CHAPTER - I

INTRODUCTION

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INTRODUCTION

[1.1] RATIONALE OF THE CHOICE OF SUBJECT -

Agriculture has been and will continue to be the lifeline of the Indian economy, since economic security is essentially based upon the agricultural sector. Even today agriculture supports 65 percent of population. It has 24 percent share in G.D.P., and has a share of about 13 percent in the national exports.

Prior to 1950's agriculture in India was very much primitive in nature. After the green revolution, and the advent of new agricultural technology, the whole scenario has changed.

Before 5-6 decades, all implements used in agriculture were age old and primitive. Most of the agricultural operations were performed by human and cattle labour in all parts of the country. The traditional implements used were wooden plough, spades, pickaxe etc. For the purpose of irrigation, big size leather buckets were used which were pulled by bullocks. Local variety seeds were saved and used from generation to generation. The farm draught power depended upon bullocks only.

After independence man and cattle driven agricultural operations were slowly replaced by diesel and electricity driven machines. During the period of 1960s agricultural mechanization, research and education was given a priority by the government. The new ideas were also welcomed by few progressive farmers. Old wooden ploughs and cultivators were replaced by iron ploughs and tractors.
Big size irrigation leather buckets were replaced by electrical and diesel driven water pump sets. These modernized agricultural practices were adopted by farmers who had adequate resources and were financially helped and patronized by various subsidies and concessions offered by the Central and State governments.

Post 1970's rural electrification and canal network have covered considerable agricultural area. In some of the progressive states like Punjab, Haryana, Karnataka, Maharashtra complete rural electrification has been done. Therefore use of diesel engines in farms has been left behind in Maharashtra.

In the real terms the adoption and the spread of modern technology and its components like mechanization, H.Y.V. seeds, chemical fertilizers, pesticides has attracted farmers by its competing efficiency and relative low overhead costs.

Another epoch making and very significant revolution has simultaneously taken place in the field of agricultural technology which played a complimentary role to the farmers' efforts, that is the planned efforts of government in the field of agricultural research education and irrigation. All India coordinated research programmes were launched. High yielding variety of seeds were already put into experiment on pilot basis. All India coordinated pulses and Cereals improvement programmes had shown good results. The agricultural sector of India started showing impressive performance. The growth in production and productivity have been particularly significant in cereals, oil seeds, rice and cotton. For example the production of cereals increased from 69.3 million tonnes during 1960-61 to 198.8
million tonnes during 2001-02. Similarly the yield per hectare of cereals increased from 753 kg per hectare during 1960-61 to 1983 Kg per hectare during 2001-02. It means that agricultural research has played a crucial role in achieving this performance. Since the green revolution, a large number of seed varieties have been developed during last four decades.

Indian agriculture has made a tremendous and significant progress during the last five decades. Top priority has been given to agricultural sector right from the First five year plan. As a result the country has achieved self sufficiency in availability of food grains even though the population has grown to almost three times since 1950. The country experienced a rapid growth in agriculture since mid sixties. States like Punjab, Haryana, Gujarat, Tamil Nadu, Karnataka Andhra and Maharashtra have achieved significant progress by adopting new agricultural technology, Inspite of this fact agriculture has been still backward in many parts of the country viz. Orissa, part of Bihar, Marathwada region in Maharashta etc. The rate of development also differed from State to State. This was mainly because of greater dependence upon rainfall. The rain is unevenly distributed all over the country. Rainfed dry land constitute 60 percent of the total cultivated area in the country. Lack of assured irrigation facilities deters agricultural production and restricts the possibility of double or multiple cropping. This results in low productivity, and consequently poverty among the farmers in rural areas.
PHASES OF AGRICULTURAL DEVELOPMENT IN INDIA -

In fact performance of Indian agriculture could be described in the following three phases.

a) FIRST PHASE - The first phase was pre-green revolution period up to mid sixties. During this phase development of irrigation, land reforms, community development and restructuring of rural credit institutions, received high priority. Despite major achievements in these spheres the growth of food grains was not sufficient to meet the needs of growing population.

Compared with other developing countries a need was felt to achieve a quantum jump in the productivity of land through the adoption of high yielding variety of seeds and greater use of Chemical Fertilizers and crop protection measures under irrigated conditions.

b) SECOND PHASE - In the second phase therefore green revolution was launched in the mid sixties. In the beginning about 10-15 years the green revolution was confined largely to well endowed regions of the country, covering crops like wheat, rice etc. During 1980s green revolution became more widespread regionally. Consequently there was a tremendous growth in the amount and usage of inputs like H.Y.V. seeds, pesticides, chemical fertilizers, and mechanization in agriculture.

