

A REVIEW OF LITERATURE ON SOME ASPECTS OF THE  
IMPACT OF NEW TECHNOLOGY ON INDIAN AGRICULTURE

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## CHAPTER I

### INTRODUCTION

In August 1965, Ministry of Food and Agriculture, Government of India, made its first general announcement of a 'New Strategy' of agricultural development. The High Yielding Varieties Programme was to be the major field programme of the 'New Strategy'.

The introduction of new varieties of seeds along with other complementary inputs to replace the local and other improved varieties has since then been one of the main strategies for increasing production and thereby meeting the deficit of foodgrains in the country.

This 'New Strategy' of agricultural development has been variously stated in the literature as 'High Yielding Varieties Programme', 'New Technological Change' in agriculture and also as 'Green Revolution'. The essence of all these expressions seems to indicate the advent of new variety of seeds and technology of production which bring about a revolutionary change leading to rapid and spectacular break through in agricultural production.

By technological change we mean, the use of new or modern inputs such as fertilisers, high yielding varieties of seeds, insecticides and pesticides etc., and the improved method of cultivation and use of machinery for various agricultural operations.

Further the applicability of new technology consisting of a packet of inputs - fertiliser - responsive high yielding varieties of seeds and pesticides remains confined to water assured areas.

Ever since the introduction of new technology there seems to have emerged two opposite views in the current debate on the impact of new technology on agricultural sector. The social scientists seem to be divided in their opinion on the nature of transformation that is taking place in the agricultural sector both across the region and along the farm size.

Walter P. Falcon<sup>1</sup> observes, 'The recent flood of literature on the Green Revolution has a certain similarity to the theologians' writings on God: both are concerned with existence, consequence, and salvation and both are equally contradictory in their conclusions!'

According to the proponents of the new technology, it has admittedly raised aggregate output of foodgrains and also transformed the traditional subsistence agriculture into modern agriculture.

On the other hand those who are sceptical about the benefits of the new technology maintain that it has not made significant impact on agricultural production. Moreover it

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<sup>1</sup> Walter P. Falcon, "The Green Revolution: Generations of Problems," American Journal of Agricultural Economics, Vol.52, No.5, December, 1970, p.698. Reprinted in Agricultural Development in Developing Countries - Comparative Experience, The Indian Society of Agricultural Economics, Papers and Proceedings of International Seminar, New Delhi, 1971.

is responsible for the growing inter-regional and inter-farm regional disparities.

The objective of the present study is to review the important literature regarding these and critically examine these two views.

The present discussion is confined to two specific aspects viz. (1) Production of foodgrains and (2) Distribution of gains that arise from new technology. This study comprises four chapters.

Chapter I serves as an introduction to the topic. It gives a brief historical background of the new technology.

Chapter II deals with the impact of new technology on aggregate production of foodgrains in India. Divergent views regarding the production aspect with the help of a brief survey of literature and a critical assessment of the impact of new technology on aggregate production of foodgrains are dealt with.

Chapter III discusses the distribution of gains from the new technology between regions and among farming community. This chapter is divided into three sections. First and second sections deal with the distribution of gains between regions and between small and large farmers, respectively. Third section discusses the distribution of gains between land owners and agricultural labourers. Chapter IV gives the conclusions of the study.

In what follows in this chapter we give a brief historical background to the advent of new technology in Indian agriculture.

Before we examine each aspect it is necessary to enumerate the circumstances under which the new technology made its appearance.

### Agriculture in the Post-Independence Period

The strategy adopted for agricultural development in post-independence period can be broadly classified into three phases. (i) General (1947-61), (ii) Intensive (1961-65) and (iii) Specialised (1966 onwards).

The general strategy was reflected in the place given to agricultural advance, in the Community Development Programme and National Extension Service. In this stage much of the infra-structure needed for agricultural progress such as roads, and irrigation system was slowly built up.

By 1957 this programme was reoriented into what is called, 'democratic decentralisation' or 'Panchayati Raj'. Under this system the responsibility of the implementation of rural development programme lay with the three-tier structure composed of the 'Panchayats' at the village level, 'Panchayat Samiti' at the block level and the 'Zilla Parishad', at the district level.

In 1959 the Ford Foundation Team prepared a report entitled, 'India's Food Crisis and Steps to Meet it'. This report led to the initiation of the Intensive Agricultural District Programme (Package Programme) in 1960-61, which attempted to raise <sup>farm</sup> ~~from~~ productivity in a number of relatively well endowed districts, by selecting and applying a package of inputs,

mainly high quality seed of improved varieties and chemical fertiliser. Subsequently the principle of intensification of agriculture through the application of package practices in areas with assured rainfall or irrigation was extended to the Intensive Agricultural Area Programme (IAAP) which covered about 1200 community development blocks in addition to the 300 blocks already covered under IADP. The IADP and IAAP results were positive but not spectacular. It became clear that with available inputs, the programmes could not solve India's food-grain shortage.

These programmes revealed the ceilings of response to inputs applied to improved local varieties and hence efforts were taken to overcome these problems.

In 1963, a selection of Mexican wheat and Taiwanese rice varieties were brought to India for breeding and trial purposes. By 1965, these had been tested and some had been accepted by Indian scientists.

In 1965-66 and 1966-67 India experienced a major shortage of foodgrains owing to monsoon failures. Famine conditions were averted only through heavy imports of foodgrains. By the mid-sixties the credibility of India to feed her teeming millions was severely impaired. Prof. T.W.Schultz characterised United States' food aid to India as 'Mal-Investment'. This critical period coincided with the preparation of the Fourth Five Year Plan which gave a new urgency for the need for a new approach to foodgrain production and agricultural development.



To meet the critical situation, the 'New Strategy' for agricultural development was put into action in a full-fledged manner from 1966, kharif onwards.

The aims of this 'New Strategy' are as under:

- 1) Cultivation of new high yielding varieties of seeds;
- 2) Development of multiple-cropping i.e. bringing additional area under crop production in the irrigated and assured rainfall areas;
- 3) Development of irrigation for intensive cultivation;
- 4) Soil and water management measures;
- 5) Using a package of practices including high yielding seeds, optimum quantity of fertilisers and pest control measures;
- 6) Emphasis on research and its application;
- 7) Farmers' training and education;
- 8) Development of infrastructure of credit, marketing, distribution system for supply of inputs; etc.

Basically this was to extend IADP concept of a package inputs and practices applied to farms in specific areas of relatively high production potential, but additionally to augment the package with a number of new varieties which had been shown to be responsive to heavy application of fertilisers under irrigated conditions.

## CHAPTER II

### NEW TECHNOLOGY AND PRODUCTION OF FOODGRAINS

In this chapter an attempt is made to evaluate the impact of new technology on aggregate production of foodgrains and more specifically to important cereals on the basis of the review of the important studies made in this regard.

As a first step we present the production statistics of the last 25 years (1951-52 to 1977-78) so as to have an overall view of the agricultural production in India.

Secondly, the divergent views on production are given. Finally on the basis of a critical analysis of the data presented an attempt is made to assess the impact of new technology in its proper perspective.

Table 2.1 gives the all India Index Numbers of foodgrains and all crops production from 1951-52 to 1977-78, i.e. for a period of about two and a half decade.

After the elimination of weather effects by taking a three year moving average of all India index numbers, the compound growth rate for foodgrains, non-foodgrains and all crops is around 2.5 per cent per annum during 1951-52 to 1977-78.

More specifically concentrating on foodgrains, which accounts for a substantial portion of the overall agricultural production, it is seen that the compound growth rate of

**Table 2.1: All-India Index Numbers of Foodgrains, Non-food-grains and All Crops Production - 1951-52 to 1977-78**

Year	Based on three year moving average		
	Foodgrains	Non-foodgrains	All-crops
1952-53	65.5	62.0	64.6
1953-54	70.4	64.7	68.9
1954-55	73.4	67.8	71.9
1955-56	73.7	72.9	73.4
1956-57	72.4	74.5	73.0
1957-58	75.6	78.6	76.4
1958-59	77.1	79.4	77.7
1959-60	82.9	83.4	83.0
1960-61	84.4	84.9	84.5
1961-62	85.6	87.9	86.3
1962-63	85.3	88.9	86.4
1963-64	87.8	94.1	89.8
1964-65	85.1	95.0	88.3
1965-66	82.4	94.1	86.1
1966-67	83.9	92.9	86.8
1967-68	91.0	95.0	92.3
1968-69	100.0	100.0	100.0
1969-70	104.7	103.2	104.2
1970-71	109.4	107.7	108.8
1971-72	108.9	107.3	108.3
1972-73	108.0	110.0	108.6
1973-74	105.6	112.5	107.8
1974-75	113.9	118.9	115.5
1975-76	115.7	119.3	116.9
1976-77	125.2	124.0	124.8
Growth rates (per cent)	2.39	2.62	2.46

**Source:** Directorate of Economics and Statistics, Ministry of Agriculture and Irrigation.

foodgrains is around 2.4 per cent, per annum during 1951-52 to 1977-78.

A break up of the last 25 year period into three sub-periods 1952-53 to 1960-61, 1960-61 to 1969-70 and 1969-70 to 1977-78 may give further insight of the data on foodgrains production.

