CHAPTER – III
THE COMING OF THE GREEN REVOLUTION

The ‘new agricultural strategy’ of India was response to the grave food crisis that the country faced in 1965. The crisis was long standing. Situation became more worse, as a result of wide spread drought in 1965-66. It led to fall in agricultural output by 17 percent per year between 1965-1968. India had to import more than ten million tons of food grains in 1966 to avoid famine like condition, most of which was supplied by the United States of America under its PL-480 programme.¹

A feeling had been growing among the donor countries that the resources available with them for international aid were limited, relative to the demand for aid from food-deficit developing countries. They argued, the aid should go to the countries which showed the greatest chance to survive a transit shortfall in their food supply. India began to be treated as a triage case which could not stand on its own feet. India had been kept away from the edge of famine for asking for food from abroad.²

Meanwhile, some of the backward countries had been showing increase in food production. Sudan during the period 1948 to 1963, increased its total crop output at a compound growth rate of 8 percent. Mexico achieved a growth rate of 6.3 percent and Taiwan 4.5 percent during the same period. All these countries had cultural and social backgrounds not far different from India. The key to their tremendous achievements lay in their adoption of scientific and modern agricultural methods in which improved varieties of seeds and huge doses of inputs like fertilizers, pesticides, weedicides and assured irrigation were used³

The renowned agricultural scientist, M.S. Swaminathan, assured that to produce 100 million tones of food grains India ought to need only 10 million hectares of land if all the results of research can be adapted on such an area.\(^4\)

Dr. Norman Borlaug’s dwarf wheat seed varieties were on trial in India at this crucial period. With the introduction of these high yielding varieties, the food grain production showed a sudden upward trend after 1966-67. This phenomenal increase in production of food grains has been known as “Green Revolution”.\(^5\) It can be defined as the technological and institutional change that have taken place in agriculture. It is also a strategy of agricultural transformation based on intensive inputs and high-yielding varieties of seeds.\(^6\)

The term “Green Revolution” was coined in 1968 by Dr. William S. Gaud, Director of the US Agency for International Development. This phrase immediately became very popular because of the dramatic impact of the semi-dwarf wheat varieties originating from the Rockefeller Foundation, Government of Mexico Programme and rice varieties originating from the International Rice Research Institute of Philippines.\(^7\)

Lal Bahadur Shastri became the prime minister of India in 1964. He took the matter seriously and appointed C. Subramaniam, the minister of food and agriculture. His approach to securing a break through in agricultural production was two fold. Firstly, he viewed that agriculture must be given the benefits of modern technology that had recently became available, to raise crop yield levels. Secondly, the farmer should be paid remunerative price for his produce, if he were to take the risk of using expensive inputs like high yielding varieties of seeds and chemical fertilizers. He argued that unless the country’s cheap grain policy was changed, food production could not go up. He suggested that the government should assure the farmers that there would be Government

\(^4\) The Indian Express, July 6, 1966.
supported base price for their produce, which would meet their costs and ensure a profit on basis of cultivation of land. His proposals for this change in the agricultural front was opposed by some senior ministers. These ministers headed by T.T. Krishnamachari argued that this proposal will lead to sharp rise in food prices all over the country and cause unrest among the urban middle class. In his response, Subramaniam asked the cabinet to choose between the self- sufficiency in food-grains and urban unrest. He also warned that without the bold policy initiative, the choice before the country lay between starvation and becoming a satellite of U.S.A.  

C. Subramaniam arranged the import of 18 tones of Maxican dwarf wheat seeds in spite of lot of opposition by senior ministers. In 1965, India also imported one ton of a new rice variety, named TN-I seed from IRRI. TN-I was sown in 60,000 hectares. At the same time, he requested the scientists in the Indian Council of Agricultural Research to intensify their effort of adapting the latest HYV Seed-fertilizers technology to Indian conditions. At the same time, India obtained a new rice variety IR-8. Up to 1968, 1.5 million hectares came under IR-8. Hybrid varieties like Jaya and Padma were released by the Indian Scientists at the end of 1968, which were more suitable for Indian weather conditions.

Food grains production of India was 66.9 million tones in 1955-56. It reached a high level of 89.3 million tones by 1964-65. With the introduction of new agricultural strategy, based on high yielding varieties and fertilizers it touched a record level of 108.4 million tons in 1970-71. Mr. Carrol P. Streeter from the Rockefeller Foundation

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remarked in 1969 “India’s Wheat and Rice Programmes have been like two powerful jet planes at the airport. Wheat rolled down the runway first and is now well aloft. Rice has only barely lifted off the ground but it is beginning its climb”.\textsuperscript{12}

India has gone a long way for increasing food production. This significant achievement has been possible as a result of several institutional, infrastructural and technological factors. The total production of food grains had risen from 55 million tons in 1950-51 to about 132 million tons in 1978-79.

The country had changed from deficit state to a surplus one. With increased production, it was possible for India to feed not only about 10 million refugees from East Pakistan but also its own growing population. It enabled India to come out of the crisis of food shortage after the stoppage of PL-480 scheme from United States.

Despite tremendous increase in food production the progress in agriculture is unequal in different states. In some states where there has been no significant improvement in agriculture, people have doubt whether the so called Green Revolution is a reality or myth. But it is a reality that a few states have gone through the era of Green Revolution and among them Punjab is at the top most. It has not only overcome the main brunt of partition but also faced bravely linguistic agitations, occasional threat of war at its boundary and reorganization three times from 1947-1966.

The partition of India in 1947 left the Punjab agriculture with the problem of land, inadequate irrigation facilities and higher density of population. It made the ‘food surplus’ state to be ‘food deficit’. However, the East Punjab had considerable potential for development of irrigation including exploitation of the ground water for cultivation of rice and wheat.

II

Punjab already had a progressive land-tenure system. The process of consolidation of land was started in Punjab in 1950s.\textsuperscript{13} It had a non problem and high-yield environment


\textsuperscript{13} National Council Applied Economic Research’s Techno-Economic Survey of Punjab, 1959-60, New Delhi, p.IX.
for agriculture. Punjab was blessed with favourable climatic composition, such as, moderately high radiation, less cloudiness, low to medium relative humidity. It was anti-pest and anti-disease. Moreover, Punjab did not have any dangerous problem of water submersion and droughts.\textsuperscript{14}

The infrastructural facilities for agriculture built in the post-independence Punjab proved very helpful in popularizing the new technology that became available around 1966-67. Development of Mexican wheat and the introduction of PV-18 & Kalyan Sona which were developed from the breeding material received from Mexico proved distinctly higher than that of local varieties for their average yields. The peasantry of Punjab recognized the potentials of new technology in agriculture.\textsuperscript{15} From 1965-66 to 1971-72, the area under the new wheat varieties increased from 1.55 million hectares to 2.33 million hectares. The average yield per hectare in the Punjab increased from 1,238 in 1966 to 3,593 kgs in 1989-90.\textsuperscript{16}

After the wheat revolution, it was turn of the rice. Paddy was not the main crop of Punjab. Before, 1965-66, rice was grown only in few areas in the state where the soil was hard clay and that had assured irrigation facilities.\textsuperscript{17} With the release of the dwarf rice varieties such IR-8 in 1968 and Jaya in 1971, the farmers of Punjab accepted the challenge of rice cultivation. The availability of improved varieties and the extension of assured irrigation changed the picture entirely by 1970. Average yield of rice increased from 1,000 kgs per hectare to 2,606kgs from 1965 to 1979-80.\textsuperscript{18} The average yield of rice

\begin{itemize}
\item \textsuperscript{14} B. Venkateswarlu, \textit{Dynamics of Green Revolution in India}, pp. 278-279.
\item \textsuperscript{15} M.S. Randhawa, \textit{Green Revolution – A Case Study of Punjab}, pp. 67-71.
\item \textsuperscript{17} Himmat Singh, \textit{Green Revolutions Reconsidered - The Rural World of Contemporary Punjab}, p. 60
\end{itemize}
rose up to 3,510 kgs per hectare in 1989-90.\textsuperscript{19} Soon the paddy – wheat- paddy cycleecame the normal feature of the crop pattern of the state.\textsuperscript{20}

**HIGH YIELDING SEED VARIETIES**

The high yielding seed varieties was the most important factor in the success of
the Green Revolution. It was the high yielding varieties which increased the produce
many times. The Mexican dwarf wheat varieties which were introduced on experimental
basis in India in 1966 proved highly successful.\textsuperscript{21} The production and distribution of
improved seeds to the farmer was handled by the Department of Agriculture and the State
Seeds Corporation. Subsidy was granted to keep the prices within reasonable limit and
easy approach of the farmers.\textsuperscript{22}