Indian agriculture experienced a spectacular and highly significant growth in the yields of crops per hectare. Production of all food grains (total)
which was only 82 million tonnes during 1960-61 increased up to 208.9 million tonnes in 1999-2000 (Economic Survey of India 2000-01). Simultaneously increase was registered in the productivity of all inputs or total factor productivity consumption of fertilizers increased from 55.16 lakh metric tonnes in 1980-81 to 180.69 lakh metric tonnes. Production of High Yielding Variety seeds which was 5929 metric tonnes in 1990-91 increased up to 8798 metric tonnes in 1999-2000. Consumption of pesticides also increased from 8650 metric tonnes to 46200 metric tonnes during the same years.

Due to rise in production and productivity there was increase in Income and Employment in agricultural sector, in general.

There had been a shift in work-force in agricultural sector from 64.8 percent in 1991 to 58.4 percent in 2000. This shows that even though the workforce was reduced the production continued to increase. In other words productivity of labour in agriculture increased and new opportunities of self employment were created by the use of new technology, in rural areas.

c) **Third Phase** - Per capita growth rate which was 1.23 in 1980s jumped to 3.06 in 1990s. It further increased to 3.99 percent but at very slow rate in 1999-2000 ("State of Indian Farmer" by G.S. Bhalla. Volume 19 Page 302 GOI Pub. 2004). Following the implementation of macro-economic reforms in the country in 1990s, Indian agriculture has now entered in the third phase of globalization and diversification.
However after 1990s Public investment in agricultural sector continued to decline due to heavy rise in subsidies etc. This had an adverse effect on development of rural infrastructure especially irrigation, agricultural research, and extension. This has slowed down the growth rate in agricultural production, on account of declining input use, factor productivity and profitability during the post reform period.

Still there has been major transformation of farming from the traditional to modern, which has benefited millions of farmers in the country.

Indian farmers have become very conscious of science and technology. They have participated in the green revolution fully and present achievements are the best results of it. Indian farmers today have entered the new era of globalization.

**NEED**

Therefore with the intent to very whether the farmers in Ahmednagar districts have become science and technology concious and whether they have achieved progress in agriculture as it happened in case of the country as a whole. Further to compare the achievements of farmers in Ahmednagar district, with national as well as state achievements as need was felt to under take this study.

This is an empirical and analytical study for measuring economic impact of technological change on agricultural development in a drought prone area like
Ahmednagar. Ahmednagar district where the technology and implements are owned and used by a single household of individual farmers.

Because of the financial constraints and partly because of the introduction of new economic policies of liberalization globalization and privatization, Indian Government, hence forth will not be able and interested to make more public investments in agricultural sector.

Therefore the technology and the production methods used by farms will depend entirely on their own. But if the tempo of production, productivity and cropping intensity is to be maintained in future, the modern technology becomes indispensable.

Hybrid technology has a high potential to increase productivity, resistance of various biotic and abiotic stresses and quality in the field of agriculture and other related with agriculture. Though 60 percent farming in India has to depend upon rainfall, the new agricultural technology has been very helpful to them to use water rationally which is very significant.

The present study clearly brings out that the use of modern technology became inevitable measure to transform rainfed and subsistence agriculture into productivity efficient and highly commercialized agriculture.

The study of economic impact of technological change on agricultural development at regional or district level becomes absolutely essential and useful for deciding present and future agricultural policies, and research in the country.
As suggested by C. Hanumantha Rao¹ "It would be useful if the analysis of regional variations in the distribution of gains could be conducted for each state by treating the district as unit of observation, because a district is usually far more homogeneous than a state".

Therefore, it was on this background, the present study was thought to be necessary and logical. It is an empirical study to assess the economic impact of new technology on agricultural development in Ahmednagar district.

[1.2] **OBJECTIVE OF THE STUDY:**

The study was undertaken with the following main objectives which are consistent with the parameters applied:

1. To study adoption level of new technology. Technology adoption index is used to measure level of adoption.

2. To study resource use efficiency. Where gross output per acre (productivity) is a crude general index of measuring efficiency at farm level.