Table 2.2 gives the foodgrains production of the above-mentioned three sub-periods.

Table 2.2: Growth and Variation: Foodgrain Production

Particulars	1952-53 to 1960-61	1960-61 to 1969-70	1969-70 to 1977-78
1. Average level of foodgrains production* (in million tonnes)	72	85	108
2. Compound rate of growth of foodgrain production** (percent per annum)	2.71	1.71	2.26

Notes: \* Based on adjusted estimates of production.

\*\* Calculated on the basis of index numbers of foodgrain production (Base: triennium ending 1969-70 = 100)

Source: Directorate of Economics and Statistics, Ministry of Agriculture and Irrigation

Table 2.2 shows that in the first sub-period (1952-53 to 1960-61) the annual average foodgrains production was 72 million tonnes. In the second sub-period (1960-61 to 1969-70) it was 85 million tonnes and for the third period (1969-70 to 1977-78), it further increased to 108 million tonnes. The data show the consistent build-up of production base.

The compound growth rate of foodgrain production in the three sub-periods are 2.71, 1.71 and 2.26 per cent per annum respectively. There is a considerable decline in the second sub-period (1960-61 to 1969-70). However, the growth rates of foodgrains in the first and third periods do not show a considerable change. (2.71 and 2.26 per cent per annum respectively).

Having presented the basic statistics of foodgrains production during the last two and a half decades and its break up into different sub-periods, we shall now briefly survey the literature expressing divergent views on the direct effect of the new technology on aggregate foodgrains production.

Let us first summarise the views which hold that the technological change in agriculture has failed to bring about any significant change in aggregate agricultural production.

C. H. Hanumantha Rao observes, "Despite the technological changes characterised mainly by the use of High Yielding Varieties of seeds in the case of wheat, bajra, rice, maize and jowar after the mid-sixties, the growth rate of the output of foodgrains and of agricultural commodities as a whole, has

declined during the decade 1970-71 as compared to the previous decade.<sup>1</sup>

He feels that even without the technological change, growth rate would have been maintained at about 2 to 2.5 per cent per annum owing to the pressure of population.

He compares the growth rates of both foodgrains and agricultural production between the two decades of 1949-50 to 1959-60 and 1960-61 to 1970-71. The output of foodgrains grew at the rate of 2.5 per cent per annum during the decade 1960-61 to 1970-71 as against 3.3 per cent per annum in the previous decade of 1949-50 to 1959-60. The annual growth rate of agricultural output was 2.1 per cent per annum during 1960-61 to 1970-71. The growth rate of agricultural production in the previous decade i.e. 1949-50 to 1959-60 was at 3.3 per cent per annum. Hence he argues that both the foodgrain production and agricultural production seemed to be lower in the decade 1960-61 to 1970-71 (associated with the new technology) as against 1949-50 to 1959-60.

However, he agrees that in the case of wheat and maize, there has been marked growth due to the introduction of new technology.

T. N. Srinivasan<sup>2</sup> is of the opinion that the green

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1 C.H.Hanumantha Rao, Technological Change and Distribution of Gains in Indian Agriculture, Institute of Economic Growth, Delhi, 1975, p.3.

2 T.N.Srinivasan, "The Green Revolution or the Wheat Revolution," Agricultural Development in Developing Countries - Comparative Experience, The Indian Society of Agricultural Economics, Papers and Proceedings of International Seminar held at New Delhi, 25-28 October, 1971, p.405.

revolution has not made a dramatic break through on agricultural production. He has shown that the trend rate of growth of all agricultural commodities fell from 3.2 per cent per annum during the period 1949-50 to 1965-66 to 2.9 per cent per annum for the period from 1949-50 to 1969-70 even after excluding the two unusual years of 1965-66 and 1966-67.

Further he argues that the trend line of productivity per hectare for the period 1949-50 to 1964-65 almost coincides with the period 1949-50 to 1969-70 excluding 1965-66 and 1966-67. Hence he concludes that the rate of growth of per hectare productivity has also not improved despite technological change.

After analysing the fluctuating tendency of the food-grains data, Ashok Mitra<sup>3</sup> concludes that the much talked 'green revolution has not occurred in India'. It is to be noted that he has included the two drought years of 1965-66 and 1966-67 in his analysis.

A statewise examination of the bumper harvest of 1970-71 by the Agricultural Prices Commission suggests that the increase of 3.3 million tonnes of foodgrains production over the previous year was more due to the favourable climatic condition, than the technological change. For example, Rajasthan, one of the poor producers contributed 4 million tonnes to the increase whereas the technologically advanced state, Punjab contributed only 2.7 million tonnes.

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3 Ashok Mitra, "Bumper Harvest has created Some Dangerous Illusions," The Statesman, October 14, 1968.

Dharm Narain<sup>4</sup> observes, "After all, even with the bumper harvest of 1970-71 the growth rate of total foodgrain output at 2.9 per cent per annum since 1949-50 through 1970-71 is no higher than that, at 3 per cent per annum, realised during the period 1949-50 to 1964-65." If cash crops are included, then the growth rate for respective periods shows a significant decline from 3.6 to 3 per cent per annum. Further the overall growth rate of agricultural output has dropped from 3.2 to 2.9 per cent during the corresponding period.

Dharm Narain remarks that owing to higher profitability associated with HYV seeds in the case of crops where they have yielded successful results, - there has been marked shifting of areas from commercial crops to foodgrain crops, which has affected the production of commercial crops.

All these studies discussed above indicate that the new technology or the so-called green revolution has failed to increase the agricultural output in any significant manner. Some of the studies also indicate that even the foodgrains production has not increased significantly in the post-green revolution period. We shall now examine the other view in this respect.

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<sup>4</sup> Dharm Narain, "Growth and Imbalances in Indian Agriculture," Journal of the Indian Society of Agricultural Statistics, Vol. XXIV, June, 1972, No.1.



The View that Impact of New Technology  
on Foodgrains Production is Significant

John W. Mellor<sup>5</sup> observes that a realistic analysis of trend could be made by comparing years of similar weather such as 1964-65 and 1970-71. In the six intervening years after the green revolution foodgrain production increased by 19.1 million tonnes, a compound annual growth rate of 3.3 per cent. This rate was 18 per cent higher than the growth rate shown by the same measures between the similar crop years 1949-50 to 1960-61. It is to be noted that the weather in 1964-65 was slightly better than in 1970-71, lending a slightly downward bias to estimates of growth rates for the intervening years.

A similar view is expressed by B. S. Minhas.<sup>6</sup> It is estimated that the annual (linear) growth rate of foodgrains production during the five years ending 1964-65 was just 1.8 per cent. Between 1964-65 and 1970-71 foodgrains production registered a growth rate of 3.4 per cent per year.

G. V. K. Rao and Thamarajakshi<sup>7</sup> observe, "The agricultural scenario to-day has undergone a qualitative change and with the achievement of a decisive break through in food production, the

<sup>5</sup> John W. Mellor, The New Economics of Growth: A Strategy for India and the Developing World, Cornell University Press, Ithaca, New York, 1976, pp.48-49.

<sup>6</sup> B.S.Minhas, "Towards National Food Security," Presidential Address delivered at the Thirtysixth Annual Conference of Indian Society of Agricultural Economics, Indian Journal of Agricultural Economics, Vol.XXXI, No.4, October-December, 1976.

<sup>7</sup> G.V.K.Rao and Thamarajakshi, "Some Aspects of Growth of Indian Agriculture," Economic and Political Weekly, December 23, 1978, p.A-118.

country has emerged from the scarcity trap." They strengthen their argument by comparing foodgrains production during peaks and troughs in the pre-green revolution period with the post-green revolution.

They argue that there is progressive improvement in the foodgrains production during the post-green revolution period, both in peaks and troughs as against the peaks and troughs in the pre-green revolution period.

Table 2.3 shows that the latest trough level of production

Table 2.3: Peaks and Troughs in Foodgrain Production

		(000 tonnes)	
Year	Trough level	Year	Peak level
1950-51	55,011	1953-54	72,326
1955-56	69,335	1956-57	72,457
1957-58	66,629	1958-59	78,803
1959-60	77,120	1961-62	82,397
1962-63	80,330	1967-68	95,052
1965-66	72,347	1970-71	1,08,422
1968-69	94,013	1973-74	1,04,665
1972-73	97,026	1975-76	1,21,034
1974-75	99,826	1977-78	1,25,605
1976-77	1,11,167		

Source: Based on adjusted estimates of production upto 1965-66 and actual estimates of production beyond 1965-66, Directorate of Economics and Statistics, Ministry of Agriculture and Irrigation.

in 1976-77 represents a doubling of the corresponding level in 1950-51. The all time record production of over 125 million tonnes in 1977-78 marks an increase of about 53 million tonnes over the year 1965-66. The trough of 1974-75 was about 5 per cent higher than the peak of 1967-68.

George Blyn<sup>8</sup> remarks, "The most dramatic gain occurred when wheat output doubled in Punjab from 1966-67 largely as a result of increased yield per acre. As is well known the yield per acre gain of recent years were primarily the result of 'miracle' high yielding seeds. The impact of this innovational wave seemed as though it might change the entire course of economic history."