During the Fourth Five-Year Plan, multiplication and distribution of improved
seeds received special attention. The seed programme was streamlined in such a way that
breeder’s seed could be produced in adequate quantities with the help of ICAR and the
NSC and foundation seeds by the NSC and selected agricultural universities. In the
production of certified seeds, a number of agencies were brought in, including state seed
farms, central state farms, private seed producers and state producers’ cooperatives.
Efforts were also made to provide the right type of storage facilities and to set up
requisite number of seed processing plants.\textsuperscript{23}

The contribution of Punjab Agricultural University, Ludhiana in developing large
varieties of improved seeds is very significant. It developed thirty four varieties of wheat

\begin{flushleft}
\textsuperscript{20} Himmat Singh, *Green Revolutions Reconsidered - The Rural World of Contemporary-Punjab*, p.62.
\textsuperscript{21} *Punjab – The Possible Dream*, Director of Public Relation, Government of Punjab, Chandigarh, 1976, p.4..
\textsuperscript{23} *Report of the National Commission on Agriculture*, p.156.
\end{flushleft}
between 1964 and 1993. Some of them were Lerma, Roja 64, Kalyana Sona, Sonara, PV-18, C-306, Sonolika, WG-357 and HD-2009 etc. Kalyan Sona, Sona Lika and PV-18 became popular in Punjab due to its high yielding. These HYV of wheat increased the production of wheat many times.

Punjab was never known for rice cultivation. But, the high yielding varieties in rice have made Punjab one of the most important rice producing states. The HYV in rice i.e. Chung No.1, IR-8 and Jaya have made surplus rice in Punjab. With the adoption of new high yielding varieties in wheat and rice, the production of these two crops recorded a phenomenal rise. The yield of wheat per hectare increased from 1,863 kgs in 1967-68 to 3,591 kgs in 1989-90, while that of rice yield increased from 1,322 kgs to 3,507 kgs per hectare.

In the same way, between 1966-67 to 2000-01 the area under wheat increased 2.1 times and production 6.3 times, while the area under rice increased seven times and yields two times between 1970-71 to 2000-01. By 1970-71, 73 percent of wheat and 36 percent of rice was under the high yielding varieties. The Punjab Development Report recorded that on 30 June 1999, 100 percent of the area under wheat and 97.6 percent under rice were covered by high yielding varieties. Wheat output which was 1.0 million

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26 During the interviews, I was told that how bewildered people were when they saw semi dwarf varieties and their yield. Interviewee told me how peasants would come to see their crop and tried to measure the length of the ears of wheat plant with hand. They were so long that peasants would not believed till they had seen them with their own eyes: Interview with Mota Singh Chabhal, Surjit Singh Chabhal, Gurbans Jasinder Singh (Gurbans Jasinder Singh had land in Zeera, Ferozepur & Ludhiana).


metric tons in 1950-51 rose to 2.4 million tons in 1964-65 and reached the level of 11.5 million tons in 1989-90. Similarly the production of rice which was 0.1 million tones in 1950-51 rose to 0.5 million tons in 1969-70 and reached 6.7 million tons in 1989-90. As a result of tremendous increase in agricultural production, Punjab has emerged as the biggest contributor to the Central Pool of the Food Corporation of India. Punjab contributes between 50 to 70 percent of total wheat and 40 to 50 percent of total rice.  

**ASSURED IRRIGATION**

Assured irrigation is a pre-condition for the successful introduction of the high yielding seed varieties even in areas known for heavy rains. The high yielding seed varieties demand more water and at specified time. So assured irrigation either through canal or tube well or other means is must for the introduction of high yielding seed varieties. In the Punjab, rain fall is not always certain and is not always timely. Hence, for attaining higher levels of agricultural production, it was necessary to provide means of assured irrigation to farmers. The introduction of high yielding varieties of crops and the application of higher and higher doses of chemical fertilizers had made it all the more necessary.  

The irrigation system in Punjab though not as developed as that of West Punjab was still in better shape than rest of India. Water from canals and Government tube-wells was not sufficient and certain to cope with the increasing demand. The farmers tried to supplement the irrigation by setting up independent and dependable sources of irrigation in the form of tube-wells, pumping sets and open wells. A large area was brought under tube-wells irrigation through the efforts of farmers themselves. In 1966, the tube wells in Punjab were estimated to be 46,000. But, there was a spectacular increase in the number of tube wells. It rose to 450 lakh by 1975-76. This increased further to 7.65 lakh by 1989-90. With an increase in tube-wells, the number of open wells decreased.

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The number of tube-wells in Punjab between 1970-71 to 1989-90 is as under:

<table>
<thead>
<tr>
<th>Year</th>
<th>Diesel Operated (Lakhs)</th>
<th>Electric Operated (Lakhs)</th>
<th>Total (Lakhs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970-71</td>
<td>1.01</td>
<td>0.91</td>
<td>1.92</td>
</tr>
<tr>
<td>1975-76</td>
<td>3.04</td>
<td>1.46</td>
<td>4.50</td>
</tr>
<tr>
<td>1980-81</td>
<td>3.20</td>
<td>2.80</td>
<td>6.00</td>
</tr>
<tr>
<td>1984-85</td>
<td>2.47</td>
<td>4.00</td>
<td>6.47</td>
</tr>
<tr>
<td>1985-86</td>
<td>2.21</td>
<td>4.41</td>
<td>6.62</td>
</tr>
<tr>
<td>1986-87</td>
<td>1.83</td>
<td>4.90</td>
<td>6.73</td>
</tr>
<tr>
<td>1987-88</td>
<td>1.73</td>
<td>5.10</td>
<td>.83</td>
</tr>
<tr>
<td>1988-89</td>
<td>2.06</td>
<td>5.36</td>
<td>7.42</td>
</tr>
<tr>
<td>1989-90</td>
<td>2.00</td>
<td>5.65</td>
<td>7.65(^{35})</td>
</tr>
</tbody>
</table>


After the partition, the East Punjab had been left with only three Canal System. The Upper-Bari Doab, the Sirhind Canal and the Western Jamuna Canal. It was only 20 percent of the joint Punjab irrigation system.\(^{36}\) Therefore, steps were taken to meet the great demand for irrigation. The construction of the Bhakra Canal System was the biggest landmark in canal irrigation system of the Punjab. It included the Bhakra Canal and the Bist-Doab Canal. After the reorganization of Punjab in 1966, 0.68 million hectares of area irrigated by the Bhakra Canal had gone to Haryana. The Bist Canal provides irrigation to an area of 257,000 hectares in Hoshiarpur, Jalandhar and Kapurthala.\(^{37}\) The discharge of water was increased to enhance the water allowance for the areas already under irrigation and also to new areas from the Upper-Bari Doab Canal and the Sirhind Canal. To increase the irrigation capacity, The Harike Project was also conceived.\(^{38}\)


\(^{36}\) Rabindra Nath Ghosh, Agriculture in Economic Development with a Special Reference to Punjab, p.40. Also see, Holly Sims, Political Regimes, Public Policy and Economic Development – Agricultural Performance and Rural Changes in Two Punjabs, pp.54-55.


