Chapter - 3

GREEN REVOLUTION

The phenomenon of Green Revolution is defined as the cumulative result of a series of research, development, innovation and technology transfer initiatives, happening between the 1940s and the late 1960s, that increased the agriculture production manifold worldwide, and in particular the developing world. Norman Ernest Borlaug, an American biologist, humanitarian and Nobel Laureate, took the initiative of developing the high yielding varieties of cereal grains, expansion of irrigation infrastructure, modernization of management techniques, distribution of hybridized seeds, synthetic fertilizers and pesticides to farmers across the developing world. In short, Norman Borlaug is called "the father of the Green Revolution", "agriculture's greatest spokesperson" and "The Man Who Saved A Billion Lives". For the recognition of his services to humanity, he was awarded the Nobel Peace Prize (1970), and also the Padma Vibushan, India's second highest civilian honour. According to the Nobel Prize Committee, ‘the kinds of grain which are the result of Dr. Borlaug’s work speed economic growth in general in the developing countries.’\textsuperscript{125}

‘The phenomenon of Green Revolution is identified with India’s being catapulted from a chronically food deficient country, with a begging bowl image, to one which was self-sufficient and which

became over time even surplus in food."\textsuperscript{126}

In 1961, the Rockefeller financed Centre in Mexico was renamed as CIMMYT (Centro Internacional de Mejoramiento de Maiz Y Trigo or the International Maize and Wheat Improvement Centre) where Dr. Borlaug released some of his famous high yield varieties such as \textit{Lerma Rojo 64, Siete Cerros, Sonora 64} and \textit{Super X}. This was the key to the success of CIMMYT.\textsuperscript{127}

In 1960, the Government of Philippines with Ford and Rockefeller Foundations established IRRI (International Rice Research Institute).\textsuperscript{128} Thus, two institutions, CIMMYT and IRRI played a major role in development of wheat and rice varieties.

\textbf{Expansion in India}

There were three groups of international agencies involved in transferring the American model of agriculture to India- the private American Foundations, especially Rockefeller Foundation, Ford Foundation, etc; the US Government and the World Bank.\textsuperscript{129}

Jawahar Lal Nehru as Prime Minister of India was fully aware of the centrality of agricultural development in achieving his goal of rapid industrialization. Keeping this objective in mind the plan outlays on agriculture since the first plan itself were substantial. In the first five year plan (1951-56), the total outlay on agriculture and irrigation was

\textsuperscript{128} Vandana Shiva, \textit{The Violence of the Green Revolution}, p.43.
\textsuperscript{129} Vandana Shiva, \textit{The Violence of the Green Revolution}, p.29.
37 percent of the total. In the Second Plan (1956-61), it was 20.9, in Third Plan (1961-66), it was 20.5, in the Annual Plans (1966-1969) it was 23.8, in Fourth Plan (1969-1974) it was 23.3.

Table - 7

**Sectoral Allocation of Expenditure in the Five Year Plans**

(in percentages)\textsuperscript{130}

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<td>Agriculture and allied sectors</td>
<td>14.8</td>
<td>11.7</td>
<td>12.7</td>
<td>16.7</td>
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<td>Irrigation and Flood Control</td>
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<td>Power</td>
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<td>18.3</td>
<td>18.6</td>
<td>18.8</td>
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<td>19.1</td>
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<td>Village and small industries</td>
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<td>4.0</td>
<td>2.8</td>
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<td>1.5</td>
<td>1.3</td>
<td>1.8</td>
<td>1.5</td>
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<tr>
<td>Industry and minerals</td>
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<td>22.8</td>
<td>18.2</td>
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<td>Transportation and Communications</td>
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<td>22.0</td>
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<td>19.5</td>
<td>17.8</td>
<td>15.9</td>
<td>16.4</td>
</tr>
<tr>
<td>Others</td>
<td>24.0</td>
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<td>17.4</td>
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<td>19.0</td>
<td>16.6</td>
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<td>Total</td>
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<td>100.00</td>
<td>100.00</td>
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<tr>
<td>Total Plan</td>
<td>19.6</td>
<td>46.7</td>
<td>85.8</td>
<td>66.3</td>
<td>158.8</td>
<td>286.5</td>
<td>975.0</td>
<td>1,800.00</td>
</tr>
</tbody>
</table>

Prime Minister Nehru, from the very beginning placed great emphasis on creating the physical and scientific infrastructure necessary for modern agriculture. According to Nehruvian vision, massive irrigation and power projects like the Bhakra-Nangal etc; numerous agricultural universities, research laboratories, fertilizer plants etc. took their place along with steel plants as the ‘Temples of Modern India.’

On 2 October 1952, with the objective to augment the agricultural production in India, 15 Community Development Projects (CDPs), each covering about 100 villages were started, with Ford Foundation’s financial assistance. In 1959, these programmes were however shed when a Ford Foundation mission of thirteen North American agronomists to India argued that it was impossible to make simultaneous headway in all of India’s 550,000 villages. Their recommendations for a selective and intensive approach among farmers and among districts led to the winding down of the Community Development Programmes (CDPs) and the launching of the Intensive Agricultural Development Programme (IADP) in 1960–

132 Vandana Shiva, *The Violence of the Green Revolution*, p.34.
Daniel Thorner, the noted economist during his survey of 117 of the ‘best’ cooperatives all over India between December 1958 and May 1959, pointed out some weaknesses in the Community Development Projects (CDPs). This was corroborated by Wolf Ladejinsky.