Kahlon<sup>9</sup> argues that the average yield of wheat in India increased by 52 per cent in 1971-72 over 1964-65. The production of wheat increased by 115 per cent over the same period. Further, there was a significant increase of 50 to 60 per cent income in wheat growing areas. Hence he concludes 'No wonder therefore that the development of high yielding varieties of wheat was considered as one of the greatest feats of biological engineering'.

Commenting on the doubling of wheat production in Punjab,

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8 George Blyn, India's Crop Output Trends: Past and Present, Reproduced in Agricultural Development of India: Policy and Problems, Ed. C.H.Sha, Bombay: Orient Longman, 1978.

9 A.S.Kahlon, "Green Revolution - Some Lessons from Indian Experience," Agricultural Situation in India, Vol.XXXI, No.1, April, 1976.

V. S. Vyas<sup>10</sup> remarks, "No other major wheat producing country in the world has surpassed this rate of increase in the production of the cereal."

It is also pointed<sup>11</sup> out that after the introduction of the new technology, the relative contribution of productivity to total gain in production has increased in rice and wheat. The contributions of area and yield increases to the absolute gain in production in 1975-76 as compared to 1964-65 were 34.4 and 65.6 per cent respectively in rice and 38.7 and 61.3 per cent respectively in wheat.

In the light of the above divergent views, it is deemed necessary to have a proper assessment of the impact of new technology on production.

As is well known the Green Revolution is associated with the discovery of high yielding varieties mainly for wheat and rice. Therefore a proper assessment of the direct effect of the new technology must be related to production and productivity of wheat and rice.

Secondly, the high yielding varieties of seeds and other related technological change made their real impact in Indian agriculture some time after 1966-67. Therefore for a proper

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10 V.S.Vyas, Progress and Performance of HYV Wheat Programme in India (1966-67 to 1971-72), Sardar Patel University, Gujarat, October 1973.

11 M.S.Swaminathan, Presidential Address delivered at the Thirtyseventh Annual Conference of the Indian Society of Agricultural Economics, Indian Journal of Agricultural Economics, Supplement to Conference Number, Vol.XXXII, July-September, 1977.

assessment of the performance of the green revolution only the post 1966-67 period is to be considered. Thirdly, as mentioned earlier the emergence of new technology remains confined to a few select regions with assured water supply, hence strictly speaking its performance need to be judged in respect of those regions only.

If we confine ourselves to these three criteria we may be able to get a more clear picture of the actual impact of the new technology on production.

The inter-state variability in the output of foodgrains due to technological change is estimated by C.H. Hanumantha Rao.<sup>12</sup> Table 2.4 shows the impact of the technological change on the regional distribution of gains in the foodgrains sector.

It is evident from Table 2.4 that states like Punjab, Haryana, Rajasthan improved their share considerably in the foodgrain output of the country from the new technology whereas Andhra Pradesh and Maharashtra experienced a significant decline in their share. States like Bihar, Orissa, West Bengal witnessed a marginal decline in the share. (see also Chapter III, Section 1). Further, the disparities in the contribution of each state in total foodgrains production appears to be more pronounced during the post-green revolution period.

Nilakantha Rath, in an unpublished exercise, has estimated the annual compound growth rates with regard to (1) Total production, (2) Area, (3) Yield for the period 1955-56 to 1975-76.

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12 C.H. Hanumantha Rao, op.cit.

Table 2.4: Output of Total Foodgrains

State	Percentage to All-India	
	1964-65	1970-71
Andhra Pradesh	8.3	6.4
Bihar	8.4	7.5
Gujarat	3.2	4.1
Kerala	1.3	1.2
Madhya Pradesh	11.5	10.0
Maharashtra	7.6	5.2
Karnataka	5.4	5.5
Orissa	5.5	4.8
Punjab, Haryana and Chandigarh	7.5	10.9
Rajasthan	5.9	8.2
Tamil Nadu	6.4	6.5
Uttar Pradesh	17.1	18.1
West Bengal	7.0	6.9
Others	4.9	4.7

Source: Directorate of Economics and Statistics, Ministry of Food and Agriculture, Government of India, Bulletin on Food Statistics.

The entire period is divided into two sub-periods. The first period 1955-56 to 1964-65 represents the pre-green revolution period and the second from 1964-65 to 1975-76 represents roughly, the post-green revolution period.\*

\* This period includes a couple of years of pre-green Revolution period.

Table 2.5 shows that the annual compound growth rate of foodgrains production for the entire period (1955-56 to 1975-76)

Table 2.5: Annual Compound Growth Rates in Indian Agriculture

	Total Production		
	1955-56 to 1964-65	1964-65 to 1975-76	1955-56 to 1975-76
Rice	3.52	2.80 (1.51) (Ex 65-67)	2.21 (2.24)
Jowar	3.17	-0.07 (0.05) (Ex 65-66 66-67 71-73)	0.58
Bajra	2.80	1.76 (6.91) (Ex 65-66 68-69 71-73 74-75)	2.73
Wheat	3.20 (3.43) (Ex 57-58 63-64)	8.69 (8.28) (Ex 65-66 73-74)	6.28 (6.19)
All Pulses	-0.29	0.44 (-0.28) (Ex 65-67 68-69 72-75)	-0.5
Foodgrains	2.75 (2.40) (Ex 57-58)	3.27 (2.64) (Ex 65-67 <del>68-69</del> 72-73 74-75)	2.41 (2.57)

Note: Figures in brackets are estimated growth rates excluding abnormal years.

was 2.41 per cent (including abnormal years). The annual compound growth rate of foodgrains production in the post-green revolution period was 3.27, whereas it was only 2.75 per cent in the pre-green revolution period (including all years). Even if we exclude all abnormal years in both the periods, it is evident from the data that the annual compound growth rate of foodgrains production was higher in the post-green revolution period as against in the pre-green revolution period.

While coming to the performance of the individual crops, the annual compound growth rate of wheat for the entire period was 6.28 per cent (including abnormal years). Excluding abnormal years the compound growth rate was 6.19 per cent per annum. In the pre-green revolution period growth rate of wheat excluding abnormal years was 3.43 per cent per annum, whereas the corresponding growth rate in the post-green revolution period was 8.28 per cent. One could easily note the spectacular increase in the production of wheat in the post-green revolution period.

When compared with wheat the performance of rice, more especially in the post-green revolution period, is disappointing. The rate of growth of production of rice in the post-green revolution period is smaller than that in the pre-green revolution period. If we exclude abnormal years in the post-green revolution period, the compound growth rate would be 1.51 per cent per annum. This indicates that the impact of new technology on rice production is not significant. Among other reasons, unfavourable agro-economic conditions, non-availability



of disease resistant high yielding variety of seeds, small size of holdings seemed to be the main causes for the poor performance of rice in the post-green revolution period.

New technology could not make much positive contribution as far as jowar was concerned. Indeed there was a negative growth rate in the post-green revolution period (if all years are included). It is mainly due to the fact that considerable portion of the country's jowar is cultivated in the unirrigated and low rainfall regions.

The growth rate of bajra in the post-green revolution period had declined considerably (including all years). However, if abnormal years are excluded its performance was next only to wheat.

The production of pulses which are grown predominantly in areas without irrigation has more or less remained stagnant.

#### Area and Yield Rate

An increase in production may result from an increase in productivity and/or an increase in the area under cultivation. We shall presently examine these two aspects and assess the contribution of each in the total production.

Tables 2.6 and 2.7 show the area and yield rate for the period 1955-56 to 1975-76. It is evident from Table 2.6 that there was a decline in the growth rate of area cultivated under foodgrains in the post-green revolution period as compared to pre-green revolution period. Table 2.7 indicates that despite

Table 2.6: Area

	1955-56 to 1964-65	1964-65 to 1975-76	1955-56 to 1975-76
Rice	1.61	0.78 (0.61) (Ex 65-67)	0.95 (0.95)
Jowar	0.98 (0.65)	-1.36 (0.98) (upto 69-70)	0.55 - 0.34 (0.58)
Bajra	0.05 (0.37) (Ex 59-60 62-64)	-0.09 (1.68) (Ex 68-69 71-73 74-76)	0.55 (1.07)
Wheat	1.00 (0.7) (Ex 57-58)	4.26 (4.08) (Ex 65-67 73-75)	2.53 (2.58)
Pulses	0.48 (0.32) (Ex 57-58)	0.06	-0.34
Foodgrains	0.85	0.67 (0.71) (Ex 65-67 72-73 74-75)	0.61 (0.72)

Note: Figures in brackets are estimated growth rates excluding abnormal years.

a decline in the growth rate of area under foodgrains, there was a considerable improvement in the yield rate in the post-green revolution period which led to increase in production of foodgrains. This seems to suggest the positive impact of new technology on aggregate production of foodgrains.

