Chapter I

INTRODUCTION

In India at present about 69 per cent of her working population is engaged in agriculture. The agricultural sector contributed about 41 per cent to domestic product in 1981-82 whereas the manufacturing sector contributed only 22 per cent.¹ In each five year plan, agriculture has been given the topmost priority. In fact the large increase in production of foodgrains recorded since the mid-sixties. In spite of this fact, agriculture is still the most backward sector of the Indian economy. The main features of Indian agriculture are low productivity and backwardness. Even after forty years of independence Indian agriculture is still regarded as a gamble in monsoons. The new strategy proposes to make a new breakthrough in agricultural production in India. This technological breakthrough has brought about large changes in agricultural production of our country.
The new agricultural strategy, adopted since the mid-sixties, had helped in revolutionising Indian agriculture. The new agricultural strategy is nothing but the adoption of HYV seeds, chemical fertilizers, pesticides and insecticides, irrigation, improved machinery and implements, soil conservation, etc.; for augmenting agricultural production. The successful adoption of these components of new strategy has resulted in to the increase in output.

The new agricultural technology with its HYV of seeds, chemical fertilizers and pesticides and improved agricultural practices has been in operation in our country for several years and has influenced different crops in different areas. It is also a fact that the mode of adoption of the new agricultural technology has also differed for different crops and for different areas. The growth in agricultural output comes from area and yield increases. There is no large scope for extending cultivation to new lands for the increased output and hence the major part of growth in output of all the crops taken
together would have to come from the faster rate of increase in the productivity per unit of cultivated land. This could be achieved either by taking more than one crop on the same piece of land or by increasing the productivity of each crop by adopting modern crop technology or by both. Thus, how to break the low yield equilibrium in Indian agriculture was the main object before agricultural scientists and policy-makers. A modernisation was made in early sixties through the initiation of Intensive Agricultural District Programme (IADP) in a few districts of the country. In mid-sixties, Intensive Agricultural Area Programme (IAAP) and High Yielding Varieties Programme (HYVP) were initiated in certain areas. The HYVP was directed towards increasing the productivity of land through the adoption of package of new inputs and practices.

The new strategy of agriculture is characterized by the adoption of HYV seeds, fertilizers, irrigation, pesticides, machinery etc. The differential adoption of new strategy due to differential opportunities in terms of factors
results into differential gains. In this chapter, an attempt is made to discuss the growth trends in important inputs, responsible for generating a large yield.

Improved Seeds:

In order to feed the increasing population there is a need to increase foodgrains production. HYV seeds are capable of increasing production of foodgrains. Such seeds are neutral to scale and can also be adopted by small farmers with meagre resources. The High-YieldingVarieties Programme (HYVP) was started in 1966 under the fourth plan. Its coverage rose from the meagre level of 1.88 million hectares to 15.38 million hectares in 1970-71 and further to 48 million hectares in 1981-82.3

There are inter-state differentials in the adoption of HYV seeds. Punjab, Haryana and Tamil Nadu are much ahead in adopting HYV seeds. The faster growth in the use of HYV seeds is mainly in the wheat growing states. There is wide disparity among the states in the adoption of HYV seeds. The yield of HYVs in wheat was the highest in Punjab followed by Haryana. The

4
trend of area under HYV seeds under various states reveals that a tremendous increase in percentage of area under improved seeds has been achieved in states such as Kerala, Orissa, West Bengal and Maharashtra.

The problems of HYV seeds technology are that it has a limited coverage and scope for adoption. This technology can only be successfully implemented where water and chemical fertilizers are available. It is rightly called water-HYV seeds-fertilizers technology. This technology also requires heavy investment.

Chemical Fertilizers:

The new varieties of seeds are highly responsive to chemical fertilizer. With increasing dosages of fertilizer the output from traditional varieties grows at a limited extent whereas the new varieties increase yields upto a very high level of fertilizer input. Fertilizers are a crucial input in agricultural production. This input of fertilizers helps in providing the nutrients to the soil and plant growth. As a
result productivity of agriculture is boosted up even in the short period. Fertilizers are the most important input for increasing agricultural productivity. In India consumption of fertilizers has been increasing steadily. In the days of traditional agriculture in India, the level of consumption of fertilizers has been very low. For example in 1967-68 an average farmer applied 7 kilograms of nitrogenous fertilizers per hectare, compared to an average of 153 kilograms in Japan and 373 kilograms in Nether-Lands. Since 1966-67 consumption of fertilizers has increased from 1.20 million tonnes in 1965-67 to 5.4 million tonnes in the year 1980-81. Total consumption rapidly increased with the introduction of HYVs from 1.10 million tonnes in 1966-67 to 2.84 million tonnes in 1973-74 in seven years.