In 1961, as a New Agricultural Strategy and under the pilot, Intensive Agricultural Development Program (I.A.D.P), a model of new approach was taken up in 15 districts, one for each State, including Ludhiana in Punjab. Initially pioneered by the Ford Foundation, the I.A.D.P. emphasized the necessity of providing the cultivator with a complete “package of practices” in order to increase yields, including credit, modern inputs, price incentives, marketing facilities and technical advice.

When the I.A.D.P was started in Ludhiana district in 1961, crop demonstration showing increased yields of 40 to 65 percent per acre with the application of the improved “package of practices” quickly convinced all categories of farmers of the superiority of modern methods and motivated them to adopt it. It is amply clear from the I.A.D.P,‘Second Report’, that between 1961-62 and 1964-65, the consumption of nitrogenous fertilizer increased by about 8 times, and of phosphate fertilizer by over 20 times. Nevertheless, it seems clear that during the first years of the I.A.D.P. at least some farmers in all

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size categories were able to take advantage of the intensive development program to increase yields per acre through the application of modern methods, especially chemical fertilizers.

The IADP streamlined the distribution of fertilizer and other inputs, improved the administrative machinery, expanded the credit distribution system, rejuvenated the extension services, and provided the proper impetus to the process of transformation that had been started.\textsuperscript{136}

The establishment of Punjab Agricultural University (P.A.U) at Ludhiana, which was set up in 1962, was another important landmark event in contributing towards the agricultural progress of Punjab. P.A.U became the epicentre and it was at this University that the visiting American agro-scientist, Norman Borlaug and his team of Indian scientists evolved new strains of Mexican dwarf wheat and passed the seed on to the farming community.\textsuperscript{137} The Punjab Agricultural University with its vigorous programme of task oriented research, meaningful teaching and farmers ‘training courses, and powerful extension work supplemented the IADP activities and enhanced the tempo of development. The university researchers developed new seeds, suitable farm machines, and better techniques of farming and plant protection. The important thing is that they kept pace with the changing agriculture in the area by successfully solving

\begin{flushleft}
\textsuperscript{136} Partap C. Aggarwal, \textit{The Green Revolution and Rural Labour}, Shri Ram Centre for Industrial Relations and Human Resources, New Delhi, 1973,p.126. \\
\end{flushleft}
the problems as they arose. Not only were the problems solved, but the confidence of the agriculturist in the new technology was also reinforced.\textsuperscript{138}

The prospects of achieving maximum output with the given 'package of practices' required the availability of assured water supply. The basic irrigation system had to be augmented by percolation wells, pumpsets, and tubewells to provide an assured source of water all year round. Large capital investments in land improvement was required as the cost of installation of the smallest tubewell, one commanding an area of about 20 to 25 acres, was about Rs. 4000 to Rs. 6000.\textsuperscript{139} The Department of Agriculture itself insisted that only cultivators having 20 acres or more of owned land would be eligible for minor irrigation loans.

With assured supply of water, and easy availability of modern inputs, under the IADP package, the farmers were able to replace less profitable crops like wheat plus gram mixture, and gram, with wheat. During the period from 1960-61 and 1965-66, the acreage under wheat increased by more than 20 percent - from 280,000 acres to 339,000 acres - while the area under wheat plus gram mixture declined from 157,000 acres to 86,000 acres; and the area under

\textsuperscript{138} Partap C. Aggarwal, \textit{The Green Revolution and Rural Labour}, p.126.
\textsuperscript{139} Francine R. Frankel, \textit{India’s Green Revolution : Economic Gains and Political Costs}, p.22.
gram from 44,000 acres to 25,000 acres.\textsuperscript{140}

Thus, during the first phase of agricultural modernization in Punjab (Ludhiana) under IADP, and prior to introduction of HYVs, the large farmers with holdings of 20 acres or more made the greatest gains. The largest cultivators benefited in two ways: by bringing a substantial portion of their holdings under the better paying wheat crop; and by increasing their yields per acre through the application of chemical fertilizer. By contrast, the gains of small farmers were limited mainly to some improvement in yields during good weather years arising from an increase in the application of fertilizers.\textsuperscript{141}

In the Third Five Year Plan (1961-66), four years of relatively static production levels, convinced the Planning Commission that continuation of short falls in agriculture would jeopardize the entire program of industrial development. In 1964, therefore, the planners announced "a fresh consideration of the assumptions, methods, and techniques as well as the machinery of planning and plan implementation in the field of agriculture". Two major departures from previous policy were initiated as a result of this re-appraisal:

(1) Development efforts would subsequently be concentrated in the 20 percent to 25 percent of the cultivated area, where


supplies of assured water created "fair prospects of achieving rapid increases in production"; and (2) within these areas, there would be a "systematic effort to extend the application of science and technology," including the "adoption of better implements and more scientific methods" to raise yields.\textsuperscript{142}

Since the mid fifties till the mid sixties India was in a crisis situation. There was a massive jump in population growth rates after Independence, to about 2.2 percent per annum from about 1 percent in the first half of 20th century, the slow but steady rise in per capita consumption put long term pressures on Indian Agriculture, creating a demand for food which Indian markets were not able to meet. In the mid fifties, food prices experienced an upward push. To meet the food shortage and to stabilize the prices, India was forced to import increasing amounts of food. The only other alternative was to go in for large scale forced procurements from the countryside at huge human cost, a path which was unacceptable to India but was adopted by countries like Russia and China.