\(^{38}\) S.M. Rai, Punjab Since Partition, pp.167-171. Also see, M. Randhawa, Green Revolution – A Case Study of Punjab, p.107.
multi purpose project on river Ravi and Beas was constructed to meet the requirement of irrigation and power.\textsuperscript{39}

Net Irrigated Area in Punjab by different source (in thousand hectares) from 1960-61 to 1989-90 is as under:

<table>
<thead>
<tr>
<th>Year</th>
<th>Govt Canals</th>
<th>Private Canals</th>
<th>Tube wells &amp; Wells</th>
<th>Other sources</th>
<th>Total</th>
<th>Percentage of net irrigated area</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960-61</td>
<td>1,173</td>
<td>7</td>
<td>829</td>
<td>11</td>
<td>2,020</td>
<td>54</td>
</tr>
<tr>
<td>1970-71</td>
<td>1,286</td>
<td>--</td>
<td>1,591</td>
<td>5</td>
<td>2,888</td>
<td>71</td>
</tr>
<tr>
<td>1975-76</td>
<td>1,366</td>
<td>--</td>
<td>1,742</td>
<td>7</td>
<td>3,119</td>
<td>75</td>
</tr>
<tr>
<td>1980-81</td>
<td>1,430</td>
<td>--</td>
<td>1,939</td>
<td>13</td>
<td>3,382</td>
<td>81</td>
</tr>
<tr>
<td>1984-85</td>
<td>1,399</td>
<td>--</td>
<td>2,212</td>
<td>10</td>
<td>3,621</td>
<td>86</td>
</tr>
<tr>
<td>1985-86</td>
<td>1,412</td>
<td>--</td>
<td>2,274</td>
<td>4</td>
<td>3,690</td>
<td>88</td>
</tr>
<tr>
<td>1986-87</td>
<td>1,440</td>
<td>--</td>
<td>2,274</td>
<td>3</td>
<td>3,717</td>
<td>88</td>
</tr>
<tr>
<td>1987-88</td>
<td>1,409</td>
<td>6</td>
<td>2,307</td>
<td>8</td>
<td>3,724</td>
<td>89</td>
</tr>
<tr>
<td>1988-89</td>
<td>1,452</td>
<td>6</td>
<td>2,309</td>
<td>9</td>
<td>3,776</td>
<td>90</td>
</tr>
<tr>
<td>1989-90</td>
<td>1,500</td>
<td>7</td>
<td>2,426</td>
<td>3</td>
<td>3,937</td>
<td>94\textsuperscript{40}</td>
</tr>
</tbody>
</table>


It is evident from the above mentioned table that the area irrigated by tube-wells and canals has increased year after year. The proportion of net irrigated area in Punjab rose from 54 percent in 1960-1961 to 94 percent by 1989-1990.\textsuperscript{41}

As a result of large public investment in canals and private investment on tube-wells by farmers themselves, Punjab is on the top most position in Indian states in the field of irrigation. Almost all the irrigable area of the state is under irrigation.\textsuperscript{42} The proportion of gross irrigation area to gross cropped area in Punjab rose from 52 percent in 1950-51 to 95 percent by 1995-96. It is far above India which is 33 percent. Tube wells irrigated 58 percent of the area in the state during 1995-96 as against 31.8 percent for

\textsuperscript{39} D.P. Gupta & K.K. Shangari, \textit{Agricultural Development in Punjab}, p.118.

\textsuperscript{40} \textit{Statistical Abstract of Punjab}, 1990, p.201

\textsuperscript{41} \textit{Ibid}, p.201.

India as a whole.\textsuperscript{43} Punjab’s experience shows that irrigation is a key factor for the success of Green Revolution.

**CHEMICAL FERTILIZERS**

After irrigation and high yielding seed varieties, the third most important factor that increased production was the use of chemical fertilizers.\textsuperscript{44} The Third Plan proposed a bigger programme for promoting use of chemical fertilizers. Specific targets were laid for nitrogenous, phosphatic and potassic fertilizers. A number of steps were taken to promote their use, which included reduction in the sale of urea, subsidy on road transport from railhead to inaccessible areas, arrangements for intermediate build storage, grant of off-season rebates on the sale of urea, calcium, ammonium, nitrate and ammonium sulphate and intensification of programmes for fertilizer demonstrations on cultivators’ fields. However, actual consumption of fertilizers did not go beyond 50 percent of the targeted levels mainly because of the shortfall in domestic production and inability to arrange for imports. The main recommendations of the Committee on Fertilizers (1965) set up under the chairmanship of Shri B. Sivaraman related to the target of fertilizer consumption during the Fourth Plan period, credit and pricing policies and arrangements for marketing, distribution and promotion. Most of the recommendations of the Committee were accepted. The private sector was allowed to set up new plants with foreign collaboration. Plants set up under the new policy as well as those licensed before December 31, 1967, were given greater freedom for marketing their products for a period of seven years from the date of starting commercial production. To ensure equitable distribution of available supplies throughout the country, the Government reserved to itself the right to lift 30 percent of production at negotiated prices.\textsuperscript{45}


\textsuperscript{44} *Report of the Expert Group on Agricultural indebtedness*, Ministry of Finance, New Delhi, July, 2007, p.19..

The Coming of The Green Revolution

The Fourth Five Year Plan, therefore, stressed on measures for stimulating demand for fertilizers and arranging speedy supply. These included improvement and extension of soil testing facilities, increased use of soil amendments, intensification of extension and sales promotion, increase in number of retail points and increased availability of distribution credit. Nitrogen, Phosphorus and Potassium (NPK) are three most important elements in the chemical fertilizers. The essential elements in soil such as Nitrogen, Phosphorus and Potassium are consumed in large quantities by crops. The nutrient removal by crops from the soil depends on the availability of nutrients in the soil and also on the nature of crops. Sometimes the soil is already deficit in nutrients which are further eroded by the sowing of the same crops year after year, which reduce the production. Therefore, to meet the requirement of removed nutrients from the soil, the use of chemical fertilizers become a necessity. The use of fertilizers along with right doses of irrigation is regarded as one of the quickest ways of increasing productivity of crops.

It had already been seen that fertilizer consumption had played a major role in boosting up agricultural production in agriculturally advanced countries of the world. In 1965-66, Punjab was behind a number of states such as Tamil Nadu, Kerala and Andhra Pradesh in the consumption of fertilizers. But by 1971-72, the per hectare consumption of fertilizer in Punjab was about 50 kgs against 45.28 kgs in Tamil Nadu, 22 kgs in Kerla, 23.47 kgs in Andhra Pradesh, 20.11 kgs in Uttar Pradesh and 16.09 kgs at the all India level.

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48 M.S. Randhawa, Green Revolution – A Case Study of Punjab, p.120.

The Coming of The Green Revolution

Consumption of Chemical Fertilizers in Punjab from 1960-61 to 1990-91 is as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>(000 metric tones)</th>
<th>Per hectare consumption in kgs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>P</td>
</tr>
<tr>
<td>1960-61</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>1970-71</td>
<td>175</td>
<td>31</td>
</tr>
<tr>
<td>1980-81</td>
<td>526</td>
<td>207</td>
</tr>
<tr>
<td>1990-91</td>
<td>877</td>
<td>328</td>
</tr>
</tbody>
</table>


The average consumption of the fertilizers on all India basis was about 15 kgs per hectare during 1974-75. It was still very low in comparison to the advanced countries, where the consumption per hectare was much higher. In Netherlands it was 610 kgs, Belgium 520, New Zealand 503 and Japan 354 kgs in the same period.⁵¹

The consumption of fertilizers during the first two Five-Year Plan was rather low but with the introduction of high yielding varieties and extension of irrigation facilities, the consumption of fertilizers showed steep rising trend. In the year 1960-61 only 5 thousand metric tones were consumed in Punjab as against 213 thousand metric tones in 1970-71, 762 thousand metric tones in 1980-81 and 1,220 thousand metric tones during 1990-91. The fertilizer consumption per hectare increased from 1.1 kgs in 1961 to 162.7 kgs in 1991 for per hectare in Punjab where as that of India, it increased from 1.92 to 67.55 kgs only for the same period.⁵²

Punjab could manage to expand its use of fertilizers basically on the strength of its growing irrigation facilities. The new high yielding seed varieties could show their production effects through the absorption of high doses of fertilizers under an assured water supply. Punjab provided required condition for the increased and expanding use of fertilizers under the irrigation-seed-fertilizer package of the new technology.

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THE HUMAN ELEMENT

In India, as well as in the rest of the world, the human element has played an important role in agricultural development. Kusum Nair, a journalist, who traveled all over India, from 1958-1960, has assessed the role of human element in rural development. She stated that she found contentment with the existing miserable conditions in number of states. However, in Punjab alone, she saw enterprising and energetic people.\(^{53}\) She has also observed that the refugee farmers were more progressive and superior in techniques of cultivation to the farmers of the East Punjab.\(^{54}\) As far back as 1881, Sir Denzil Ibbetson had described the Sikh Jats of the Punjab as “the finest peasantry in India”.\(^{55}\) Malcolm Darling also gave credit to Jat Sikh farmers for their remarkable farming skills and their readiness to innovate and take risks.\(^{56}\)

M.S. Randhawa too says that human element of Sikh peasantry, to a large extent, is responsible for bringing Green Revolution in Punjab. He observed, “Sikh farmers like the Reddies of Andhra Pradesh and Gounders of Coimbatore are efficient farmers. Their love for land is almost mystical. Education is wide spread among them and they easily understand intricacies of balanced use of chemical fertilizers and plant protection chemicals. Among them are about half a million serving soldiers and pensioners, who have aptitude and knowledge of machinery. There are large number of policemen, teachers and government servants of various categories who are son’s of farmers. Most of these persons invest their savings in land development. The villagers which migrated to foreign countries also invest their savings in agriculture. Recent development in this direction is the impact of gift tractors in Punjab from foreign countries”.\(^{57}\)


\(^{54}\) M.S. Randhawa, *Green Revolution – A Case Study of Punjab*, p.33.