There was an appreciable increase in the growth rate of area under wheat, in the post-green revolution period as against pre-green revolution period (1 per cent to 4.26 per cent). The

Table 2.7: Yield Rate

	1955-56 to 1964-65	1964-65 to 1975-76	1955-56 to 1975-76
Rice	1.91 (1.79) (Ex 57-58 62-63)	2.01 (1.46) (Ex 65-67 72-73 74-75)	1.25 (1.31)
Jowar	2.20 (2.48) (Ex 61-62)	1.28 (1.38) (Ex 65-66 71-73)	0.92 (1.36)
Bajra	2.31 (1.54) (Ex 56-57 60-61)	1.90 (3.49) (Ex 65-66 68-69 72-73 74-75)	2.22 (3.09)
Wheat	2.20 (3.45) (Ex 62-64)	4.40 (4.26) (Ex 65-66 73-74)	3.75 (3.79)
Pulses	-0.66 (0.34) (Ex 57-58 59-60 61-64)	0.57 (0.22) (Ex 65-67 68-69 72-73 (73-74, 74-75)	-0.02 (0.11)
Foodgrains	1.52 (1.24) (Ex 57-58)	2.23 (1.58) (Ex 65-67 72-73 (74-75)	1.54 (1.65)

Note: Figures in brackets are estimated growth rates excluding abnormal years.

corresponding increase in the yield rate was from 2.20 to 4.40 per cent for the same period. The greater yield experienced under HYVs seemed to have influenced the farmers to increase substantially the area also under HYV wheat.

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Data on HYV

With regard to rice despite a decline in the growth rate of area in the post-green revolution period, there was an increase in the yield rate for the same period. However, due to unfavourable agro-economic factors and other factors mentioned earlier - the aggregate production of rice registered a decline in the post-green revolution period.

In the case of jowar and bajra despite a negative growth rate in area there was a positive yield rate in the post-green revolution period (including all years). It may be argued that in the absence of new technology, the production would have declined.

From the above study on production, area, productivity of foodgrains, it appears that the significant increase in production in the post-green revolution period is <sup>relatively</sup> more due to the increase in yield than an increase in area.

The impact of new technology could also be judged from the use of inputs.

Dantwala<sup>13</sup> argues that the impact of new technology should not be judged only from the point of view of production data as this could be presented in a variety of manner - depending upon the selection of base years and commodities. Hence he suggests that a better test could be to ascertain whether the advent of the Green Revolution has changed the attitudes and behaviour of the farmers. He then provides relevant data to

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13 M.L.Dantwala, "Agricultural Policy since Independence," Indian Journal of Agricultural Economics, Vol. XXVI, No. 4.

show that there had been a significant change in the short and long term investment decisions of the farmers.

The number of private tube wells increased from 0.1 million in 1965 to 0.47 million in 1971 and the number of pump sets - diesel and electric went up from 0.88 million to 3.24 million during the same period. The consumption of chemical fertilisers per cropped acre registered a significant increase of 4 kg. to 16 kg. or by 400 per cent.

Further the percentage of expenditure on modern inputs to the total spent on all inputs of agriculture has increased sharply from 6.19 to 21 at constant (1960-61) prices.

He concludes that the upsurge in the use of modern inputs since the advent of new technology is phenomenal and therefore it may lead to a change in the traditional subsistence agriculture into modern commercial agriculture.

To sum up and draw a meaningful conclusion from the above discussion, it is necessary to note that the growth rate is highly sensitive to the selection of the base and terminal years and much depends on how the statistics regarding production are compiled and presented. It may be mainly because of this reason that a large number of studies dealing with this aspect arrive at divergent conclusions.

However, a critical review of these studies and the re-examination of the data on aggregate foodgrains production over the last 25 years or so and the appropriate break up of the entire period into different sub-periods do indicate a positive contribution (though not very pronounced) of the technological

change on aggregate foodgrains production. It is noted that even after adjusting for the abnormal years which appear both in the beginning of and end of the sub-periods, the rate of growth of aggregate foodgrains production is higher in the post-green revolution period.

In fact if we examine the performance of the green revolution in the context of the three criteria mentioned earlier i.e. (i) crop which has been most successful in High Yielding Variety Programme i.e. wheat (ii) the regions in which its impact has been most felt and (iii) the period during which its real impact on production was felt, we find that the technological change has made substantial contribution towards the aggregate foodgrains production during the period 1966 to 1978.

The fact that a secular rate of growth of 2.4 per cent per annum of foodgrains production has been achieved over the last 25 years or so, is itself not a negation but a positive evidence of the significant contribution of the technological change towards aggregate foodgrains production. Only a few countries of comparable size and development has achieved this growth rate.

It is obvious from the fact that the rate of growth of foodgrain production which declined during the period 1956-57 to 1965-66 and it was only due to a relatively high rate of growth during the period 1966-67 to 1976-77 (post-green revolution period) that an overall rate of growth of around 2.4 per cent per annum could be maintained.

Further the phenomenal upsurge in the use of modern inputs since the advent of new technology is another evidence on the achievement of the green revolution.

However, it is true that the revolution in the sense of a dramatic break through from the situation that existed before the revolution has not been achieved but at the same time it cannot be denied that the technological change has made some positive contribution towards the aggregate production of foodgrains. The new technology it seems has yet to prove its worth in case of rice, jowar, bajra and cereals in general. However, its performance in the case of wheat is impressive. As wheat constitutes a substantial portion of aggregate foodgrains production, it is reasonable to assume that in the absence of the spectacular and unprecedented rate of growth in the production of wheat, the food situation would have been critical.

It would be appropriate to end this section by quoting Dantwala<sup>14</sup> in this context.

In a paper presented to the 15th International Conference of Agricultural Economists in 1976, he mentions, "The only claim which can however be made with some confidence is that the technology associated with HYVs opened up a process of modernisation of Indian agriculture and significantly raised its production capacity. This is all the more important."

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14 Ibid.

## CHAPTER III

### NEW TECHNOLOGY AND DISTRIBUTION OF GAINS

#### Section 1

##### New Technology and Distribution of Gains between Regions

Having assessed the impact of new technology on production, we shall examine in this section, how the gains that arise from new technology are distributed between regions.

As already noted, new technology concentrates scarce resources in select high growth pockets rather than spreading them relatively thinly. As a result three fourths of India's cultivated acreage lie outside the orbit of the new technology. Hence a vast portion can claim 'small islands' within.

To quote Fourth Plan, "the new agricultural strategy tends to add a further dimension of disparity between those who have the resources to make use of them and those who have not. There is thus the danger of a sharp polarisation between the most privileged classes in the rural sector, the privilege in this instance, relating to resources and tools of development."<sup>1</sup>

Even the proponents of the new technology have expressed their concern in the growing disparities between regions and

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<sup>1</sup> Government of India, Planning Commission, Fourth Five Year Plan.



among farming community. The impact of new technology has not been uniform in all states. Hence regional imbalances in agricultural development can create serious problems in terms of human welfare and also it may retard further economic growth.

In this context in what follows we shall review the studies made and literature available in this regard.

Dayanantha Jha<sup>2</sup> has examined the variations in agricultural growth rate in different states over the period 1953-71. He has divided the entire period into three sub-periods.

Table 3.1 shows annual linear growth rates of agricultural output of fifteen major states for the period 1953-54 to 1970-71. It can be seen from Table 3.1 that there was a uniform pattern of growth in agricultural output in most of the states in the first period. This may be due to the blanket development strategy followed by the government during fifties.

However, the uniform pattern of growth started breaking in the second period. Except in Gujarat, Orissa, Uttar Pradesh and West Bengal, the growth rates either increased marginally or declined in the second period as against the first.

In the third period (which is associated with the new technology) the rate of growth showed a wide range of variation between states. In states like Andhra Pradesh, Bihar, Maharashtra, Orissa and West Bengal there had been a further decline in output growth in the third period as compared to second

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<sup>2</sup> Dayanantha Jha, "Agricultural Growth, Technology and Equity," Indian Journal of Agricultural Economics, Vol. XXIX, No. 3, July-September, 1974, pp. 207-215.

**Table 3.1: Annual Linear Growth Rates of Agricultural Output  
1953-54 to 1970-71**

	1953-56 to 1958-61	1958-61 to 1963-65	1963-65 to 1969-71
1. Andhra Pradesh	2.42	2.63	-0.24
2. Assam	1.22	1.48	5.45
3. Bihar	3.43	2.36	1.57
4. Gujarat	3.00	4.71	7.13
5. Haryana	4.73	1.23	20.40
6. Kerala	3.00	1.30	2.15
7. Madhya Pradesh	4.45	0.76	3.00
8. Maharashtra	3.59	0.85	0.08
9. Karnataka	3.97	2.96	1.93
10. Orissa	0.88	4.80	3.15
11. Punjab	4.73	3.60	19.20
12. Rajasthan	3.51	0.06	13.60
13. Tamil Nadu	4.48	1.77	3.08
14. Uttar Pradesh	1.87	2.47	4.87
15. West Bengal	0.36	4.66	2.18

**Source:** R.E.Evenson, and D. Jha, "The Contribution of Agricultural Research System to Agricultural Production in India," Indian Journal of Agricultural Economics, Vol. XXVIII, No. 4, October-December, 1973.

period. Disparities between these states with others like Assam, Gujarat, Haryana, Punjab, Rajasthan, Tamil Nadu and

Uttar Pradesh tended to increase during the third period which is the post-green revolution period.

Another study<sup>3</sup> which examined the impact of new technology on per hectare productivity of major food crops in different states remarked that the benefits of green revolution were more confined to wheat growing areas. Moreover within these areas the share of benefits would be determined by the relative economic importance given to wheat in the cropping pattern.