The controversial agreements made by India to import food from the US under the PL-480 scheme started in the year 1956. Under that scheme nearly 3 million tonnes of food grains were imported in the very first year and the volume of imports kept rising reaching about

\textsuperscript{142} Planning Commission, India, \textit{Memorandum on the Fourth Five-Year Plan} (Delhi, October 1964), 26, 29.
4.5 million tonnes in the year 1963.\textsuperscript{143}

When the import of food grains was going on, the political scenario changed with Indo-China war in 1962 and Indo-Pak war in 1965. To further complicate the situation there were two successive droughts in the year 1965 and 1966, leading to fall in agricultural output by 17 percent. India was forced to import more than 10 million tonnes of food grains in 1966. Such a situation was defined as India's desperate dependence on the US for food.\textsuperscript{144}

In this complex scenario of the mid-sixties, economic self-reliance and particularly self-sufficiency in food grains became the top priority objective of India's economic policy and also for that matter India's foreign policy. The new Agricultural Strategy was drawn up. The then Prime Minister, Lal Bahadur Shastri, Agriculture and Food Minister, C. Subramaniam and Indira Gandhi, who followed Shastri in 1966, all gave full support for developing Indian agriculture on new lines.

Within India, the main supporter of the Green Revolution strategy was C. Subramaniam, who became Agriculture minister in 1964 and M.S. Swaminathan, who became the Director of Indian

\textsuperscript{143} Bipan Chandra, Mridula Mukherjee and Aditya Mukherjee, \textit{India After Independence (1947-2000)}, p.412.

\textsuperscript{144} Bipan Chandra, Mridula Mukherjee and Aditya Mukherjee, \textit{India After Independence (1947-2000)}, pp.412-413.
Agricultural Research Institute (IARI) in 1965, and had been trained by Norman Borlaug. In March 1962, a few of the Borlaug’s dwarf spring wheat strains were grown in the fields of the Indian Agricultural Research Institute (IARI) in Pusa, New Delhi. In March 1963, the Rockefeller Foundation and the Mexican Government sent Borlaug and Dr. Robert Glenn Anderson to India to continue his work. After a trip to India in 1963, Dr. Borlaug despatched 400 kg of semi-dwarf varieties to be tested in India. In 1964, rice seeds were brought in from IRRI in the Philippines.  

In October 1965, the new policy was put into practice when 114 districts (out of 325) were selected for an Intensive Agricultural Areas Program (I.A.A.P.). In November 1965, the Food Ministry was ready with a full blown version of the “New Strategy”: in essence it called for the implementation of a High Yielding Varieties Program in districts that had already been selected for intensive development under the I.A.D.P. and I.A.A.P. schemes.

The advent of the new high yielding dwarf varieties of Mexican wheat in 1966-67 marked the beginning of a second stage of agricultural development in Punjab (Ludhiana district) that opened unprecedented opportunities for increasing net returns to farm

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management.\textsuperscript{146} The HYV seed was so much more productive that it considerably reduced the risk of change. For instance, in Ludhiana the per hectare production of wheat increased about 2 1/2 times. This level of superiority provided an adequate cushion to absorb the risk, particularly of the increased investment in inputs.\textsuperscript{147}

The Mexican wheat seeds had a very high yield because of their responsiveness to higher doses of fertilizers. \textit{Lerma Rojo} - a Mexican wheat variety; after adaptive research at PAU was introduced as P.V. 18, Kalyan Sona, and then PBW-222, PBW-215.\textsuperscript{148}

In the fall of 1966, India spent $ 2.5 million for 18,000 tons of Mexican wheat seed,\textsuperscript{149} the largest purchase and import of any seed in the world at that time.

In 1968, biologist Paul R. Ehrlich presented a new theory which stated that, "the battle to feed all of humanity is over... In the 1970’s and 1980’s hundreds of millions of people will starve to death inspite of any crash programs embarked upon now". Ehrlich further stated that, "I have yet to meet anyone familiar with the situation who thinks India will be self-sufficient in food by 1971 and India couldn’t possibly

\textsuperscript{146} Francine R. Frankel, \textit{India’s Green Revolution :Economic Gains and Political Costs},p.23.

\textsuperscript{147} Partap C. Aggarwal, \textit{The Green Revolution and Rural Labour},p.125.


\textsuperscript{149} Vandana Shiva, \textit{The Violence of the Green Revolution}, p.62.
feed two hundred million more people by 1980". In 1968, when Ehrlich's book was released, William Gaud of the United States Agency for International Development (USAID) was calling Borlaug's work as "Green Revolution".

By 1968, nearly half of the wheat planted came from Borlaug's dwarf varieties. The gospel spread so fast that by 1972-73, 16.8 million hectares were planted with dwarf wheat and 15.7 million hectares were planted with dwarf rice across the Third world. 94 percent of the hybrid rice area was in Asia of which nearly half was in India. High yields led to a shortage of various utilities, labour to harvest the crops, bullock carts to haul it to the threshing floor, jute bags, trucks, rail cars, and grain storage facilities. Some local government were forced to close school buildings, temporarily to use them for grain storage.