\(^{57}\) M.S. Randhawa, “*Uneven Progress in Agriculture*, *The Financial Express*, New Delhi, May 9, 1974.
It is a universal fact that socio-cultural background plays an important role in the development of human stuff. Punjab is an agrarian state. More than 75 percent of its population depend on agriculture. Farming is regarded as the best profession in Punjab.\textsuperscript{58} The Sikhism broke the shackles of caste system. Artisans comprising black smiths, masons and carpenters, known as born engineers, played a vital role in the development of agro-industry in Punjab. After partition, they re-settled with speed and modernized the agriculture of Punjab with loans for sinking wells and for the purchase of tractors.\textsuperscript{59}

**PUNJAB AGRICULTURAL UNIVERSITY**

Agricultural University, Ludhiana has played a pivotal role in the development of agriculture in Punjab. The university was established in 1962 on the model of the Land Grant Universities of the U.S.A. It has proved to be a powerful engine for the advent of Green Revolution.\textsuperscript{60} The main motive behind the establishment of the agricultural university was to bring about an integration of teaching, research and extension education programme in agriculture and allied fields.\textsuperscript{61}

Punjab Agricultural University, Ludhiana succeeded in developing large varieties of improved seeds of major crops such as wheat, rice, maize, bajra, oil seeds, cotton, sugarcane and pulses.\textsuperscript{62} The university has released more than 268 improved varieties of various crops having increased resistance to various diseases and pests. These varieties also have suitability for cultivation under various agro-climate conditions.\textsuperscript{63}

The first dwarf variety of wheat PV-18 was launched by Punjab Agricultural University in 1966. Kalyan Sona was developed in 1967 which out lashed the PV-18 in


\textsuperscript{60} Partap C. Aggarwal, *Green Revolution and Rural Labour - A Study in Ludhiana*, p.117.


quantity as well as in quality. This variety has been responsible for bringing about a revolution in wheat production in Punjab.\textsuperscript{64} WG-357, WG-377 and WL 410 were other good varieties developed by the university. The Punjab Agricultural University brought out thirty-four varieties of wheat between 1964 to 1993.\textsuperscript{65} Besides wheat, Punjab Agricultural University played a significant role in rice breeding. A dwarf rice variety IR-8 was released in 1968. Jaya was released in 1971.\textsuperscript{66}

The agriculture university has played a vital role in extension services and extension education. Apart from the university, it has more than 63 demonstration centres throughout the state. About one hundred training camps for farmers are organized in a year to give the farmers practical training in the use of new technology.\textsuperscript{67} Punjab Agricultural University organize Kisan Melas on the campus twice a year. Farmers from all over the Punjab and even from other states come in large numbers to attend the melas. All the new varieties of plants are put on display together with full details about their merits and their method of cultivation. Improved machines and animals are also exhibited. Scientists explain their research findings and discuss them with visiting farmers.\textsuperscript{68} It has close link with All India Radio. The farm and home broadcasting unit of All India Radio, Jalandhar started functioning from April, 1966.\textsuperscript{69}

It can be said that Punjab Agricultural University has become an outstanding institution in the field of agriculture in the country. It has done remarkable job in the fields of teaching, research and extension. It has not only done tremendous job in

\begin{thebibliography}{9}
\bibitem{64} Amrit Parkash Singh, \textit{Role of Punjab in Green Revolution}, p.45.
\bibitem{65} Himmat Singh, \textit{Green Revolutions Reconsidered - The Rural World of Contemporary Punjab}, p.54.
\bibitem{67} Amrit Parkash Singh, \textit{Role of Green Revolution}, p.47.
\end{thebibliography}
improving crop varieties and animal culture, but it has also won the faith and appreciation of the entire peasantry of the Punjab. Farmers consider this university as a place of pilgrimage, a seat of learning and a institution on which they can always depend in modernizing their cultivation. The same sentiments were expressed by the progressive farmers with whom I held up interviews. They told me about the co-operation they were given by the university. Some, however felt that it was the farmer around Ludhiana who benefited more as university did not have extension centres in Majha area.

The University has been able to make a major contribution in bringing about a breakthrough in wheat and rice production in the state and in making Punjab the ‘rice bowl’ and the ‘bread basket’ of the country. Punjab, which was not a traditionally rice growing state, today leads other states in supplying rice to the national food pool. Mira Kamdar, a senior fellow at the World Policy Institute, New York, from 1992-2006, wrote in 2008 “if a single institution can take credit for bringing the Green Revolution to Punjab, it is Punjab Agriculture University”.

FARM MECHANISATION

Mechanisation can be regarded as one of the chief manifestations of advanced farming. It can be defined as the use of improved types of hand tools, animal-driven implements and power-driven equipments. It is not a direct component but is instrumental in increasing the area under high yielding varieties seeds.

The mechanization of agriculture means use of different machines such as tractors, thrashers, pumping sets, tube wells, tillers, disc harrows, sprayers etc. In a

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71 Interview with Mota Singh Chabhal, Gurbans Jasinder Singh, Colonel Balraj Singh Riar and Surjit Singh Chabhal.

72 Interview with Ajit Singh and Jagir Singh of Village Khankot, District Amritsar.


75 Ali Mohammed (ed.), Dynamics of Agricultural Development in India, p.XXII.
mechanized farm, ploughing is done by tractor, sowing of seeds and applying of fertilizer by the drill and reaping and thrashing by the combined harvest thrasher. Mechanisation reduce human labour and displace animal labour completely in the process of cultivation. The use of improved agricultural implements and machinery increased production, cuts down cost and helps farmers in the timely performance of various agricultural operations.\(^76\)

High yielding varieties of seeds not only gives high production but also mature in short period. For a double cropping and multiple-cropping, the farmer has to fight against time. Loss of time between harvesting a mature crop and planting a new one means loss in terms of output and income.\(^77\) A delay of 15 to 20 days could convert a possible bumper crop into an average. For example, to reap a bumper wheat crop the sowing of *Kalyan Sona* and *PV-18* wheat varieties should commence from the 1\(^{st}\) week of November. By early sowing these varieties escape exposure to mid-season rush and high temperature near maturity. Delaying beyond the optimum sowing period result in a progressive decline in yield.\(^78\) To achieve spectacular result from high yielding varieties, fertilizers should be put at right time at right depth. For the protection of plant from pest, mechanical sprayers and other equipments are needed. They enable the farmer to apply pesticides uniformly in correct doses at right time. Mechanisation had thus become an essential element for the spread of Green Revolution.\(^79\) If one hand mechanisation was an

\(^{76}\) Kewal Krishan Dewett, J.D. Verma & M.L. Sharma, *Indian Economics (A Development – Oriented Study)*, S. Chand and Company Limited, New Delhi, 1972, p.71

\(^{77}\) R.N. Chopra, *Green Revolution in India – The Relevance of Administrative Support for its Success*, p.100.


essential element for the spread of Green Revolution, on the other it was the result of more money because of high yielding varieties.\(^{80}\)

The farmers of Punjab have shown higher levels of adoption of technological innovations. It can be seen from the following table: -

<table>
<thead>
<tr>
<th>Agricultural machinery and implements in Punjab (000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Ploughs</td>
</tr>
<tr>
<td>i) Wooden</td>
</tr>
<tr>
<td>ii) Iron</td>
</tr>
<tr>
<td>iii) Disc Harreo</td>
</tr>
<tr>
<td>2. Sugarcane crushers</td>
</tr>
<tr>
<td>i) Worked by power</td>
</tr>
<tr>
<td>ii) Worked by bullocks</td>
</tr>
<tr>
<td>3. Tractors</td>
</tr>
<tr>
<td>4. Threshers &amp; Drumies</td>
</tr>
<tr>
<td>5. Seed Fertilisers Drills</td>
</tr>
<tr>
<td>6. Oil engines with pumping sets</td>
</tr>
<tr>
<td>7. Electric pumps for tube-wells</td>
</tr>
</tbody>
</table>

(a) * less than 500.
(b) N.A. means Not Available.