Fertilizer use also depends upon the availability of factors such as irrigation, credit facilities, etc. In India, we find inter-state variations in the use of chemical fertilizers. Consumption of fertilizers is higher in Punjab, Haryana, Uttar Pradesh and Tamil Nadu where irrigation facility has increased tremendously due to the increases in investment in wells. Punjab
is using the highest dose of fertilizers per hectare of cropped area.

Thus the chemical fertilizers are helpful in increasing productivity in the presence of irrigation and assured rainfall.

Irrigation:

Irrigation is one of the most powerful constraints holding back the increase of agricultural production in India. In traditional agriculture, irrigation was recognised only for its protective role, as an insurance against drought. But with new strategy of HYV seeds and multiple cropping controlled irrigation has become a basic prerequisite for getting high yields. It is one of the fundamental factors in the adoption of new agricultural strategy. Multiple cropping, intensive and effective use of land and higher production can be achieved through irrigation. Irrigation facilities are not only helpful in increasing productivity but their availability is a pre-condition for application of other productivity increasing inputs of new
agricultural strategy. It helps in increasing production per unit of land, particularly when used in an appropriate combination with other inputs. Output per acre is higher in irrigated lands than in dry lands in India. Total gross irrigated area in India was only 22.6 million hectares in 1950-51 which increased to 30.9 million hectares in 1965-66 and further to 55 million hectares in 1980-81. For the country as a whole, the proportion of gross irrigated area as per cent of gross sown area has increased from 19.3 per cent in 1965-66 to 31.8 per cent in 1980-81. Irrigation from wells has increased at a much faster rate between 1965-66 and 1980-81. The mode of irrigation also differs from state to state. Canals, tanks and wells are the main sources of irrigation in the state. It is found that wells irrigated, more than 50 per cent of net area irrigated in Gujarat, Maharashtra, Punjab, Rajasthan and Utter Pradesh. On the other hand, more than 50 per cent of irrigated area in Assam, Haryana, Jammu and Kashmir and Orissa is irrigated from canals. The irrigation facilities have been responsible for inter-state variations in agricultural productivity.
and output. It has been estimated that about 54 per cent of variation in agricultural output between regions is associated with differences in irrigation facilities alone. This indicates the need of creating a balanced irrigation development in the various states in order to reduce productivity and output variation across the states. Most of the successful green revolution areas of India were known for their developed canal irrigation system. Irrigation is a precondition for the successful introduction of the productivity increasing new varieties of seeds and application of fertilizers. In the alliance of which, application of these inputs may not bring a big break-through in agricultural productivity. In India, there is considerable scope for increasing the total area under irrigation and for a more efficient and less wasteful system of water distribution.
Mechanization:

Introduction of HYV along with adequate water and chemical fertilizers has made possible a large harvest and multiple cropping. These improved seeds can show their production potential if all the operations of farming are conducted at the proper time. All the operations performed with human and animal energy, are not satisfactory and can not be finished in time. Therefore, the object of timely farm operations can be achieved by using improved farm machinery and implements. For timely ploughing tractors are more reliable than bullocks. Bullocks serve many functions in a traditional agriculture. They are used for ploughing, harvesting, transport and water lifting. During the pre-new technology period the bullock was the main source of energy in Indian agriculture. Tractor can be used mainly for three kinds of operations, ploughing, threshing and transport, and in all these operations the tractor replaces both bullock power and human power. Tractor
ploughing is easier in fields with thick weed growth and heavy soil and particularly in dry season when the soil is too hard for the bullocks. Cultivation of the HYV crops during the dry season is also an important factor contributing for use of tractors. The use of tractors also saves the trouble of managing bullocks in muddy fields. The tractor is also used as a mean of transport for carrying fertilizer, seeds, crops and people. A study on tractor utilization by Parthasarathy and Abraham, supports the view that tractor technology is less expensive, despite its capital intensive nature from the points of view of large farmers. A large number of studies, especially in Punjab, show the tractor farms as having a higher level of cropping intensity than the bullock farms. The scope for mechanization in agriculture is limited in India because of the very small size of the holding. Before the fifties there were no significant use of machines in Indian agriculture. The important machines used are tractors, electric pump-sets and oil engines. Use of these machines has been increasing rapidly since 1966.
In India the growth in mechanical inputs in farming practices is very low. However, since the introduction of commercial agriculture farmers are adopting it on an increasing scale. The growth of mechanization is high in Punjab, Haryana, Uttar Pradesh, Andhra Pradesh and Tamil Nadu. Mechanized irrigation offers an opportunity for reducing risk by ensuring timely supply of water. It also makes possible and profitable to practice multiple cropping. When the time between harvesting one crop and planting of another is very short, animal and human power are not able for finishing operations in time particularly on large farms. At this time mechanization contributes to meeting these peak power needs. The sharp increase in the use of machines appeared during the Green Revolution Period. In 1951 there were only 7 tractors for one lakh hectares of gross cropped area which increased to only 34 in 1966, 213 in 1978 and 270 in 1980. The same trend has been followed by oil engines and electric pumpsets. In 1966 only 267 electric pump sets were available for one lakh hectares of gross cropped area and number increased to 1606 in 1976 and 1657 in 1980.13
Plant Protection:

Plant protection is very important in order to reduce crop losses and to improve crop yields. The nature of new agricultural strategy is such that it yields more production, albeit expensive. Therefore a cultivator does not like to lose even a part of his crop. The quick growth of plant with the use of fertilizer and irrigation has created tremendous pest and disease problem. New seed varieties are more prone to pests and diseases. Though plant protection chemicals are costly, they are profitable.

A major breakthrough in plant protection was achieved in 1949 when BHC and DDT were imported and used extensively for the control of pests. The popularity of BHC and DDT led to indigenous manufacture of BHC in 1952 and DDT in 1954. The trend since then is rising. The use of pesticides is higher in the states of Andhra Pradesh, Punjab, Haryana and Uttar Pradesh. The pesticides are mainly used to give protection and support to the HYV cereals. Its utilization can easily be extended to other crops.
Thus, the new agricultural strategy is a package approach. New high yielding varieties of seeds, fertilizers, pesticides, controlled water supply and mechanical equipments. All these agricultural inputs together form a package. Without new seeds, water and fertilizer would not achieve full potential and without pesticides their output would be highly variable and without mechanization their multiple-cropping would remain under utilized. The adoption of whole package or at least that of water-seed-fertilizer may lead to both increased productivity and production in agriculture.

In India, the share of increased productivity has been much more than that of area in the growth of agricultural production. There is no scope for extending cultivation to new lands. Therefore, for increasing total agricultural output, the productivity must be increased further by way of adopting new agricultural technology consisting of HYV seeds, water, fertilizers, pesticides, and improved farm implements. Good combination of these inputs,
when applied in agriculture, leads to increased agricultural productivity and production.

In Marathwada region of Maharashtra state, the scope for extending cultivation to new lands seems to be very limited. Therefore, in order to increase productivity and production in agriculture of this backward region of the state, we have to rely only on adoption of new strategy. It would be interesting to study the pace of adoption of this new agricultural strategy and its impact on productivity of agriculture in Marathwada. No one has so far dealt with this particular aspect of agricultural development in Marathwada for the post-1965 period. Hence, the present study is undertaken to meet this exigency and attempts to study as to what extent the farmers in the Marathwada region have acquainted with the adoption of new agricultural technology and its consequences on agricultural productivity.
Objectives of the study:

The following are the main objectives of the present study:

1. To study the pace of adoption of new agricultural technology in different districts of Marathwada region;

2. To study the pre-new technology period and post-new technology period productivity levels of major crops in different districts of Marathwada;

3. To examine the impact of new technology on productivity of certain crops in different districts of Marathwada; and

4. To suggest suitable policy measures to increase the pace of adoption of new inputs to enhance both agricultural productivity and production in Marathwada.
Research Methodology:

The present study attempts to investigate the impact of new agricultural technology on productivity of some principal crops in each district of Marathwada region. The study covers the period of thirty four years from 1951-52 to 1986-87. The crops chosen to study the impact of new technology on their productivity are rice, wheat, jowar (total), bajra, other cereals, gram, tur, other pulses, sugarcane, cotton and groundnut. In order to assess the impact of new technology the chosen period is split into two sub-periods: Period I - 1951-52 to 1964-65 (pre-green revolution period) and period II - 1967-68 to 1986-87 (i.e. post-green revolution period). The two years i.e. 1965-66 and 1966-67 are dropped for assuring the proper results. The study is absolutely based on the secondary data. The data about area, yield and production of chosen crops was collected from different sources. Statistical information regarding area, yield and production was sought from various issues of season and crop report, District Statistical Abstract of Aurangabad, Jalna, Parbhani, Beed, Nanded, Latur and Osmanabad districts and Epitome of
Agriculture of Maharashtra state. This data was collected for all the districts in Marathwada and for Maharashtra state for the selected period.

Some secondary data about soil, rainfall, population, agricultural and non-agricultural workers, irrigated area under different crops, net irrigated area, net area sown, farm implements and machinery, consumption of fertilizer was collected from the various issues of District Statistical Abstracts of Aurangabad, Jalna, Parbhani, Beed, Nanded, Latur and Osmanabad districts; Epitome of agriculture of Maharashtra state; the office of the Soil Survey Sub-Division, Aurangabad and Census Hand-Book of Maharashtra.

For studying the impact of new agricultural technology five main inputs are taken into consideration. They are: HYV seeds, chemical fertilisers, insecticides and pesticides, irrigation and mechanisation. For this purpose, district-wise data about these five inputs was collected for Marathwada region. District-wise data about HYV seeds was collected in the form of district-wise distribution of HYV seeds in Marathwada region for the period from 1961-62 to 1964-65 and from
1982-83 to 1986-87. The data about crop-wise achievement under high-yielding varieties in Marathwada region was also collected. These data was collected for the year 1975-76 and for the period from 1980-81 to 1986-87. The percentage of total area under HYV of cereals to area under total cereals is calculated. The percentage increase in area under HYV seeds in 1986-87 over 1975-76 is also calculated for each crop and for each district of Marathwada.

The district-wise data of fertilizer consumption was collected for the period from 1968-69 to 1986-87. Data is not available for 1973-74 and 1974-75. In order to study the adoption rate of fertilizers, the compound growth rates are calculated for each district of Marathwada for the period from 1968-69 to 1986-87.

The data about irrigation was collected in the form of total area irrigated in each district of Marathwada region for the period of thirty one years from 1954-55 to 1984-85. In order to assess the impact of new technology, the total period is split into two sub-periods:
period I - 1954-55 to 1964-65 (pre-green revolution period) and period II - 1965-66 to 1986-87 (i.e. post-green revolution period). For studying the growth of irrigation input, the annual compound growth rates of irrigated area are calculated for each district of Marathwada region for all three periods. The growth rates for post-green revolution period (period - II) are compared with the growth rates for pre-green revolution period (period - I) and growth of irrigation is studied. The data was also collected in the form of district-wise area irrigated under different crops in Marathwada region. This data was collected for all the crops chosen for the purpose of the present study. The compound growth rates are calculated for studying the growth in crop-wise irrigated area in different districts of Marathwada during pre- and post-green revolution periods.

The district-wise data about agricultural implements and machinery was collected from different sources for the agricultural census years from 1956 to 1983. The availability of each farm implement or machinery
for one thousand hectares of gross cropped area is calculated for each district of Marathwada during each agricultural census year. This would help in studying the growth in the availability of agricultural machinery in different districts of Marathwada over time as well as the inter-district variation in use of these implements.

The data about plant protection was collected in the form of district-wise distribution of chemical pesticides in Marathwada region. This data was collected from statistical abstract of Bombay State, Bureau of Economics and Statistics, Government of Bombay, and from the Office of the Superintendent of Agriculture, Divisional Office, Aurangabad. The technique of percentage is used to study the growth in the consumption of pesticides in different districts of Marathwada. The percentage increases in pesticides consumption in 1986-87 over 1967-68 are calculated.

Above data was collected from various sources i.e. District Statistical Abstracts of Aurangabad, Jalna, Parbhani, Beed, Nanded, Latur and Osmanabad districts, Epitome of agriculture of
Maharashtra state, Annual Report of the Fertiliser Association of India, the office of the Divisional Statistical Officer Aurangabad, the office of the Superintendent, of Agriculture Divisional Office Aurangabad, the office of the Director of Agriculture, Poona, the office of the Maharashtra Agricultural Industries Development Corporation (MAIDC), etc.