In India, with the rapid introduction of high yielding wheat varieties, production reached a record high of 16.6 million tons in 1967-68, one third more than the previous peak output of 12.3 million tons achieved in the last good weather year of 1964-65. Moreover, despite a recurrence of drought and other unfavourable seasonal conditions, wheat production in 1968-69 exceeded the new level,

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giving substance to the slogan of a “green revolution” in the wheat areas. Indeed, in 1969-70, national wheat output rose to another record high of approximately 20 million tons.¹⁵¹

Regionally, in India, the greatest effect of the Green Revolution has occurred in the wheat growing areas of Punjab, Haryana and Western U.P. In South India, the effects of Green Revolution have been concentrated in the States of Andhra, Tamil Nadu and Kerala.

It remains true that the Green Revolution’s most spectacular effect have occurred with wheat production. The average yield of rice went up by 60.1 percent in the period from 1969-70 to 1988-89, whereas it went up by 97.1 percent for wheat.

Table - 8

Index Numbers of Agricultural Production, Area, and Yield of Principal Crops, 1969-70 TO 1988-89
(Post-Green Revolution), Base Year 1969-70=100\textsuperscript{152}

<table>
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<tr>
<th>Crop/Year</th>
<th>Production</th>
<th>Area</th>
<th>Yield</th>
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<tr>
<td>All Cereals</td>
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<td></td>
</tr>
<tr>
<td>1970-71</td>
<td>114.1</td>
<td>102.0</td>
<td>110.4</td>
</tr>
<tr>
<td>1975-76</td>
<td>128.8</td>
<td>104.0</td>
<td>118.8</td>
</tr>
<tr>
<td>1980-81</td>
<td>143.1</td>
<td>104.5</td>
<td>129.3</td>
</tr>
<tr>
<td>1985-86</td>
<td>167.3</td>
<td>103.7</td>
<td>149.6</td>
</tr>
<tr>
<td>1988-89</td>
<td>149.6</td>
<td>105.1</td>
<td>166.9</td>
</tr>
<tr>
<td>Rice</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1970-71</td>
<td>107.4</td>
<td>101.5</td>
<td>105.8</td>
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<tr>
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<td>116.9</td>
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<tr>
<td>1980-81</td>
<td>137.2</td>
<td>108.6</td>
<td>126.3</td>
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<tr>
<td>1985-86</td>
<td>163.7</td>
<td>111.3</td>
<td>147.1</td>
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<tr>
<td>1988-89</td>
<td>181.2</td>
<td>133.3</td>
<td>160.1</td>
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<td>Wheat</td>
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<td>1970-71</td>
<td>132.1</td>
<td>114.9</td>
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<td>114.7</td>
<td>98.0</td>
<td>117.2</td>
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<td>1980-81</td>
<td>106.7</td>
<td>88.8</td>
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<tr>
<td><strong>All Pulses</strong></td>
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<tr>
<td>1970-71</td>
<td>104.4</td>
<td>111.2</td>
<td>103.2</td>
<td>120.1</td>
<td>123.9</td>
</tr>
<tr>
<td>1975-76</td>
<td>115.3</td>
<td>111.2</td>
<td>105.0</td>
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<tr>
<td>1980-81</td>
<td>95.8</td>
<td>103.2</td>
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<td>1985-86</td>
<td>120.1</td>
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<td>108.4</td>
<td></td>
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<tr>
<td>1988-89</td>
<td>123.9</td>
<td>106.9</td>
<td>117.2</td>
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<tr>
<td><strong>Gram</strong></td>
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<tr>
<td>1970-71</td>
<td>99.7</td>
<td>101.7</td>
<td>98.0</td>
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<tr>
<td>1975-76</td>
<td>112.9</td>
<td>108.2</td>
<td>104.3</td>
<td></td>
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<tr>
<td>1980-81</td>
<td>83.2</td>
<td>85.6</td>
<td>97.2</td>
<td></td>
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</tr>
<tr>
<td>1984-85</td>
<td>87.3</td>
<td>89.2</td>
<td>97.9</td>
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</table>

This differential increases in production, concentrated in particular regions, on particular crops, under Government’s New Agricultural Policy, perpetuated existing region imbalances, and further created new ones, leading ultimately to “increased inter-regional disparities in agricultural production and so in prosperity.”153

The Rates of return to growers are highest in ‘wheat, paddy, and cash crops.’154 The highest rates of return for wheat are in Punjab, Haryana, Rajasthan. Insofar as paddy is concerned, the rates of return per hectare are highest in Karnataka, Punjab, Haryana. Taking all major crops together, the high productivity, high profit States are

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154 Sarthi Acharya, “Rates of Return in Indian Agriculture”, *EPW*, XXVII, No 3 (January 18, 1992), p.112.
Punjab, Haryana, Gujarat and Tamil Nadu.\textsuperscript{155}

\textsuperscript{155} Sarthi Acharya, “Rates of Return in Indian Agriculture”, \textit{EPW}, XXVII, No 3 (January 18, 1992), p.119.
Figure-4: Production of Rice and Wheat Under the High Yielding Varieties Program, 1976.\textsuperscript{156}

In Punjab, agriculturally the most advanced and best documented Green Revolution case study, the technological changes associated with Green revolution have been consolidated among virtually all farmers and in all parts of the State, particularly with regard to wheat, the State’s principal crop. Punjab surpasses all other States in terms of the gains of the green revolution.