V. S. Vyas<sup>4</sup> shows the imbalances in the foodgrains production in major states between 1959-61 to 1969-71, with the help of per capita production of foodgrains. The first and second trienniums represent the pre and post-green revolution periods respectively.

Table 3.2 shows that eight out of fifteen states registered an increase of per capita foodgrains production in the second triennium. Punjab ranked first among the states with a 70 per cent increase in the per capita production of foodgrains. Maharashtra recorded a substantial decline of more than 30 per cent in per capita production of foodgrains. Other states which experienced a decline were Andhra Pradesh, Bihar, Assam, Orissa, Kerala and Madhya Pradesh. On all India level there was

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3 C.B.Singh, and A.S.Sirohi, "Disparities in Agricultural Growth and Equity in India," Indian Journal of Agricultural Economics, Vol.XXIX, No.3, July-September, 1974.

4 V.S.Vyas, "Regional Imbalances in Foodgrains Production in the last Decade: Some Preliminary Results," Economic and Political Weekly, Review of Agriculture, December, 1973.

**Table 3.2: Changes in Per Capita Production of Foodgrains in First Triennium and Second Triennium in Different States**

State	Triennium I 1959-61 (kgs)	Triennium II 1969-71 (kgs)	Difference (kgs)	Change (percentage)
1. Andhra Pradesh	185.44	163.26	-22.18	-11.96
2. Assam	145.47	143.16	-2.31	-1.59
3. Bihar	153.82	143.97	-9.95	-6.40
4. Gujarat	99.86	148.00	+48.14	+48.20
5. Jammu & Kashmir	168.62	222.77	+54.15	+32.08
6. Kerala	63.03	61.42	-1.61	-2.55
7. Madhya Pradesh	295.55	256.17	-39.38	-13.32
8. Maharashtra	167.25	115.60	-51.65	-30.88
9. Karnataka	167.72	204.10	+36.38	+21.69
10. Rajasthan	246.30	258.66	+12.36	+5.02
11. Punjab	299.34	511.87	+212.53	+70.99
12. Orissa	229.46	224.66	-4.80	-2.09
13. Tamil Nadu	159.95	164.19	+4.24	+2.65
14. Uttar Pradesh	189.97	206.48	+16.51	+8.69
15. West Bengal	151.57	174.10	+22.53	+14.86
All India	181.93	190.35	+8.42	+4.63

**Source:** V.S.Vyas, "Regional Imbalances in Foodgrains Production in the Last Decade: Some Preliminary Results," Economic and Political Weekly, (Review of Agriculture), December, 1973.

an increase of 4 per cent in the per capita production of foodgrains in the post-green revolution period. The increase in the share of foodgrains production in certain states were attributed to one or combination of the following conditions:

- i) an increase in the area under foodgrains;
- ii) an increase in the area under crops with higher yields; and
- iii) an increase in yield per hectare. Converse factors would explain the relative decline in the contribution by other states.

Another study<sup>5</sup> which examined the causes of inter-regional disparities remarks that the regional disparities are partly from the character of new technology and partly from the regional differences in factor endowments, physical and institutional infrastructure and entrepreneurship. Therefore, regional disparities are inevitable in the initial phases of technological changes. However, in the long run through public policy the disparities could be considerably reduced, if not eliminated.

The study further points out that the inter-state disparities increased due to differences in the supply of institutional credit per hectare and the variations in the percentage of net sown area irrigated from private sources such as wells. However, the regional disparities with regard to the proportion of area irrigated by public sources such as canals declined.

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5 C.H.Hanumantha Rao, op.cit.

Similarly, the inter-state variation in the consumption of fertilisers per hectare also declined to some extent.

Sitaram Yechuri<sup>6</sup> while examining the inter-state variations in agricultural growth rates, remarks that around 75 per cent of variations in the growth of crop output is due to variations in the growth of irrigation.

It must be noted that besides new technology, other factors like differences in natural and physical endowments are also responsible for inter-regional disparities.

On the basis of the extent of rainfall recorded the country has been roughly divided into three broad regions such as high, medium and low rainfalls.

It is observed<sup>7</sup> that 77 out of 328 districts lie in these low rainfall regions (less than 750 mm) and they account for about one third of the total sown area in the country. This shows that agricultural area subject to low rainfall forms a substantial part of India.

From the <sup>earlier</sup> ~~above~~ discussion it seems the new technology distinctly favours high growth pockets. This built-in mechanism of the new technology appears to have further magnified the already existing regional disparities.

6 Sitaram Yechuri, "Inter-State Variations in Agricultural Growth Rate, 1962-1974," Economic and Political Weekly, Review of Agriculture, December 1976.

7 N.Rath, "A Note on Agricultural Regions and Small Farmers with Special Reference to Maharashtra," 1969 (unpublished).

However, the regional disparities have not occurred as unanticipated. A host of factors are responsible for the growing inter-regional disparities, such as natural and physical endowments which include irrigational facilities, cropping pattern, relative economic importance of the high yielding varieties in the cropping pattern, pace and level of adoption of agricultural innovations. In addition to these, social and political factors further accentuate the growing regional disparities.

In this context, it would be appropriate to close this section by quoting Wolf Ladejinsky, "The imbalances are the result of all the social, religious, political and economic forces which govern the village and which admittedly are mirrored in the shape which the new technology has assumed. It is not the fault of the green revolution that credit service does not serve those for whom it was intended, the extension service is weak and ineffective, that the village 'Panchayats' or councils are essentially political than developmental bodies, that security of tenure is not given to the many, that rents are exorbitant, that ceilings on land ownership are notional, that even rising wage scales are hardly sufficient to satisfy the basic essentials of the farm labourer, or that generally speaking in those conditions economic and social justice of and for the village poor do not ride in tandem."<sup>8</sup>

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<sup>8</sup> Wolf Ladejinsky, "How Green is Green Revolution?," Economic and Political Weekly, Review of Agriculture, December 1973, pp.A-133-34.

Section 2Distribution of Gains between  
Small and Large Farmers

There seems to have developed divergent views on the question of sharing of gains from the new technology between small and large farmers.

A few hold the view that the introduction of new technology has led to the unequal sharing of gains between small and large farmers. They argue that the new technology is capital-intensive which marks a major shift from an essentially labour-based technology of the past. Therefore the large farmers when compared to small farmers are better endowed with necessary resources and capacity to bear risks and uncertainties involved in the adoption of the new technology - which leads to the unequal sharing of gains between small and large farmers.

A few others hold a different view. They argue that the new technology is not discriminating between small and large farmers as it is size-neutral. The 'neutrality' is based on the proposition that inputs are divisible in the sense that even a small holder can use them profitably proportionate to his size. Therefore, the use of combination of water, improved varieties of seeds, fertiliser and insecticides does not discriminate between small and large holders of land.

In the light of the above observations, it is necessary to examine the available literature and studies made regarding



the distribution of gains between small and large farmers in the context of technological change.

We shall first review the studies concluding that the new technology is 'scale neutral' and to that extent it is not biased against the small land holders.

Those who hold the above view argue that the proportion of irrigated area is higher on smaller size of farms and since HYV technique is very much associated with assured water supply, relatively speaking small farmers are in a better position to take advantage of the new technology. They further argue that the farm management studies conducted in 50's and 60's reveal that in per acre productivity is larger on the small farms. It would be more revealing to review a few important studies in this respect.

B. Sen <sup>9</sup> argues that the new technology offers better opportunities to small farmers\* in improving their economic conditions.

Data in Table 3.3 have been derived by combining and averaging sixteenth and seventeenth rounds estimates of the National Sample Survey.

Column 4 of Table 3.3 shows that size group II is the largest single group that has irrigation. This group with 2.64

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<sup>9</sup> B.Sen, "Opportunities in the Green Revolution," Economic and Political Weekly, Vol.V, No.13, March 28, 1970, pp.A33-40.

\* The farmers in the size-group of 1 to 5 acres with an average of 2.68 acres per farm are considered as small farmers.

Table 3.3: Distribution of Gains from New Technology

Size group (acres)	No. of farms (*000)	Area ope- rated (000 acres)	Average size of farms (acres)	No. of farms with irri- gation (*000)	Average irrigated per farm with ir- rigation (acres)	Ratio of irri- gated acreage per farm with irrigation to average size of holding ( $\frac{\text{Col.5}}{\text{Col.3}}$ ) (6)
	(1)	(2)	(3)	(4)	(5)	(6)
I. 0 - 1	9,124	4,245	0.46	3,460	0.41	0.89
II. 1 - 5	22,017	58,151	2.64	10,532	1.68	0.63
III. 5 - 10	9,661	66,647	6.89	4,601	3.75	0.54
IV. 10 - 15	3,892	45,986	11.81	1,787	5.49	0.46
V. 15 - 25	2,967	55,069	18.56	1,348	7.39	0.39
VI. 25 - 50	1,788	58,794	32.88	787	9.86	0.29
VII. 50 & above	525	38,979	74.24	204	16.65	0.22
<b>Total</b>	<b>49,975</b>	<b>3,27,873</b>	<b>6.56</b>	<b>22,725</b>		

Source : B. Sen, " Opportunities in the Green Revolution",  
Economic and Political Weekly, Vol. V. No.13, March 28, 1970, pp A-33-40.

acres per farm on an average, constitutes 46 per cent of the farmers who have irrigation facilities.