In order to study the objectives of the present study, different statistical tools have been used for analysing the data. In order to study the inter-district disparity in respect of soils, irrigation, crop pattern and population, the technique of percentage is used and table method is adopted. For studying the impact of new technology, the compound annual growth rates of area, production and yield are calculated for each crop and for each district of Marathwada region for three periods; Period-I - 1951-52 to 1964-65, Period-II - 1967-68 to 1986-87 and Period-III - 1951-52 to 1986-87. The growth rates for post-green revolution period (Period II) are compared with the growth rates for pre-green revolution period (period-I) and impact of new technology is assured. The compound growth rates of area, yield and production of principal crops are also calculated for
Maharashtra state and then compared with Marathwada. The compound growth rates of area, production and yield of selected crops in different districts of Marathwada have been calculated by the exponential function of the form:

\[ Y = AB^x \]

\[ r = (B-1) \times 100 \text{ (in percentage)} \]

The standard error of the growth rate \( r \) is:

\[
SE(r) = \frac{100B}{e^{\left(\frac{\sum \log Y - (\sum \log Y) - (\log Y)^2}{\sum X - \frac{1}{10} \sum Y} \right) N}}
\]

\[
(N-2) \sum X
\]

Where,

\( Y \) = Area/Yield/Production

\( A \) = Constant

\( B \) = 1 + r

\( r \) = Compound Growth Rate (CGR)

\( N \) = Number of Observations.

\[ \log_{10} e = 0.43429 \]

For studying the impact of main components of new agricultural technology (i.e. HYV seeds, fertilisers, plant protection, irrigation and mechanisation) on productivity of certain crops, the growth rates of these components are calculated in each district of Marathwada region. The above formula is used to calculate these compound growth rates. The technique of
rank correlation co-efficient is used to assess the impact of technology variables on production and productivity of cereals, pulses and total foodgrains.

Scheme of Chapters:

The thesis is divided into seven chapters.

The first chapter deals with the importance of the study. The objectives of the study, methodology adopted to study them and the scheme of chapters are also given in this introductory chapter.

The agricultural economy of Marathwada region is posed in the second chapter. In this chapter the aspects like topographical features, rivers, quality of soil, rainfall, size of land-holding, population, cropping-pattern, irrigation, farm implements and machinery etc. are discussed. The district-wise discussion of all these aspects clearly indicates the nature of agricultural economy of Marathwada.

The third chapter deals with the review of literature on the issues considered in the present study. In the present study, it is aimed to study the impact of new agricultural technology on productivity. Available literature indicated that the rate of adoption of the new technology has differed for
different crops and different areas. It is also pointed out that due to adoption of new technology the yield has increased substantially. So the related important past research work and the findings drawn in them have been reviewed in this chapter.

The fourth chapter is devoted to compare the growth in production and productivity of some principal crops in Marathwada with the growth profile of these crops at the Maharashtra state level.

The fifth chapter is devoted to discuss the growth performance of important crops in Marathwada during the pre- and post-green revolution periods. The crop-wise analysis of growth in production and productivity of certain principal crops is made. The crops that are considered for the said purpose are: rice, wheat, jowar, bajra, other cereals, gram, tur, other pulses, sugarcane, cotton and groundnut.

The sixth chapter is devoted to discuss the pace of adoption of new agricultural technology in Marathwada. The modern inputs considered in this chapter are: HYV seeds, chemical fertilisers, plant protection, irrigation and mechanisation. The growth trends in these important inputs are studied.
The seventh and the final chapter summarises the findings of the present study and suggests suitable policy measures to promote the adoption of new inputs for augmenting production and productivity in Marathwada agriculture.

References:

1. Sadhu, A.N. and Mahajan, R.K.:


3. Report:

4. Das Gupta, Biplab:
5. Sadhu A. N. and Mahajan R.K. :

6. Das Gupta, Biplab :

7. Report :

8. Sadhu, A.N. and Mahajan R.K. :

9. Ibid.

10. Ibid.

11. Das Gupta, Biplab :

12. Ibid.
13. Wolf Ladejinsky:

"The Green Revolution in Punjab: A Field Trip",
Economic and Political Weekly, June 28, 1969.

14. Sadhu, A.N. and Mahajan R.K.:

"Technological Change and Agricultural Development in India",

15. Ibid.