In 1972, Byres points out that 'Punjab is an unusual State in several respects. It has always been a high growth area; it has the smallest proportion of farm workers who are landless of all the Indian states; Its farms are on average twice as large as the all-India size; consolidation has proceeded far more than elsewhere; Irrigation is more widespread, and so on'.

Punjab in general and Ludhiana in particular got off to a brilliant start as far as maximizing agricultural output is concerned and leading the turn around, which was never witnessed in Indian agriculture. This phenomenon was termed as Green Revolution. The comparative success of the green revolution in Punjab is due to a number of favourable conditions prevailing in Punjab.

Ludhiana, the case study of Punjab, presented an unusually favourable environment for the rapid modernization of the agricultural economy once modern techniques became available. Being located in Central Punjab, Ludhiana forms part of the fertile Indo-Gangetic

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plain, and is especially fortunate in having large quantities of good subsoil water that can easily be tapped through minor irrigation works. In Ludhiana, like other parts of the Punjab (but unlike most other areas in the wheat belt), consolidation of holdings was carried out on a large scale, leaving cultivators with compact and economic units for land development. ‘Punjab implemented various land reforms far more efficiently than any other State in the Union. For instance, consolidation of landholdings was begun in Punjab soon after Independence and it has already been completed, whereas this important reform has not even begun in some States and in some others, such as UP and Maharashtra, only a fraction of the work has been completed.’ By 1961, almost 50 percent of the net cropped area was irrigated, mainly from privately owned wells and tubewells.

Apart from various natural features, Ludhiana district was densely populated having population density of 773 persons per square mile. Ludhiana had hundreds of manufacturing enterprises in the fields of hosiery, cycles, machine tools, motor parts, agricultural machinery, oil engines, a variety of other consumer goods and thus styled itself as the ‘Small- Scale Industrial Capital of India.’ Thus, providing a back up for the Agricultural surplus labour.

There was unusually favourable land-man ratio, with 37 percent

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of all cultivators operated holdings of 20 acres or more, accounting for about 55 percent of the total cultivated area of the district. Another 43 percent had holdings between 10 acres and 20 acres, taking up another 35 percent of the area. Only 20 percent of cultivating families operated on holding of less than 10 acres and they accounted for only 10 percent of the cultivated land.

The district had other advantages. Compared to a literacy rate of 24.2 percent for Punjab State as a whole, the literacy percentage in Ludhiana was 36.3 percent. Even in rural areas, almost 42 percent of adult males were literate; among males working as cultivators, this proportion was 31 percent.\textsuperscript{160}

Another important factor in the rapid progress of Ludhiana and the State as a whole is that in Ludhiana, the majority population, about 63 percent, are members of the Sikh community,\textsuperscript{161} and Sikhs are usually exposed to modern values and foreign ways in larger numbers than their Hindu neighbours, and are a major source for promoting change when they return to their villages. In Ludhiana, the dominant landowning caste, the Jats, is the back bone of the Sikh community.

Thus, with the advent of the dwarf varieties, it became possible to double output per acre from one season to the next-over and above the yield increases that had already been achieved with local varieties.

\textsuperscript{160} District Census Handbook, No.11, Ludhiana District, 1965, 32,37,168.

\textsuperscript{161} District Census Handbook, No.11, Ludhiana District, 1965, 33.
The implication of this productivity breakthrough for the profitability of wheat is clear from the following example. In 1966-67, the average yield of local wheat varieties was 2108 pounds per acre, a little less than 10 quintals. During the same year, those farmers who adopted the Mexican varieties (mainly *Lerma Rojo*) achieved an average yield of 4235 pounds per acre, about 20 quintals or exactly twice the first amount.\(^{162}\)

Given the procurement price of Rs. 76 per quintal for Mexican varieties, the innovative farmer grossed about Rs. 1520 per acre. Allowing for cost of cash inputs of some Rs. 260 per acre, the net return to management was about Rs. 1260. By contrast, the farmer growing local varieties, who probably sold his output at a somewhat higher price, of about Rs. 80 per quintal, grossed only Rs. 800 per acre. Allowing for a lower cash expenditure on purchased inputs of about Rs.40 - Rs.100, the net income per acre was about Rs. 700 to Rs. 760.\(^{163}\)

Thus, it is clear that the farmers, who adopted the high-yielding varieties in 1966-67 doubled their output and in one jump, increased their net income by over 70 percent. The spread of dwarf wheat was rapid. In 1968-69, almost the entire wheat area was covered, approximately 420,000 acres out of 450,000 acres with the dwarf


\(^{163}\) *Ibid*, 44.
wheat.\textsuperscript{164}

The large farmers, those with 20 acres or more, were the first to adopt the high yielding varieties. The larger landholders, who had easier access to credit were able to sink more tube wells, buy tractors, use modern inputs and thus treble the output from their lands.\textsuperscript{165}