The number of iron ploughs have increased considerably. The proportion of wooden to the total number of ploughs have declined from 62 percent in 1961 to 52 percent in 1966, indicating the tendency that these were being replaced by the iron ploughs. Oil engines increased during the period under review by about three and a half times. More sophisticated implements like tractor, threshers, seed–cum fertilisers drills became very popular.\(^{82}\)

There has been a phenomenal increase in tractors in Punjab. There were 4,900 tractors in 1961 in the state. The number of tractors further grew to 60,000 in 1976-77, 82,000 in 1979-80 and 1,10,000 in 1980-81. There has been 22 times increase since

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80 The view was expressed by Fateh Singh Sandhu of Village Garha, DistrictLudhiana that they and many like them were able to buy tractors and new implements with the money they earned from high yielding varieties: Interview with Fateh Singh Sandhu.


82 Ibid. p.21.
1961. There were 580 tractors-driven and 206 self-mechanized harvesting combines in Punjab during 1979-80. The number of thrasher reached to 2.45 lakh in 1979-80. The thrashing operations have been fully mechanized in the Green Revolution era.

The number of tube wells also increased many times after 1966. The Persian Wheel, which was the major source of irrigation before the Green Revolution has been completely replaced by tube-wells. There were only 25,000 tube wells in 1966 but the number increased tremendously. The electric operated tube wells increased from 91,000 in 1970-71 to 7,65,000 in 2002-03.

**AGRICULTURAL CREDIT**

With the introduction of new agricultural strategy, farmers needed credit for the purchase of new seeds, better implements, chemical fertilizers, pesticides and for introducing improvements in lands. The facilities of cheap agricultural credit has encouraged the adoption of new agricultural technology. The Cooperative movement in India was introduced in 1904 to solve the problems of rural indebtedness by passing the Cooperative Credit Societies Act of 1904. H. Calvert, M.L. Darling and C.F. Strickland helped Punjab in the era of Cooperative Movement. They laid the foundation of sound Cooperative Movement in Punjab. The number of Cooperative Societies was 24,054, with a membership of 1,124,000 and a working capital of Rs 24.45 crores in 1946.

In 1951-52, a comprehensive enquiry into agricultural credit was carried out by the Rural Credit Survey Committee at the instance of the Reserve Bank of India. The Rural Credit Survey Committee remarked in its report that the share of the co-operative

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88 M.S. Randhawa, Green Revolution – A Case Study of Punjab, p. 82.
in total agricultural credit was only 3.1 percent, that of the government 3.3 percent and the rest was provided by individuals including moneylenders.\textsuperscript{89}

A multi-agency approach was adopted to make credit available. It included Cooperatives, Commercial Banks and Regional Rural Banks. The cooperatives programme functioned at three levels – Agricultural Credit Societies at the village level, Central Cooperative Banks at district level and the State Cooperative Banks at the state headquarters level. They provided short term production credit and medium term investment credit to the agriculturalists. Land Mortgage Banks issued long term credit at the primary and state level.\textsuperscript{90}

The Primary Cooperative Credit Societies advanced short-term loans. Where as Land Mortgage Banks, other Co-operative Institutions and Nationalized Banks have been actively engaged in extending medium and long term credit for various investment purposes. Between 1969-70 and 1982-83, loans given by the Primary Land Mortgage Banks for the purchase of tractors expanded more than 3 fold and for the improvement of land nearly 10 folds. These banks advanced about 34.0 percent of the loans for the purchase of tractors, nearly 53.0 percent for tube-wells installations and about 10.5 percent for the improvement of land in 1969-70. During 1982-83, the corresponding percentages were 45.07, 9.17 and 41.61 respectively. It has been found that most important long term needs for which the farmers borrow money from different sources was for the purchase of tractors and installations of tube-wells.\textsuperscript{91}

Total loans of Primary Agricultural Cooperative Credit Societies in Punjab rose from Rs. 22 million in 1950-51 to Rs. 4,693 million by 1989-90 and to Rs 25,551 million by 1996-97.\textsuperscript{92} The total cooperative loans to agriculture per hectare rose from Rs. 7 in 1951-52 to Rs. 833 in 1989-90 in Punjab compared with an increase from Rs 2 to Rs. 306

\textsuperscript{89} \textit{Report of the National Commission on Agriculture}, Part I, p. 162.
\textsuperscript{90} \textit{Ibid}, pp. 162-163, Also see, R.N. Chopra, \textit{Green Revolution in India – The Relevance for its Success Support for its Success}, p.91.
for India as a whole.\textsuperscript{93} Punjab had 36 Banking Offices per thousand square kilometers of area in June, 1983. It was next only to Kerla.\textsuperscript{94} The percent of long term borrowing from moneylenders, has gone down considerably with the growth of Cooperative Societies, Land Mortgage Banks and the availability of credit from the Commercial Banks and the Government.\textsuperscript{95}

The Co-operative Movement in Punjab has played a significant role in the economic life of the people particularly in the rural area. Punjab is one of the few states of India which have a good credit-cooperative record. An admirable aspect of the cooperative credit structure in Punjab was that short term loans for the purchase of fertilizers were given.\textsuperscript{96} The government agencies and Land Mortgage Banks give the greatest aid to the small farmers. Cooperatives in Punjab, have helped in distributing the fruits of Green Revolution equally among farmers of all categories such as marginal, small, medium and big. The cooperative credit structure of the Punjab is responsible for bringing a large number of farmers into the main stream of production. It provided them an equal chance of technological change. It is because of involvement of these co-operatives societies that the small farmers have been able to adopt the capital intensive technology.\textsuperscript{97}

The Royal Commission on Agriculture remarked in 1928, “If Cooperation fails, there will fail the best hope of rural India”. The general scenario of Cooperative Credit movement in Punjab is satisfactory. It is basically sound and well equipped with the

\begin{itemize}
\end{itemize}
cooperation shown by the farmers. Punjab today stands ahead of most of other states in regard to cooperative agriculture credit. The system has been misused also. In the case of tractors it has been more successful than in the case of fertilizers.

**POWER FOR AGRICULTURE**

Electricity is one of the most essential components for modernized agriculture. It is used for lifting water by tube well, processing and preserving agricultural produce and sprinkle irrigation. Only 1,300 villages had been electrified and 6,400 electrical pump sets were working in the whole country at the time of independence. Programme of rural electrification was taken up in right direction in the five year plans.\(^98\)

The condition of electricity in Punjab was not satisfactory at the time of independence. Punjab ranked far below other states in the use of electricity in 1951. Punjab’s per capita generation of electricity was about 5.89 kwh compared to Mysore’s 55.6 and West Bengal’s 49.3 in 1951.\(^99\)

Power was given the top most priority in the five year plans of Punjab. There had been an enormous increase in the demand for electricity in the Punjab as a result of large scale sinking of tube-wells, use of electricity for agricultural operations and the growth of industrialization in the state. The installed capacity in Punjab was 48 MW in 1947.\(^100\)

From the beginning of the sixties, power generation and per capita consumption increased considerably in the state.\(^101\) Per thousand population consumption of electricity in the Punjab during 1969-70 was 1,81,044 kwh as against the national average of 76,012 kwh. Maharashtra with consumption of 1,43,358 kwh and Tamilnadu with 1,20,508 kwh were next to Punjab.\(^102\) In the same way, annual per capita consumption of


power for irrigation purposes in rural Punjab rapidly rose with the coming of the Green Revolution. From 10.86 per capita per annum power consumption for irrigation in 1967-68, it increased to 26.60 kwh in 1969-70 which shows the tremendous rise in power operated tubewells.\textsuperscript{103} The number of consumers also rose from 46,047 in 1967-68 to 73,761 in 1969-70. For the same period, the national level per capita per annum consumption of power for agriculture was 6.99 kwh.\textsuperscript{104}

The decision of the Punjab Government to provide irrigation at cheap rate led to increase in generation of power. It made arrangement for the supply of electricity to the tube wells. The Punjab State Electricity Board launched a crash programme of tube well energization in May, 1967.\textsuperscript{105} The number of electric operated tube wells increased from 4,196 in 1968 to 1,96,515 in March, 1976 showing an increase of 249 percent.\textsuperscript{106} With the introduction of new agriculture strategy, Punjab expanded its installed capacity sharply as per its own demand.