By combining size group II with that of size group I, he shows that about 61 per cent of the potential beneficiaries are small farmers.

He distinguishes between (i) absolute advantage and (ii) relative advantage. Estimation of size of absolute difference is given in column 5.

Relative gain is measured as the ratio of irrigated acreage held per beneficiary farm (column 5) to the average area held per farm in each size group (column 3) multiplied by 100 gives the percentage rate by which relative income per farm should increase. Hence the relative gain per farm declines as one moves from small to large farms. The important conclusion, he arrives at is that the percentage increase in per farm income is likely to be the largest for the small farms.

The findings of Sen with the help of aggregate data at national level is supported by another study<sup>10</sup> with the help of data from individual farmers at micro level in Thanjavur (Tamil Nadu).

The study points out that the small farmers (cultivating less than 5 acres) do not lag very much behind the large farmers. It is also pointed out that the share of the small farmers in the

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10 C. Muthiah, "Green Revolution - Participation by Small Versus Large Farmers," Indian Journal of Agricultural Economics, Vol. XXVI, No. 1, January-March, 1971, pp. 53-56.

total HYV acreage has been more than their corresponding share in the total cultivated acreage. Hence the study concludes that the HYV programme may be considered as an important tool to improve the economic conditions of the small farmers.

Another study<sup>11</sup> conducted in the same district (Thanjavur) which analysed the distribution of benefits between small and large farmers in the context of new technology concluded that the small farmers (2.5 to 5.0 acres) and the very large farmers (20 acres and above) had gained almost equally (21.7 and 22.3 per cent respectively).

Venkatapphia, while evaluating the studies made by Programme Evaluation Organisation remarks that the small holders readily participate in the programme though in some cases, they may lag by a season.

From the review of the above studies it appears that the new technology is not necessarily unfavourable to small land holders, in fact a few studies indicate that the relative gains from the adoption of the new technology is larger in the case of small land holders.

We shall now review a few important studies arriving at contrary opinion that the new technology without any doubt is biased against the small farmers and that to that extent the type of technological change that the Indian agriculture is

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11 Geoffrey Swenson, "The Distribution of Benefits from Increased Production in Thanjavur District, South India," Indian Journal of Agricultural Economics, Vol. XXXI, No. 1, January-March, 1976.

experiencing would heighten the income disparities between the rural households.

Pranab Bhattacharya and Abdul Majid (Jr.)<sup>12</sup> examined the differential impact of the green revolution on small and large farms. Their study reveals the comparative differences in output between small and large farmers of Punjab. The reference period of the study was agricultural year 1972-73. Out of the 12 districts of Punjab, they selected one village from each district. Small farmers were defined as those with holdings upto seven acres and those with more than ten acres as large farmers.

Table 3.4 shows that in all major crops large farms enjoy

Table 3.4: Yield per Acre of Different Crops

Categories	Wheat HYV	Gram	Paddy	Maize	Cotton
Small farms (quintals per acre)	8.57	3.80	9.16	5.62	3.82
Big farms (quintals per acre)	10.01	5.07	12.88	6.32	4.45
Difference (percentage)	14.38	25.04	28.88	11.07	14.15

12 Pranab Bhattacharya and Abdul Majid (Jr.), "Impact of Green Revolution on Output, Cost, Income of Small and Big Farmers," Economic and Political Weekly, Review of Agriculture, December, 1976.

a higher per hectare yield. This is a significant conclusion of the study. It seems from the data that the new technology contributes to wipe out the inverse relation between farm size and yield.

Saini's<sup>13</sup> analysis of farm management data pertaining to the districts of Ferozpur in Punjab and Muzzafarnagar in Uttar Pradesh between 1955-57 and 1969-70, reveals that there was inverse relationship between farm size and income per acre in both regions in the mid-fifties.

However, he points out that owing to the technological change the inverse relationship, yielded to positive relationship in the post-green revolution period indicating that the new technology can be more efficiently adopted by the large land holders. Hence he concludes that the green revolution is likely to widen the gap between the small and large farmers.

A few other studies highlight the inherent capacity of the large farmers to take advantage of the new technology.

M. Schluter and John W. Mellor<sup>14</sup> point out that there is a significant positive relationship between adoption and farm size in most areas. They observe that either the cost of cultivation or uncertainty is responsible for the differential rates

13 G.R.Saini, "Green Revolution and Distribution of Farm Incomes," Economic and Political Weekly, Review of Agriculture March, 1976.

14 M. Schluter and John W. Mellor, "New Seed Varieties and the Small Farm," Economic and Political Weekly, Vol.VII, March, 25, 1972.

of adoption between farm size groups. Between credit and uncertainty, they observe that the latter appears to be critical constraint in the adoption of new technology among small farmers.

The discussion reviewing the seminar papers<sup>15</sup> on economic aspects of HYV programme concludes, 'In so far as the success of HYV programme depends on the ready and adequate availability of credit, access to knowhow, markets, etc., and so far as these are positively related to size-holding, the HYV may benefit richer farmers to a greater extent than the poor ones.'

Another study<sup>16</sup> based on the results obtained by the Agro-Economic Research Centre, Visva Bharati - from the evaluation of HYV programme in the districts of Birbhum and Saran in West Bengal and Bihar respectively in the crop year 1969, supports the positive relationship between adoption of new technology and farm size.

A few other micro studies suggest that the small farmers could not enjoy the benefits from new technology owing to insufficient capital.

R.P. Singh<sup>17</sup> in his study of Raghunathpur Village (Azamgarh District of East Uttar Pradesh) where 66 per cent of cultivated

15 Rapporteur's Report on Economic Aspects of HYV Programme, Indian Journal of Agricultural Economics, Vol. XXIII, No. 4, October-December, 1968.

16 B.K. Chowdhury, "Disparity in Farm Income in Context of HYV," Economic and Political Weekly, Review of Agriculture, September, 1970.

17 R.P. Singh, Socio-Economic Survey of a Village in East U.P., Agro-Economic Research Centre, University of Allahabad, (Mimeographed).

area was irrigated, observed that despite the introduction of new technology, and more availability of improved wheat varieties, the farmers were growing more barely than wheat. This was mainly due to their poor economic base which did not permit them to make use of costly seeds, fertilisers and other inputs - which affected their cropping pattern.

Chauhan and Mundle,<sup>18</sup> on the basis of their study in Sangli District of Maharashtra argue that neither the improvements in the managerial ability and skills nor the new high yielding farming technology is capable of making small farm viable. They conclude that credit in combination with new technology could bring about a significant improvement in their economic position.

Another study<sup>19</sup> shows similar views. It is pointed out that small farmers could not exploit the opportunities offered by the green revolution due to lack of capital and their lower risk bearing capacity.

Another study<sup>20</sup> conducted in Ludhiana district concludes that after the introduction of new technology small farmers

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18 K.K.S.Chauhan, and S.Mundle, Possibilities of Increasing Farm Income on Small Farms, Seminar Series, XII, Indian Society of Agricultural Economics, 1974.

19 Rajendra M. Chakrabarty, 'Some Limiting Factors to an Agricultural Revolution,' Paper read at Indian Economic Conference, Gauhati, 1970, Popular Prakashan, Bombay.

20 A.S.Kahlon and Tilak Kumar, "Differences in Form and Intensity of Input Mixed Yield Levels on Small and Large Farm Organisation in the I.A.D.P. District, Ludhiana, A Case Study," Indian Journal of Agricultural Economics, January-March, 1968.



are placed relatively in a disadvantageous position in the factor as well as product markets.

Wolf Ladejnisky<sup>21</sup> points out that the real sharing of benefits of the new technology may be restricted to 10 or at the most 20 per cent of the farm households in Punjab. It is also pointed out that the new seeds can be used by, at most 1 in 12 Indian farmers because the other 11 may need institutional credit and necessary inputs.<sup>22</sup>

C.H.Hanumantha Rao<sup>23</sup> argues that the new technology may be size-neutral but it is not resource-neutral. Despite technological change a relative deterioration in the economic gains of the bottom 20 per cent who hold 10 acres or less, in Ludhiana has been observed by Francine Frankel.<sup>24</sup>

There are also a few studies which show that small farmers are met with adequate credit for the adoption of the new technology.

21 Wolf Ladejnisky, "The Green Revolution in Punjab: A Field Trip," Economic and Political Weekly, June, 1969.

22 Michael Lipton, "India's Agricultural Performance, Achievements, Distortions and Ideologies," Reproduced in Comparative Experience of Agricultural Development in Developing Countries of Asia and the South-East since World War II, Papers and Proceedings of International Seminar held at New Delhi, October 25-28, 1974, The Indian Society of Agricultural Economics.

23 C.H.Hanumantha Rao, op.cit.,

24 Francine Frankel, India's Green Revolution, Economic Gains and Political Costs, Princeton University Press, 1971.

B.M.Desai and D.K.Desai<sup>25</sup> point out that the existing availability of working capital including credit is not inadequate for the small farmers to meet the requirements of technological changes.

They conclude that with proper understanding of the developmental role and efficient credit allocation, much could be achieved even in the existing resources of institutional credit.