An important factor that led to the Green Revolution was indigenization of technology. After independence, India adopted a policy of rapid industrialization. Financial and other aids were provided to Indian Industry in addition to tariff protection. With the result, a booming small-scale industry was established in Ludhiana. Some features were; local entrepreneurship, intermediate technology requiring a high level of skill in the workers etc. The villagers acquired the knowledge and discipline of the fast running machine, repair services became adequate, machines and parts became available, and oils and fuels became procurable even in rural areas.\textsuperscript{166}

Medium sized landholders having holdings of 10 to 20 acres also adopted high yielding varieties. The greatest aid to the farmers in adopting the high yielding varieties had been the relaxation of criteria for eligibility for tubewell loans both by government agencies and land mortgage banks. In 1969, the Agriculture Department made cultivators with holdings as small as 5 acres eligible for government


\textsuperscript{165} Khushwant Singh, \textit{A History of the Sikhs}, p.323.

\textsuperscript{166} Partap C. Aggarwal, \textit{The Green Revolution and Rural Labour}, p.126.
loans for tubewells.

There is also a large amount of production credit available from the cooperatives. The medium farm holders were relying most heavily on the cooperatives for financing the costlier inputs, required by the high-yielding varieties. In 1967, the command area of the smallest tubewell was 20 to 25 acres. Extension workers and the economists at PAU agree that the optimum size of holding for the efficient cultivation of the high-yielding varieties, assuming a tubewell and bullock power, is about 20 to 25 acres; this floor can be reduced with efficient management to 15 acres, but not below that. The returns to his investment in a tubewell will be lower than on 20 to 25 acres farms. The limitation of size of farm is also a crucial constraint with respect to mechanization. The viability of owning a tractor and the maintenance and running costs was dependent on the land size. Therefore, the small farmer is denied the economies to scale enjoyed by large landowners.

During the first stage of agricultural modernization(1961-1964) it appears that the position of agricultural labourers improved. The growing prosperity of the majority land holders resulted in an increased economic activity that provided employment opportunities to the farm labourers during the off season, especially in the construction of houses and roads, and in the various land improvement schemes like the leveling of farm lands, installation of
tubewells, drains and culverts. In 1967-68, in the second phase, with the introduction of high-yielding varieties, the economic situation of landless labourers improved further with more intensive cropping, large increase in irrigation facilities, more labour intensive farm practices per crop, diversification of the cropping pattern, the demand for workers went up even during the traditionally slack seasons, e.g., during December to mid-March for crushing sugar cane, and during July and August for hoeing and weeding maize. Even the cash wages for casual labor increased.

Whereas the local varieties could be harvested over a period of 20 days or so, the dwarf wheats tend to shatter unless they are harvested within 10 or 15 days. With such a high premium placed on timely labor, agricultural workers attempted to exploit their new advantage by bargaining with landowners for increased wages, often threatening to work elsewhere if their terms were not met. But with migrating labor also available, these techniques were only partially successful. 167

'However, it is the bottom 20 percent of the cultivators, with holdings of less than 10 acres, who have fared worst as a result of the green revolution. These farmers may have been able to make some marginal gains in good weather years by applying small additional doses of chemical fertilizer to Mexican wheats, but, in general, they

have not been able to sustain the indivisible inputs - tubewells and agricultural machinery - required for the efficient cultivation of the new varieties. Actually, there is some reason to believe that their position may have suffered an absolute deterioration as a result of the green revolution.\(^{168}\)

There is a debate that the landed classes have become the hegemonic class, who are regarded as the new “lords of the land”. The rise of the landed classes in Punjab and elsewhere in India have been benefitted particularly with three sets of events;

The first is the land reforms adopted in post-Independence era in nearly all parts of the country, which abolished the Zamindari System (tax-farming system), but did not involve effective land ceilings with land redistribution, thus enhancing the position of the groups with land below the big ex-landlords. In Punjab by the time the first agrarian reform legislation, the Punjab Land Ceiling Act, 1955 was passed, land distribution in the State had levelled off considerably. A study concluded that as a result of these agrarian legislations, 20 million statutory tenants acquired occupancy rights.\(^{169}\)

The Second set of events were various government policies adopted by the State Governments, which themselves came to be largely controlled by the persons from the dominant peasant castes,


such as price supports, getting easy credits from Government agencies and Mortgage banks, and subsidized inputs of all sorts, which favoured the peasantry. The dominant peasant caste’s control over the State Power made it easier for them to obtain loans from cooperative credit agencies. Not only did they pocket most of the loans, but the rich farmers were also involved in credit scams. The Kulaks-controlled State Legislatures also resorted to such populist measures as waiving of farm loans to give relief to the agricultural sector. A study notes that with the increase in the size of the holding the dependence on moneylenders decreased. Big farmers were least dependent on the non-institutional source,\textsuperscript{170} thus no exploitation.

The third was the technological changes associated with Green Revolution, where ‘package of practices’ including High Yielding Varieties of seeds, fertilizers, pesticides, insecticides, mechanisation of farms, etc were introduced, which, it is argued benefitted principally the members of the ‘landed class’ and increased substantially the profitability of their farm operations.