\textbf{Installed plant capacity and electricity generated in Punjab from the year 1965-66 to 1988-89 is as follows: -}

<table>
<thead>
<tr>
<th>Year</th>
<th>Installed capacity of Electricity (MW)</th>
<th>Generated Electricity (Million Kwh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965-66</td>
<td>433</td>
<td>1818.79</td>
</tr>
<tr>
<td>1970-71</td>
<td>680</td>
<td>2364.80</td>
</tr>
<tr>
<td>1975-76</td>
<td>1009</td>
<td>3841.21</td>
</tr>
<tr>
<td>1980-81</td>
<td>1536</td>
<td>6482.95</td>
</tr>
<tr>
<td>1984-85</td>
<td>2315</td>
<td>8629.01</td>
</tr>
<tr>
<td>1985-86</td>
<td>2449</td>
<td>10688.94</td>
</tr>
<tr>
<td>1986-87</td>
<td>2459</td>
<td>12181.71</td>
</tr>
<tr>
<td>1987-88</td>
<td>2660</td>
<td>12207.79</td>
</tr>
<tr>
<td>1988-89</td>
<td>3048</td>
<td>12130.61\textsuperscript{107}</td>
</tr>
</tbody>
</table>

\textit{Source} - \textit{Statistical Abstract of Punjab, 1990.}

\textsuperscript{103} \textit{Statistical Abstract of Punjab, 1971}, p.190.

\textsuperscript{104} \textit{Ibid}, p.204.

\textsuperscript{105} M.S. Randhawa, \textit{Green Revolution – A Case Study of Punjab}, p.133.

\textsuperscript{106} D.P. Gupta and K.K. Sangari, \textit{Agricultural Development in Punjab}, p.124.

\textsuperscript{107} \textit{Statistical Abstract of Punjab, 1990}, p. 221.
Punjab expanded its installed capacity from 433 MW in 1965-66 to 680 MW in 1970-71. It went up to 1,536 MW in 1980-81 and 3,048 MW in 1988-89. However, Punjab was still short of electricity in 1990. To fulfill the demand of power, Ropar Thermal Project, Mukerian Hydel Project-Phase II, Anandpur Sahib Hydel Project, Thein Dam and Sahpur Kandi Projects were completed on a priority basis. After Haryana, Punjab was the second state in India to achieve 100 percent rural electrification in 1979 compared with 37.7 percent at national level.

High consumption of electricity by the farmers is another distinguishing factor responsible for the state’s agriculture development. Consumption of electricity increased from 46.3 crores kwh in 1970-71 to 823.3 crores kwh in 1999-2000, an increase of 18 times.

In Punjab, agriculture stand next to the industrial sector in the consumption of electric power. The phenomenal increase in electric consumption in the agriculture sector proves the fact that the extension of irrigational facilities became very essential with the introduction of high yielding seed varieties. By 1982-83 about 40.7 percent of the electricity was used for agriculture in Punjab while the national consumption for agriculture was 18.6 percent.

The revenue returns from state run tube-wells was very low. It was an uneconomical programme for the Punjab Electricity Board. But its demands was increasing day-by-day. The pending applications for power connections to tube-wells were near about 25,000 in 1966 that crossed the figure of 2 lakh in 1990. The free

112 M.S. Randhawa, Green Revolution – A Case Study of Punjab, pp.131-133.
power to agriculture after 1997, exorbitant rates for industry and unpaid bills to coal suppliers showed the uneconomical condition of the Punjab Electricity Board. The possibility of a major increase in power generation in Punjab exists only via the thermal route. Punjab was already buying 25 percent of its requirements from other agencies in 2000 and this will increase up to 50 percent by 2015.\textsuperscript{115}

MARKETING

Marketing of agricultural produce and other farm products play a vital role in the economy of the farmer and has a direct bearing on the farm income. The production programmes cannot make headway unless these are supported adequately by a suitable marketing system. An efficient marketing system helps the farmer to get a fair price of his product.

The seasonal nature of the agricultural production indicates an extensive need for storing and processing. The risk involved in the storage of perishable products is great. So, for efficient farming, a well organized marketing system backed by transport and scientific storage facilities, is essential.\textsuperscript{116}

The Green Revolution has made farmers more dependent on the market not only for purchasing inputs but also for selling of agriculture produce. In pre-Green Revolution period, the disposal of produce did not create any serious problem. Much part of produce was taken by the local moneylenders and the rest was consumed by the families of the farmers. However, after the Green Revolution, the production of agriculture had multiplied manifold. The farmer had to approach the market to sell his produce. The farmers of Punjab to some extent suffered in the fifties since the marketing facilities did not keep pace with their growing needs. The area-allotted by a regulated market was disproportionately large. So, the farmers had to face a lot of difficulties.\textsuperscript{117}

\textsuperscript{115} Punjab Development Report, 2002, p. VIII.


The State Agricultural Board was established in 1960 to deal with the inadequate space to handle growing needs. Under it, the marketing yard of regulated markets, sub-yards, procurement centres, storage spaces and other marketing facilities were upgraded.\textsuperscript{118}

Apart from organizations such as Punjab-Agro-Industries Corporation, Punjab State Corporative Supply and Marketing Federation (MARKFED), purchasing centres were established to help farmers. The State Agricultural Department helped the farmers through marketing new services and grading of agricultural commodities.\textsuperscript{119}

The number of regulated markets in the state increased from 87 in 1966-67 to 91 in 1970-71 and 93 in 1972-73 and sub-yards attached to such markets rose from 154 to 162 during the same period. The districts-wise distribution of markets and their sub-yards is given in the table below:

<table>
<thead>
<tr>
<th>District</th>
<th>No. of Regulated Markets</th>
<th>No. of sub-yards attached with regulated markets</th>
<th>Average No of villages served per regulated markets</th>
<th>Average area per regulated market (Sq. Kms.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amritsar</td>
<td>8</td>
<td>8</td>
<td>23</td>
<td>21</td>
</tr>
<tr>
<td>Hoshiarpur</td>
<td>4</td>
<td>4</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>Jalandhar</td>
<td>9</td>
<td>9</td>
<td>24</td>
<td>21</td>
</tr>
<tr>
<td>Ludhiana</td>
<td>8</td>
<td>9</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>Ferojpur</td>
<td>15</td>
<td>15</td>
<td>21</td>
<td>22</td>
</tr>
<tr>
<td>Gurdaspur</td>
<td>6</td>
<td>6</td>
<td>11</td>
<td>13</td>
</tr>
<tr>
<td>Patiala</td>
<td>8</td>
<td>9</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Sangrur</td>
<td>8</td>
<td>10</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>Bhatinda</td>
<td>13</td>
<td>13</td>
<td>9</td>
<td>13</td>
</tr>
<tr>
<td>Kapurthala</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Ropar</td>
<td>4</td>
<td>4</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>87</td>
<td>91</td>
<td>154</td>
<td>162</td>
</tr>
</tbody>
</table>


\textsuperscript{118} Himmat Singh, \textit{Green Revolutions Reconsidered - The Rural World of Contemporary Punjab}, p.179.

\textsuperscript{119} Parminder Singh, \textit{Sources of Variation in Agricultural Productivity in Punjab (An Inter-district analysis)}. pp.84-85.

In the southern districts there were more markets, because of larger marketable surpluses in this area. In the sub-mountain districts, however, the number of markets were less because of difficult terrain and peculiar topographical conditions, lack of means of transport and communication and also of because surpluses for the market were smaller.\footnote{121} The total number of regulated markets increased to 144 in 1992-93. The average area allotted to regulated market decreased from 573 sq kms to 352 sq kms for the same period.\footnote{122}

Besides marketing, the storage capacity of Punjab also increased dramatically in the Green Revolution period. It increased from 27.47 lakh metric tons in 1973-74 to 30.75 lakh metric tons by 1975-76. It increased to 117.63 lakh metric tone in 1985-86.

