of harvest when the farmers sell and raise it a few months later when there was acute consumer demand was defeated. The impact of this policy can be judged from the fact that the wheat acreage in the country which was 12.8 million hectares in 1966-67 rose to 15.8 million hectares in 1969-70 and production rose from 11.3 million tonnes to 20.4 million tonnes. The average yield per hectare rose from 887 kg. to 1,263 kg. It is for the first time that the empty grainaries of India filled up, we are largely emancipated from dependence on PL-480 supplies. The pivot of the programme is remunerative price for the farmers. So long

as the farmers get a remunerative price for their production which enables them to meet the cost of inputs such as : fertilizers, plant protection chemicals, quality seed, charges for family as well as hired labour, bills for electricity and diesel oil, depreciation of agricultural machinery, and also make a reasonable profit, they will continue to invest and the agricultural revolution will roll along bringing still larger areas under its sweep. However, the temptation of whittling down the profit of the farmers should be resisted so that their enthusiasm is not killed. The requirements of modern agriculture in terms of resources are tremendous. The farmers have been ploughing back their profit in land improvement, sinking of tubewells, installing underground systems of irrigation, purchase of tractors, pumping-sets, sprayers and costly implements. Let this process go on for a number of years and we will notice the liquidization of rural slums over vast areas in India, and firm foundation would have been laid for development in other sectors of economy.

The term Green Revolution conjures in the minds of some people visions of prosperity, which are not in consonance with reality. The area which has experienced this agricultural change is confined to Punjab, Haryana and Western U.P. So far, the only crop in which spectacular increase in production has taken place is wheat. The production of cotton, sugarcane and maize is still low. The standard of living of farmers is still miserably low. Their housing is wretched and furniture is practically non-existent in their homes. The only solid achievement of the agricultural change is that the farmers and their labourers eat better, they have provided food to the city-dwellers of India, and they have liberated the country from its dependence on foreign countries for their daily bread. Besides they have earned a breathing spell of a few years against the torrent of rising population during which the family planning programme should be effectively implemented.