The new ‘landed class’ of farmers with the affluence turned into Capitalist farmers. Some large farmers made even more spectacular gains out of this. With the release of more disease resistant Mexican varieties (PV 18, S227, and S308) in 1967-68, there was such a high demand for scarce supplies that many cultivators took up production

\textsuperscript{170} Harish K.Puri, Green Revolution and Its impact on Punjab Politics’.\textit{The Indian Political Science Review}, 1983, p.103.
of seed rather than grain, and sold their stocks at ‘fantastic’ prices of about Rs. 150 per quintal. Some used their additional income for the purchase of agricultural machinery - tractors, threshers, and seed drills. The replacement of bullock power with tractors and threshers made agriculture more efficient, permitting cultivators to double and even triple crop.171

Another indication of Capitalistic farming was the increased reinvestment in agriculture. For example, in 1972 the top 10 percent of the farmers, owning more than 20 acres of land, bought 68.75 percent of all tractors sold in the State, 24.72 percent of the tubewells/ pumpsets, 28.40 percent of threshers and 15.4 percent of land.172 Even the bottom 48 percent of farmers, purchased 18 percent of the tubewells/pumpsets, 20.31 percent of the threshers and 15.4 percent of the land.173 As a result, in 1972, there was one tractor for every 102 acres of net sown area in Punjab, against 922 acres at the all-India level. In the same year, there was one tubewell for every 14 acres of net sown area.174 The tractors, threshers and combines bought by the rich farmers on credit through State owned cooperative credit agencies brought them additional income as the farm machinery was leased to small farmers and lower rung of the middle category of farmers.

Some large farmers used their capital to establish ancillary

174 Ibid.
enterprises like poultry farming, or even to start small-scale industries, e.g. dealerships in spare parts for the new machinery that came flooding into the villages. Some went for diversification into commercial crops like sugar cane, cotton and orchards. As result of these innovations, the farmers with substantial holdings experienced a qualitative change in their standard of life which represents a new departure from the existing pattern. They attained a level of prosperity in terms of consumption and the acquisition of amenities, including refrigerators, telephones and even cars.\footnote{Francine R. Frankel, \textit{India's Green Revolution : Economic Gains and Political Costs}, p.26.}

The ‘landed class’ were characterized not only as the Capitalist, but as a politcally dominant class as well. The politically aware and progressive among the landed class started dabbling in the political arena with principal political parties in Punjab, Congress and the Akali Dal cadres swelling in numbers. The process of political entry by the members of the ‘landed class’ was a gradual and hierarchical. They started from the basic level of the grass root politics at the level of village panchayats. Gradually, they moved to the next higher levels of Block Samitis, Zila Parishads, District boards, State Assembly and the Parliament. With the passage of time, the control and dominance of the members of the new class is evidenced and expressed in numerous forms-through its control of local institutions of government and administration such as Panchayats, Zila Parishads,
District Boards, the different Public Sector Boards, the Corporations, Cooperatives, the managing boards of various educational institutions etc. The Jat cultivators of the Punjab have wielded immense power and influence in the governmental process.¹⁷⁶

Thus, those farmers who have benefited most from the Green Revolution have also become even more market oriented and price conscious and therefore, more oriented to influencing the State policies on product and input prices and grain procurement. In the 1970s non-party political movements among middle peasants and larger farmers demanding “remunerative prices” for farm products and other concessions in the terms of trade between agriculture and the non-agricultural sectors acquired strong support in western U.P., Maharashtra and Punjab, that it threatened the local support bases of previously entrenched political parties and caused concern to national policy makers.¹⁷⁷ One consequence of these agitations was the inclusion in the 1980s of farmer representatives on the Commission for Agricultural Costs and Prices (CACP), which determines the procurement and support prices for agricultural products.”¹⁷⁸

In some areas of the country, for example in Tamil Nadu and in Bihar, the affluence of the ‘Landed class’ brought in by the Green revolution strategies have resulted in the inter-class clashes. Probably

the most famous was Kilvenmani incident in Thanjavur district of Tamil Nadu on 25 December 1968, when accumulated hostilities exploded. In the attack, 43 women and children, families of striking Scheduled Caste farm laborers were burned alive in their huts. Among the 200 attackers reportedly involved were some of the richest landowners in East Thanjavur.'

One radical Marxist critique of the Green revolution argues that in Punjab as also elsewhere, in India, the Green revolution has benefited mostly the big farmers, ‘rich peasants’, Kulaks, or Capitalists. It is further elaborated that with the further success and accumulation of wealth, it has led to an increasing gap between the rich and poor peasants and landless, to ‘differentiation of the peasantry,’ class polarization, ‘growing landlessness’, and ‘agrarian revolts’.

Iqbal Singh, Parkash Tandon, Sucha Singh Gill and K.C. Singhal have put forward their viewpoint that Green Revolution in Punjab resulted in class disparities. They have built up an argument that the Punjab movement in the 1980s, including the rise of Bhindranwale, is itself to be attributed to the inequalities produced by the Green revolution and particularly the dissatisfaction of ‘the ones

left behind by it'.\textsuperscript{183}

Most non-Marxist perspectives however see greater diffusion of the gains of the Green Revolution, while recognizing its “differential spread”. Bigger farmers were in a better position to take the risks involved in adopting such a technology. The large landholders with assured water i.e. having private tubewells, sophisticated farm equipments such as improved ploughs, discs and harrows for proper land leveling; seed and fertilizer drills for shallow planting and exact spacing of seedlings; plant protection equipment to ward off rusts and other diseases were able to double or even treble their output and net income.