**STORAGE CAPACITY OF PUNJAB***(Lakh Metric Tonnes)***

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Food Corporation of India</td>
<td>10.81</td>
<td>51.80</td>
<td>45.99</td>
<td>58.35</td>
<td>46.36</td>
<td>49.63</td>
<td>43.63</td>
<td>46.38</td>
</tr>
<tr>
<td>2.</td>
<td>Civil Supplies Department</td>
<td>5.07</td>
<td>26.07</td>
<td>22.20</td>
<td>7.13</td>
<td>5.63</td>
<td>4.10</td>
<td>4.00</td>
<td>4.58</td>
</tr>
<tr>
<td>3.</td>
<td>Markfed Punjab</td>
<td>7.84</td>
<td>12.83</td>
<td>17.97</td>
<td>18.36</td>
<td>16.02</td>
<td>16.05</td>
<td>16.09</td>
<td>16.17</td>
</tr>
<tr>
<td>4.</td>
<td>State Warehousing Corporation</td>
<td>5.41</td>
<td>8.60</td>
<td>14.20</td>
<td>11.81</td>
<td>18.62</td>
<td>22.21</td>
<td>19.73</td>
<td>20.02</td>
</tr>
<tr>
<td>5.</td>
<td>Central Warehousing Corporation</td>
<td>0.81</td>
<td>4.05</td>
<td>5.52</td>
<td>5.42</td>
<td>5.42</td>
<td>6.06</td>
<td>6.15</td>
<td>6.15</td>
</tr>
<tr>
<td>6.</td>
<td>Punjab State Civil Supply Corporation</td>
<td>0.81</td>
<td>8.38</td>
<td>11.75</td>
<td>8.05</td>
<td>5.83</td>
<td>9.41</td>
<td>7.26</td>
<td>7.74</td>
</tr>
<tr>
<td>7.</td>
<td>Marketing Board</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2.41</td>
<td>2.41</td>
<td>2.41</td>
<td>2.41</td>
<td>2.41</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>30.75</strong></td>
<td><strong>111.73</strong></td>
<td><strong>117.63</strong></td>
<td><strong>111.53</strong></td>
<td><strong>100.29</strong></td>
<td><strong>109.87</strong></td>
<td><strong>99.27</strong></td>
<td><strong>103.45</strong></td>
</tr>
</tbody>
</table>

*Includes hired storage capacity and open capacity.

\textbf{Source} – Statistical Abstract of Punjab, 1993.\footnote{123}


\footnote{122} Statistical Abstract of Punjab, 1993, p.208

\footnote{123} Ibid. p.209.

111
It has remained almost constant or declined after 1985-86. It can be seen from the above table. However, the arrivals in the market have gone up and have been increasing day-by-day in the case of wheat and rice. It was 757 percent and 2,272 percent respectively for wheat and rice from 1966-67 to 1995-96.124

Punjab has given a lead in regulating its market. The efficient marketing system of Punjab has played a big role in the development of agriculture. It helped the farmers to get remunerative prices for their produce.125

Despite the fact that the marketing system of agricultural produce in the Punjab is the best in India, yet it has to come up to the standards recommended in the plan. Most of the marketing yards do not have concrete surface to keep the arrivals in good conditions. A number of purchasing centres continue to have earthen floor. So, the wheat and paddy arrivals get dusty and need to be cleaned before weighing, bagged and stitched. Moreover, the wheat and rice remain in the open and are not well protected during the rainy season. As a result, the quality of stored stocks deteriorates. A number of times, ruined stock has to be destroyed.126

THE AGRICULTURAL PRICE POLICY

The adoption of new agricultural technology had increased production but it had also increased the expenditure because new inputs had to be purchased from the market. Therefore, the prices of agricultural products had to be reasonably high so that the farmers are able to meet the expenditure incurred on the purchase of new inputs and also that they are able to reap more profit through the adoption of modern technology.

The support price policy for wheat and rice adopted by the Government of India was another key factor that helped in the success of Green Revolution. To give incentives to the farmers for growing food crops, the Government of India started a policy of price

support to agricultural produce from June 1957. In 1964-65, the Food Grains Price Committee was appointed under the chairmanship of Shri L.K. Jha to advise on the minimum price of rice, wheat and other cereals. It was also to suggest a suitable organisation for the formulation of price policy. On the recommendation of the Jha Committee, the Agricultural Price Commission was established in January, 1965. This Committee recommended that minimum price should stimulate domestic production of food grains by assuring a reasonable margin of profit and induce more investment in farm inputs and infrastructure.¹²⁷

The price policy has played a major role in the spread of new technology. It ensured stable and remunerative price for those crops, where investment was very high. The Food Corporation of India and the State Marketing Federation also made arrangement for purchase food grains. The support price policy of the Government and the FCI had played a special role in checking the malpractices of grain dealers. The grain dealers used to depress the price at the time of harvest and raise it after sometime.¹²⁸ It saved the farmers from price slumps, middle and market level natural and man-made depredations. Actually, it was introduced to protect the produces from market slums in the post-harvest period. For this purpose, the Government stood in the market as a buyer of last resort.¹²⁹

The impact of the price policy can be judged from the fact that the area under wheat which was 12.8 million hectares in 1966-67 rose to 15.8 million hectare in 1969-70 in the country. The production of wheat increased from 11.3 million tons to 20.4 million tons in the same period.¹³⁰ From 1967-68 to 1985-86, the procurement price of wheat paid by the Food Corporation of India rose from 104 to 152 percent of the average cost in Punjab. The procurement price for paddy rose between 107 to 124 percent during the

¹²⁷ Report of the National Commission on Agriculture, Part I, pp.166-167
¹³⁰ M.S. Randhawa, Green Revolution – A Case Study of Punjab, p.181
same period. The minimum support price has been increasing year after year. It has increased from Rs. 105 per quintal in 1988-81 to Rs. 530 per quintal in 2001-02 for paddy. For wheat, it has risen from Rs. 130 per quintal to Rs. 580 per quintal for the same period. The farmers of Punjab who produced a large quantity of wheat and rice were the major beneficiaries of the support price policy.

**PLANT PROTECTION**

Plant protection work in the country was placed on a better footing during the First Plan period with the establishment of four regional plant protection centres. During the early years, locust control operations received greater attention as locust attacks were more frequent and India was taking part in the international efforts organized by the Food & Agriculture Organization (FAO) of the United Nations for checking the breeding of desert locust. The regional centres were strengthened and new centres were set up during the Second and Third Plans for providing a broader base for plant protection operations. In the

Third Plan prophylactic measures constituted the bulk of the programme. The distribution system was improved for supplying plant-protection chemicals and equipments. A number of legislations were enacted by state to deal with agricultural pests and diseases. These measures, however were not very effective. With the launching of intensive cultivation programmes, measures were taken to reorganize the regional plant protection centres. The Aerial Unit of the Directorate of Plant Protection, Quarantine and Storage (DPPQS) Ministry of Agriculture and Irrigation was strengthened by providing additional aircraft and staff.

The Fourth Five Year Plan envisaged more intensive measures for seed treatment, weed control and post-sowing prophylactic treatment. Important measures were taken for

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the extension of aerial spraying operation; helping small farmer in the eradication of pests/diseases in endemic areas by aero-chemical operations; rodent control; technical guidance and central assistance to states under the Natural Calamities Relief Fund for control of sudden outbreak of pests or diseases etc. Consequent to the expansion of activities like aerial spraying, the Aerial Unit of the DPPQS was reorganized into a separate Directorate of Agricultural Aviation in January, 1971. Insecticides Act, 1968 and the rules made there under, came into force from August 1, 1971 to regulate the manufacture, distribution, sale and transport of insecticides in the country. The provisions of the Act were mainly aimed at preventing hazards to human and animal life.  

The Government of Punjab passed the East Punjab Agricultural Pests, Diseases and Noxious Weeds Act in 1949. According to this Act, it was the duty of the land owner to carry out the preventive and remedial measures to ward off reappearance of pests, plant diseases and weeds. In the case of failure, the Government may carry out on the expense of occupier.

The new high yielding varieties of seeds increased the production of various crops. But, the crops sown through new seeds were more prone to disease. Infact, the high yielding varieties of seeds, intensive use of water & fertilizers and the development of new cropping pattern increased the challenge from pests, insects, weeds and rodents. The programme that include seed treatment, intensive ground and aerial spraying, weed control and rodent control is known as the plant protection measures. So, these measures become necessary in order to get the maximum yield from the new seeds.