A recent study<sup>26</sup> on financing small and marginal farmers by co-operative societies in Maharashtra reports, 'There is little evidence to suggest that very small and small farmers do not receive their due share in the total short term credit dispensed through the co-operative credit structure. In fact they seem to receive more than their due share in comparison with medium and large farmers.'

From the foregoing discussion it appears that there are divergent views on whether adequate credit to small farmers, to take advantage of the new technology, flows or not. Nevertheless, perhaps it would not be entirely wrong to conclude from a large number of evidence provided - that due to very low risk bearing capacity of the small farmers in the face of

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25 B.M.Desai and D.K.Desai, "Is Inadequacy of Institutional Credit a Problem in Changing Agriculture," Economic and Political Weekly, Review of Agriculture, September, 1970.

26 Maharashtra State Co-operative Bank: Report of the Committee under the Chairmanship of Prof.V.M.Dandekar on Financing Small and Marginal Farmers through Cooperative Credit Structure, Bombay, 1976.

uncertainty in crop production, there is the incidence of 'internal and external capital rationing' and this in its turn comes in the way of small farmers utilising the required amount of working capital for the adoption of the new technology.

In order to have a further insight into the problems whether small landholders are biased against new technology or not, it is necessary to further examine the two facets of the new technology, viz. (a) Biological-Chemical Techniques (use of HYVs, fertilisers and insecticides), (b) Mechanisation (use of pump sets, tractors, drillers, reapers, threshers, harvest combines etc.).

One feature common to both technique is the requirement of increased investment. However, the investment requirement of Bio-Chemical Technique is relatively lesser than that of mechanical and it is more or less confined to the use of working capital.

Therefore so far as first facet of the new technique is concerned, apparently it seems to be scale neutral. However, even here as mentioned earlier, sometime the internal and external capital rationing come in the way of small farmers adequately fulfilling the working capital needs.

So far as the other facet (mechanisation) of the new technology is concerned, it certainly is not scale neutral as it needs considerable amount of investible surplus for which the larger farmers are favourably placed compared to their smaller counterparts.

Hence, the very requirement of capital in carrying out the new technology appears to have tilted the balance against small farmers.

With inadequate availability of working capital and negligible investible surplus these farmers find it extremely difficult to adopt the new technology of production.

Large farmers on the other hand with their better command over resources and greater risk-bearing capacity seem to be placed in a better position vis-a-vis small farmers.

Hence it seems compared to small farmers, large farmers stand to gain more from the advent of the new technology.

However, the debate on the relative gains to small and large holders due to the introduction of new technology in foodgrains production is still inconclusive and the question is still open for discussion.

Section 3New Technology - Distribution of Gains between  
Agricultural Labourers and Lendowners

From the earlier discussion we understand that the introduction of new technology appears to have resulted in an increase of foodgrains production in a few selected regions.

The seed fertiliser revolution seems to have increased the demand for labour inputs especially during peak seasons and particularly in high growth pockets. It is argued that this situation has given rise to a shortage of labour during peak periods and consequent rise in wages during those periods. Therefore a few have expressed their concern that in the long run, it may lead to widespread introduction of labour-displacing machines and finally retard employment opportunities in a labour abundant economy like ours.

However, on the other hand it is also argued that - though the new technology has led to some increase in employment, it has not led to a simultaneous increase in money wages in all the regions. It is further argued by some that despite an increase in demand for labour inputs, real wages have either remained constant or declined in most of the states. In the light of the above observations, we shall first examine the studies which bring out the results that agricultural labourers have benefited as a result of the introduction of new technology.

Martin H. Billings and Arjan Singh<sup>27</sup> studied the impact of the use of different mechanical appliances on demand for labour - high yielding varieties without mechanisation vis-a-vis traditional varieties and also HYV with pump sets, threshers, corn shellers, tractors and reapers.

Their study reveals that the demand for labour diminishes only when threshers, tractors and reapers are successively introduced. The HYVs appear to have increased the demand for labour inputs by 6 per cent in Punjab in 1968-69 over the traditional varieties. However, the introduction of machines like pump sets, threshers and tractors reduced the demand for human energy by 4 per cent, 5 per cent and 1 per cent respectively in Punjab. They point out that in the long run there is a likelihood of deterioration in the employment position.

S. S. Acharya<sup>28</sup> observes that the new technology is certainly labour absorbing, despite the use of electric pump sets and tractors. His study reveals that the use of tractors have decreased labour employment by 50 per cent. However, by tending high yielding varieties on an area of 35 per cent of the acreage combined with a similar degree of intensity of cultivation may result in a net 14 per cent increase in labour demand compared to non-mechanised, non-participant farms.

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27 Martin H. Billings and Arjan Singh, "The Labour and Green Revolution: The Experience of Punjab," Economic and Political Weekly, December, 1969.

28 S.S.Acharya, "Green Revolution and Farm Employment," Indian Journal of Agricultural Economics, July-September, 1973.

However, it is to be noted that the introduction of more sophisticated labour-saving equipment like combine-harvester is likely to displace labour inputs.

The study of Agro-Economic Research Centre in West Godavari district in kharif paddy (1968-69) also shows that the participants used 66 man days per acre for IR-8 paddy while they used only 55 days for traditional varieties.

Another study<sup>29</sup> indicates that the installation of pump sets and tube wells create demand for casual labour and replace permanent servants, whereas tractors create demand for permanent servants and replace casual labour. It is also observed<sup>30</sup> that tractorisation replaces only animal labour.

R.K.Lahiri<sup>31</sup> examined the impact of HYVP on labour market with the help of data available from Farm Management Studies and Programme Evaluation Organisation. He compared the labour requirements for paddy and wheat in the pre and post-green revolution periods in selected states. He concluded that in both crops there was significant rise in the demand for hired labour in the post-green revolution period.

29 Ashok Rudra, "Employment Pattern in Large Scale Farms of Punjab," Economic and Political Weekly, Vol.IV, No.52, December, 27, 1971.

30 A.S.Kahlon, "New Farm Technology - Its Implications in Agriculture Economics," Indian Journal of Agricultural Economics, Vol.XXV, No.4, October-December, 1970.

31 R.K.Lahiri, "Impact of HYVP on Rural Labour Market," Economic and Political Weekly, Review of Agriculture, September, 1970, pp.A-111-14.

The studies mentioned above deal only with the employment aspect and seem to conclude that the introduction of the new technology leads to increase in employment.

Deepak Lal<sup>32</sup> by using the data available from 25th Round of the National Sample Survey for 1970-71 pointed out that the real agricultural wages had risen in all states as a result of the introduction of new technology except West Bengal for which no NSS data were available.

Table 3.5 gives the index numbers of real wage rates for male agricultural labourers from 1964-65 to 1970-71 as per 'Agricultural Wages in India' (AWI) and NSS data from labour enquiries.

In delineating real wage trends, it is observed that the NSS data are considered to be more reliable than AWI, because in AWI richer villages are selected and they are over-represented.

It can be noted from columns 4 and 5 of Table 3.5 that between 1956-57 and 1970-71 real wages for agricultural labourers had risen in all states except West Bengal for which NSS data were not available.

From NSS data for the period 1956-57 to 1964-65, it can be seen, that the real wages had fallen only in four states (Karnataka, Punjab, Uttar Pradesh and West Bengal).

However, in the period 1964-65 to 1970-71 (post-green revolution period) the real wages had increased in all states except Orissa.

32 Deepak Lal, "Agricultural Growth, Real Wages and the Rural Poor in India," Economic and Political Weekly, Vol. XI, No. 26, June 26, 1976.



**Table 3.5: Index Numbers of Real Wages for Male Agricultural Labourers (Base Year 1956-57 = 100)**

State (1)	AWI		NSS	
	1964-65 (2)	1970-71 (3)	1964-65 (4)	1970-71 (5)
1. Andhra Pradesh	116	139	102	136
2. Assam	74	81	101	111
3. Bihar	89	(104)	101	121
4. Gujarat	102	120	124	159
5. Kerala	121	149	118	146
6. Madhya Pradesh	93	99	106	113
7. Maharashtra	93	108	110	134
8. Karnataka	98	89	88	108
9. Orissa	128	95	110	107
10. Punjab*	103	155	77	120
11. Rajasthan	N.A.	N.A.	132	156
12. Tamil Nadu	99	109	118	162
13. Uttar Pradesh	110	175	74	149
14. West Bengal	95	89	93	N.A.

**Notes:** \* Includes Haryana.

Figure in bracket is for 1968-69 as no data for 1970-71 are available.

**Source:** Deepak Lal, "Agricultural Growth, Real Wages and Rural Poor in India," Economic and Political Weekly, Vol.XI, No.26, 26 June, 1976.

One of the limitations of his study is that he has estimated real wages for male agricultural labourers only. Female and child labour who form a considerable part among agricultural labourers are left out. The findings of Deepak Lal were questioned by A.V. Jose.<sup>33</sup> He argues that inspite of an increase in agricultural productivity and increased demand for labour, the real wages have failed to increase in most of the states except Kerala and Punjab in the post-green revolution period.