The strongest evidence against the Marxist argument that the Green Revolution has had a radicalizing effect, which has promoted class polarization and class conflict, is the relative absence of major peasant movements in the one area in India where there is no dispute that a Green Revolution has taken place, that has altered significantly the older agrarian system, namely Punjab and Haryana. Indeed, in his review of the consequences for peasant and labor class action in Punjab and Haryana up to 1977, Byres could find only one major incident of class confrontation between the rich peasants and laborers in a single village in Ludhiana,\textsuperscript{184} unlike other States of India like


\textsuperscript{184} Terrence J. Byres, “The Political Economy of Technological Innovations in Indian Agriculture,” p.53.
Tamil Nadu and Bihar.

Paul R. Brass has summed up the realities of caste, class and power in the Indian countryside that is true for Punjab also. The first is that there are, indeed, sets of landed castes in every region of India who control most of the land and other economic resources and who are also politically powerful. The second is that these caste groups constitute politically solidary groups in relation to other castes. The third is that where there is a diversity of land-controlling castes, these relatively solidary caste groups are in strong competition with each other for favoured access to scarce resources and political power. The fourth is that the landless and wage laborers at the bottom of the caste Hindu hierarchy are relatively powerless.185

In Punjab, during the period of Green revolution, Industrial revolution has lagged behind the agricultural revolution. The transition of capital from agriculture to Industry has primarily been in agro-processing industries, which constitute 40 percent of all industrial enterprises in the State. In terms of all India share and production, of its agro-processing sector, Punjab is among the top three states of India. But unlike the other two States, Maharashtra and Gujarat, the agro-processing industry in Punjab, with the exception of sugar cooperative mills, is in private hands. The capitalists who have invested in agro-processing take full advantage of

the State subsidies for this sector.

In post-Nehru era, the Centre’s exclusive control over licensing for heavy industries also played a role in the lack of heavy industries in Punjab which could have generated employment opportunities for the surplus population of the State. On account of the uneven capitalist development of the Centre, Punjab received less than the national average for its industrial development, but more for its agricultural development.

Environmental activist Vandana Shiva has written extensively about the social, political and economic impacts of the Green Revolution in Punjab. She claims that the Green Revolution have left Punjab ravaged by violence and ecological scarcity. Instead of abundance, Punjab has been left with diseased soil, pest-infested crops, water-logged deserts, and indebted and discontended farmers. The reliance on heavy use of chemical inputs and monocultures has resulted in water scarcity, vulnerability to pests, and incidents of violent conflict and social marginalization.

The fruits of the Green Revolution have not been equally shared by all classes of the farmers. Wolf Ladejinsky also noticed that the new technology has tilted the balance in favour of the big farmers. He stated that, "At this point, however, one must be careful not to mistake illusion for reality, for meaningful... one has to remind oneself

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that the real sharing in it is restricted to relatively few, perhaps only 10% and surely not more than 20% of the farm households of Punjab. Hence a fly in the ointment, which stems from the fact that growth and prosperity cannot hide the fact that the new agricultural policy which has done a yeoman job in generating them is also the indirect cause of the widening of the gap between the rich and the poor. Precisely because the Green Revolution has found its widest application in Punjab, the probability is that, relatively speaking the gap is greater there than in any other part of rural India.\textsuperscript{187}

The Economic and Statistical Organization, Punjab conducted a sample survey covering the entire state in 1972 with a view to have an idea of the socio-economic conditions of the people living in rural area. It observed, "Green Revolution has brought a certain degree of prosperity to the country-side. Relatively bigger and well placed cultivators have been in a position to take full advantage of this economic progress due to their larger size of holdings. As the small farmers did not possess the essential requisites for the agricultural development, there had not been proportionate improvement in their economic conditions. Small farmers owning less than 7.50 acres of land still continue to be living at subsistence level.\textsuperscript{188}


\textsuperscript{188} Report on the Socio-Economic Conditions in Rural Area-Economic and Statistical Organization, Punjab. 1972.
In spite of all the criticism, agricultural progress was witnessed in India in general and Punjab in particular. The whole progress in the form of Green Revolution can be summed up in the words of S.H. Whittwater. After his visit to Punjab in 1975, S.H. Whittwater, Director, Michigan State University stated that, "The greatest progress of all time in agricultural development has not been in the USA; it has been in Punjab......... Punjab probably made more agricultural progress in the last ten years than any other region on the face of the earth at all time."\textsuperscript{189}

Norman Borlaug dismissed certain claims of critics, but did take other concerns seriously and stated that his work has been: "a change in the right direction, but it has not transformed the world into a Utopia".

On environmental lobbyists, he said:

"some of the environmental lobbyists of the Western nations are the salt of the earth, but many of them are elitists. They've never experienced the physical sensation of hunger. They do their lobbying from comfortable office suites in Washington or Brussels...If they lived just one month amid the misery of the developing world, as I have for fifty years, they'd be crying out for tractors and fertilizer and irrigation canals and be outraged

that fashionable elitists back home were trying to deny them these things".190

190 Reported by Gregg Easterbrook in January 1997 interview for The Atlantic Monthly, Washington, D.C.