India is losing about Rs 5,000 crore worth of agriculture production or about 18 percent of the gross national production to pests. Weeds alone claim the 45 percent of the total loss. There has been an increase in the cropping intensity and use of fertilizers in the

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irrigated areas. These factors have transferred the ecological balance in favour of weeds.\textsuperscript{137}

Protection of the plant from pests and disease has been considered the major component of the Green Revolution. The consumption of pesticide in India increased from 2,000 tons a year in the fifties to over 1,20,000 tons by 1989-90.\textsuperscript{138} Only 50,041 tons of insecticides and pesticides were produced in India by 1979-80 and 83,000 tons in 1993-94. In order to meet the requirement, a large quantity of pesticides were imported from outside.\textsuperscript{139}

Pesticides have played a crucial role for increasing agricultural production in Punjab. For sustaining productivity in Punjab, the scientists of Punjab Agricultural University adopted two ways. They tried to evolve crop varieties resistant to pests and disease. Secondly, chemical and other methods for control were discovered. The spray schedules which had been recommended for various crops proved very effective. The cultivators in Punjab used them widely. Punjab used 4,000 tons of pesticides by 1992. The Government of Punjab had made arrangements to supply weedicides and pesticides at subsidized rates.\textsuperscript{140}

**LAND RECLAMATION**

The reclamation of arable land was an important project under the new agricultural strategy. The work of land reclamation and land development was carried out mainly by the Central and State Tractor Organization. The Central Tractor Organisation however, was in operation at field level only till 1958-59. In August, 1956, a large mechanized farm was set up at Suratgarh mainly by reclaiming culturable waste lands

\begin{itemize}
  \item \textsuperscript{137} Khem Singh Gill, *A Growing Agricultural Economy – Technological Changes, Constraints and Sustainability*, p.277.
  \item \textsuperscript{138} *Ibid.* p.280.
  \item \textsuperscript{139} R.N. Soni, *Leading Issues in Agricultural Economics*, p.445.
\end{itemize}
with the help of agricultural machinery and equipment gifted by the Government of USSR. In view of the limited scope for reclamation, target fixed was 0.6 Mha in the Second Five Year Plan and 1.5 Mha in the Third Five Year Plan.\textsuperscript{141}

An Expert Committee on Waste Land was appointed in June, 1957. The work of this committee was to survey and locate compact blocks of waste lands. It indicated that an area of 2.2 Mha was available for reclamation by the end of sixties. However, in the Fourth Five-Year Plan the target was fixed of 1.0 Mha to bring under plough.\textsuperscript{142}

The Government of Punjab passed the East Punjab Reclamation of Lands Act, 1949, for the reclamation and cultivation of reclaimed area. Another step was taken by passing the Utilization of Lands Act, 1950. It enabled the Collector of a district to take over agricultural lands which had not been cultivated for six years and lease it out to prospective cultivators.\textsuperscript{143}

In Punjab, 4.64 lakh hectares area out of 6.98 lakh hectares was affected with alkalinity and salinity in 1951-52. Saline and alkaline soils contain excessive salt which is harmful to crops. Soil become saline when the water table is high and soluble salt come to the surface. It severely affect the quality of soil and the loss of the crop is about 20 to 25 percent in saline and alkaline areas.\textsuperscript{144} The Agriculture Department of Punjab advised the farmers to use gypsum and supplies were made easily available. Four tons of gypsum per acre was proposed for moderate to severe salinity.\textsuperscript{145} The Government of Punjab gave subsidy on gypsum at the rate of 75 percent to small farmers and 50 percent to the other farmers to increase the fertility of the soil.\textsuperscript{146} The increase in cultivated area to total area

\textsuperscript{141} Report of the National Commission on Agriculture, pp.158-159.
\textsuperscript{142} Ibid, p. 159.
\textsuperscript{144} Report of the National Commission on Agriculture, p.184. Also see, Pritam Singh, 
Emerging Pattern of Punjab Economy, Sterling Publishers, New Delhi, 1983, p.33 and 
Holly Sims, Political Regimes, Public Policy and Economic Development – Agricultural 
Performance and Rural Changes in Two Punjabs, p.98.
\textsuperscript{145} D.P. Gupta and K.K. Shangari, Agricultural Development in Punjab, p. 119 and Holly 
Sims, Political Regimes, Public Policy and Economic Development – Agricultural 
\textsuperscript{146} Pritam Singh, Emerging Pattern of Punjab Economy, p. 33.
from 70.5 percent in 1950-51 to 83 percent in 1976-77 had been mainly due to the reclamation of waste and alkaline lands.\textsuperscript{147}

The agricultural land increased from 37.57 lakh hectares in 1960-61 to 41.91 lakh hectares in 1980-81. Eighty four percent of the total area of Punjab was under cultivation as compared with a national average of 43 percent.\textsuperscript{148} This was mainly due to favourable physical milieu, easy workability of soils, assured irrigation and enterprising nature of the Punjab peasantry. It shows that Punjab had almost reached the saturation point in the matter of increasing net cultivated area in the post-Green Revolution period.

**ROADS**

Another important component that helped in the growth of agriculture in Punjab was link roads and development of feeder roads. Prof. A.W. Ashby, a British Agricultural Economist by giving importance to roads for the agricultural development writes “If I could do only one thing in a region to spur agricultural development, I would build roads, if to this I could add a second, I would build more roads. And If to these I could add a third, I would build still more roads”.\textsuperscript{149}

The rural roads had been an integral part of strategy for integrated development because without them input and output markets become imperfect and un-integrated. With the facility of roads, farmers can sell their produce and are also able to purchase fertilizers, plant protection chemicals and agricultural implements easily. There were 2,800 kms of roads at the time of partition in Punjab which meant 5.50 kms per 100 sq km of area.\textsuperscript{150} Roads construction did not make any significant progress in Punjab during the first three Five Year Plans. However, the situation changed after the reorganization of Punjab in 1966.\textsuperscript{151}

\textsuperscript{149} A.W. Ashby, British Agricultural Economist, quoted by Sudhir Sen, *A Richer Harvest*, p.27.
\textsuperscript{150} Parminder Singh, *Sources of Variation in Agricultural Productivity in Punjab* (An Inter-district analysis), p.83.
\textsuperscript{151} R.N. Chopra, *Green Revolution in India – The Relevance of Administrative Support for its Success* (A study of Punjab, Haryana & U.P.), p.120.
The Government was aware that it was not only a question of carting the harvest to market but also providing the farms with more fertilizers, better roads, improved implements and technical knowledge. It also realized that if roads to rural areas were not provided the future agricultural development would suffer. To meet these demands, the Government of Punjab launched a crash programme for the construction of village roads in 1968. This programme received unanimous support from the rural people. Knowing the popularity of the crash programme and impact on the economy and life of the people, the Government continued with the road construction programme. There were 6,668 kms *pacca* roads in Punjab which was 13.24 kms per 100 sq kms in 1968. It increased to 13,377 kms in 1971-72; 30,836 kms in 1978-79 and 31,840 kms in 1979-80. It further increased to 32,446 kms by 1980-81 which means 64 kms per 100 sq kms.\(^{152}\) The road network in Punjab had increased up to 39,950 kms by 1995-96, an increase of 180 percent. The quality of roads also improved during this time.\(^{153}\) By 2000-01, almost 99.24% villages were connected by roads.\(^{154}\) With the development of rural roads in the state, the economy took a new turn.

Various agro-technological, socio-economic, institutional and administrative factors have contributed towards agricultural transformation in Punjab. The Punjab Agricultural University played a major role in the development of semi-dwarf high-yielding varieties. The role of Government in building infrastructure such as building dams, canals, link roads in villages, appropriate credit and banking facilities and support price policy for major crops has been responsible for spectacular transformation of agriculture in Punjab. Above all, the enterprising nature of the Punjab farmer has been a


key factor in the adoption of package of practices and new technologies recommended by the scientists. All these factors led to the Green Revolution in the Punjab.

The Government of Punjab took necessary steps to implement all the programmes and planning regarding the development of agriculture. Punjab has been one of the world’s most remarkable examples of agricultural growth after independence. The outstanding agricultural growth in Punjab is acknowledged by the increase in Punjab wheat production from 1.9 to 5.6 million tons during the years 1965 to 1972. The state is now universally known as the heart land of Green Revolution. Punjab has only 0.3 percent of total cultivated area of the world and it produced 1.97 percent of the total wheat produce of the world. Punjab which broke the shackles of traditional agriculture ushered the Green Revolution. Though Punjab showed a phenomenal development in agriculture, yet it is still far behind the developed nations. The yield rate of rice was 5,128 kgs in Japan, 4,935 kgs in USA, 4,217 kgs in USSR, 4,163 kgs in China. It was still 2,736 kgs in Punjab and 2,010 kgs in India per hectare in 1980.

The yield rate of wheat, during the same period was 5,653 kgs in UK, 5,167 kgs in France, 2,730 kgs in Punjab and only 1,436 kgs in India per hectare. Infact, there are large gaps between yield rates of individual crops in India and Punjab and many other countries. These gaps indicate the scope for further agricultural improvements.

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156 The Tribune, September 22, 1980.