The study, Agro-Economic Research Centre in West Godavari district in kharif paddy (1968-69), examined the relative share of labour in the gross values accruing to the cultivator as a result of shift from traditional to IR-8. For this purpose they used the rabi yields of 1968-69 for traditional and IR-8 varieties. The study reveals the vast disparities in the gains between land owners and agricultural labourers.

It is evident from Table 3.6 that the excess was apportioned largely between owners of land and capital (58 per cent) in rural areas and the urban manufacturers of the non-traditional inputs (26 per cent).

The hired labour received only 7 per cent of the gains. This analysis shows the degree to which inequalities in a relative sense would be sharpened between hired labourers and land owners as a result of the introduction of new technology.

Another study<sup>34</sup> reveals the unequal factorial distribution

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33 A.V. Jose, "Real Wages, Employment and Income of Agricultural Labourers," Economic and Political Weekly, Vol. XII, No. 2, March 25, 1978.

34 Dayanantha Jha, op.cit.

**Table 3.6: Excess of Gross Value of Paddy as a Result of Shift from Traditional to IR-8 per Acre:Rs.455.39**

Excess due to	Rupees	Percentage
1. Returns to land, enterprises and capital of the farmer and own labour (of which own labour Rs.15/=)	261	58
2. Additional hired labour input	30	7
3. Input whose locus is the village farm yard manure	13	3
4. Interest	5	1
5. Fertilisers, pesticides and tractor charges	120	26
6. Miscellaneous	26	5
All figures are round off	455	100

Source: G.Parthasarathy, "Green Revolution and Weaker Sections," Occasional Paper 5, Agro-Economic Research Centre, Allahabad, 1970.

of income between land and labour in different states between 1961 and 1971.

It is evident from Table 3.7 that in all states the share of land has gone up. It shows that landowners have gained relatively large shares from new technology.

Column 6 shows the index of real wages in 1969-70. <sup>Col.5 shows that</sup> The share of labour has gone down in all states except in Haryana, Punjab and Maharashtra.

**Table 3.7: Estimated Factor Shares : 1960-61 and 1970-71 and Index of Real Wages**

State	Land*		Labour		Index of real wage in 1969-70 (1961-62=100)
	1960-61	1970-71	1960-61	1970-71	
(1)	(2)	(3)	(4)	(5)	(6)
1. Andhra Pradesh	0.397	0.465	0.451	0.407	86(f)
2. Assam	0.185	0.316	0.683	0.570	85(f)
3. Bihar	0.266	0.361	0.569	0.510	104(p)
4. Gujarat	0.330	0.381	0.574	0.539	77(f)
5. Haryana	0.339	0.395	0.516	0.530	-
6. Kerala	0.306	0.438	0.595	0.478	114(f)
7. Madhya Pradesh	0.366	0.438	0.457	0.425	82(p)
8. Maharashtra	0.387	0.425	0.441	0.453	98(f)
9. Karnataka	0.387	0.432	0.501	0.390	74(f)
10. Orissa	0.539	0.641	0.319	0.197	87(f)(a)
11. Punjab	0.380	0.384	0.430	0.489	115
12. Rajasthan	0.468	0.578	0.430	0.342	-
13. Tamil Nadu	0.331	0.396	0.497	0.443	95(p)
14. Uttar Pradesh	0.309	0.388	0.479	0.404	102(p)
15. West Bengal	0.255	0.348	0.589	0.525	88(f)(a)

**Notes:** \* Includes irrigation which is in fact land augmenting.

(a) Wage figures for Orissa and West Bengal relate to 1968-69 and 1967-68 respectively.

(p) & (f) refer to ploughman and field labourer categories respectively.

**Source:** 1) R.E.Evanson and Dayanantha Jha, "The Contribution of Agricultural Research System to Agricultural Production in India," Indian Journal of Agricultural Economics, Vol.XXVIII, No.4, October-December, 1973, pp. 212-30.

2) Absolute wage rates data were taken from C.H. Hanumantha Rao, op.cit., These have been deflated by index of all agricultural commodity prices index.

In most of the states the real wages have declined considerably in the post-green revolution period.

The real wages of the agricultural labourers however have increased considerably in Punjab and Kerala. In Bihar and Uttar Pradesh the increase is negligible.

The study concludes that the unequal distribution of income between land and labour may be more due to the present agrarian structure than that of any inherent characteristic of the new technology.

From the foregoing discussion, in this section, it can be summarised that there has been an increase in the demand for labour inputs as a result of the introduction of the new technology. This might lead to an increase in the total volume of employment and thereby total income of the agricultural labour households.

However, it also appears from a few studies that despite the introduction of the new technology there has not been much improvement in the economic conditions of the agricultural labourers in most of the states except in Punjab and Kerala.

As is common, the wage rates will be determined by the demand for and supply of agricultural labourers. In those regions where agricultural households are proportionately greater and where relatively low non-agricultural operations exist, presumably, the wage rates will remain depressed. And the opposite may happen in those regions where the availability of agricultural labour households is proportionately lower and where relatively greater employment opportunities are available in non-agricultural operations.

Though we have not reviewed any literature on the money wages of the agricultural labourers, it is generally believed, that the money wage rates of agricultural labourers have increased in a number of regions in the post-green revolution period.

Even if an increase in wage rates is granted, it need not necessarily improve the general economic conditions of the agricultural labourers.

Therefore a better yardstick to measure the general economic conditions of the agricultural labourers would be the real wages which in turn is determined by a combination of variables such as (i) agricultural wage rates, (ii) the quantum of employment available per year and (iii) the price of wage goods consumed by members of the family household.

It appears from the few studies reviewed that - inspite of the introduction of the new technology, there has not been much improvement in the economic conditions of the agricultural labourers in most states except Punjab and Kerala. Moreover, it appears that the gains from the new technology are more in favour of the land owners than the agricultural labourers.

## CHAPTER IV

### CONCLUSION

In the foregoing chapters an attempt has been made to review the major studies dealing with two important aspects of the impact of the new technology in Indian agriculture namely (1) production of foodgrains and (2) the distribution of gains between regions and among farming community.

An important reason for the divergent views regarding the impact of new technology on production seems to be the different data base and sensitiveness of growth rates to the selection of base year and terminal year. Different methodology used in the computation of growth rates also give varying estimates of growth rate. And these are the reasons why divergent views are expressed about the contribution of new technology in the aggregate foodgrains production.

In order to get a proper perspective into the performance of the new technology on foodgrains production, it is necessary to assess its impact from three criteria - (i) the crop which has been most successful in the HYV programme, viz. wheat, (ii) the regions in which its impact has been most felt and (iii) the period during which its real impact has been most felt. The data on foodgrain production viewed against these three criteria reveal that the impact of new technology on aggregate foodgrains production is not insignificant.

The very achievement of a secular growth rate of 2.5 per cent per annum in case of all crops over the last 25 years testifies to the positive impact of the new technology.

Among the individual food crops, the performance of wheat is quite impressive during the period of technological change.

But for the spectacular improvement in the growth rate of wheat, the overall growth rate of 2.4 per cent per annum could not have been maintained in case of foodgrains production. However, the performance of other foodgrain crops does not appear to be satisfactory during this period.

A review of the studies of the impact of new technology on distribution of gains, indicates firstly that the new technology appears to have further magnified the already existing regional disparities.

Since the applicability of new technology remains confined to water assured areas, it seems to have developed further the already developed regions.

However, it must be noted that the new technology alone is not responsible for the growing inter-regional disparities. Factors such as differences in natural and physical endowments as well as social and political factors aggravate the inter-regional disparities.

Secondly, regarding the sharing of gains of new technology as between small and large land holders, it appears that the capital intensive nature of the new technology and the low risk bearing capacity of the small farmers in the face of



uncertainty in crop production, seem to inhibit them from the adoption of new technology.

Further, there is evidence of internal and external rationing of credit and this in turn comes in the way of small farmers utilising adequate amount of working capital for the adoption of new technology.

Therefore, compared to small farmers, it appears, large farmers stand to gain more from the new technology.

However, the debate on the relative gains to small and large holders due to the introduction of new technology in foodgrains production is still inconclusive and the question is still open for discussion.

The seed-fertiliser technology, it appears, increases the demand for labour inputs and thereby leads to an increase in employment and wages of agricultural labourers. But this increase in wages does not seem to improve their economic conditions when viewed in terms of real wages excepting in Punjab and Kerala.

Further the gains from new technology appear to have been more in favour of land owners than the agricultural labourers.

Although the new technology appears to have made a fairly favourable impact on the production of foodgrains, its indirect effect on the distribution of gains between the regions and along the farm size is highly debated.

It may be noted that just before the advent of the new

technology the country was faced with the problem of severe food shortage. So the whole objective of the agricultural development was geared to increasing foodgrains production, in order to feed the teeming millions.

Therefore, even at the cost of disparities across the region and along the farm size, the efforts at increasing foodgrains production were concentrated by and large in the high growth regions. There did not seem to be any other option left before the policy makers.

However, the problem of uneven distribution of gains can be reduced, if not eliminated, with appropriate policy decisions.

It is true that 'Green Revolution' in the sense of a dramatic break-through from the situation that existed before the revolution has not been achieved, but at the same time it cannot be denied that the technological change has made some positive contribution to the growth and development of the agricultural sector.

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