3. To study farm employment and returns to scale. Owned labour and hired labour is studied in mandays per acre.

4. To study area under cash crops. Comparison between area under conventional crops and cash crops is made.

To study farm income distribution. Income from agricultural sources and non-agricultural sources like selling milk, trading or hiring out wages is studied.

**HYPOTHESIS** -

Development and adoption of modern agricultural techniques, particularly after the decades of green revolution has lead to the use of modern High Yielding Variety of seeds, mechanization, integrated pest management, chemical fertilizers, irrigation, rural electrification, drought sustaining variety of crops which has been instrumental in making India self sustainable and surplus in food grains by increments in production and productivity in general and that of Ahmednagar district in particular, which helped the farmers to achieve economic development.

Ahmednagar is the largest district in Maharashtra having 14 talukas and a geographical area of about 17048 Square Kilometers. According to the census 2001 its total population was 40,88,077 out of which rural population was 32,84,480. Thus 80 percent population of the district was rural. The district is not industrially developed, therefore large portion of population depends upon agriculture for their livelihood.

The district had been declared as drought prone area by 'Sukhtankar Committee' in 1973. But farmers in Ahmednagar district have been very progressive and adopted new agricultural technology for more than three decades. This gave a positive economic impact on the house hold economy of the farmers,
as the production and productivity increased. Moreover they have been able to increase their non-farm income significantly during the last decade. Main source of non-farm income is production of milk.

Consequently, the under employment and disguised unemployment among the farmers decreased to a greater extent.

This hypothesis has been dealt with all along the study and tested properly and scientifically for arriving at the conclusions.

[1.4] **ECONOMIC IMPACT PARAMETERS**

As this study aims at measuring economic impact, the following parameters were applied to test the hypothesis.

1. Improvement in productivity of farms.
2. Improvement in employment.
3. Shift towards higher remunerative crops.
4. Increase in income of farmers.
5. Adoption level of new technology.

As a criterion, positive answers to these parameters indicate economic development in the region concerned.

These parameters have been used by several researchers to assess the economic impact of various agricultural schemes launched by government. For example, The National Watershed Development Project For Rainfed Areas (NWDPRA) was initiated in the Seventh Five Year Plan Period, covering 99 districts in 21 states and two Union Territories. The Central Government team
comprising R.S. Deshpande and Narayanmurthy in 1999 analysed the said project across the country. The above said parameters were successfully used by them to measure the economic impact on agricultural development of farmers under the scheme.

[1.5] RESEARCH METHODOLOGY -

Generally impact of change in technology on agriculture of any region could better be assessed after 2 - 3 decades of adoption, because, it takes some time to spread new knowledge and technique amongst the vast number of cultivators, and particularly in the developing country like India. It is since four decades i.e. since green revolution (1960-61) the Indian farmers started adopting new agricultural technology. Therefore in this study the time span of Ten years from 1991 - 2000 has been selected for assessing economic impact of change in technology.

The research methodology adopted to attain the objectives of the study has been described hereunder. The criteria for selecting sample was that various categories of farmers and also area be properly represented.

(A) SELECTION OF SAMPLES :

a) Geographical area -

Entire Ahmednagar district has been taken for study. North region of the district is irrigated and south region is rainfed.
There are 14 talukas (tehsils) in the district. To make the study more analytical and meaningful and for comparison between irrigated and rainfed regions, all 14 talukas have been divided into two groups viz. region - A irrigated and region-B non-irrigated. The region-A comprised of talukas having assured irrigation facilities, viz. Kopargaon, Rahata, Shirdi, Sangamner, Akole, Rahuri, Newasa and Shrirampur. This makes northern part of the district. While as in region-B those talukas have been included, where almost 90 percent farming is rainfed; viz. Jamkhed, Karjat, Parner, Shrigonda, Pathardi, Sheogaon and Ahmednagar taluka. This makes southern part of the district.

While selecting the sample either of the villages or of the farmers the purposive sampling method was used. The universe is very large and therefore it was felt that the purposive sampling be done carefully taking into account the new technology adopted by the farmers in the particular village.

Therefore at the first stage taluka talathis were contacted to collect primary record of farm holders from those record samples were selected purposively.

At second stage concerned village talathis and gramsevaks were contacted as it was felt that direct personal contact could be made with farmers in the villages and on farms.
The total number of villages in Ahmednagar district is 1581. Out of all these villages 2 to 4 villages have been selected from each taluka, from different regions. 22 villages from irrigated talukas and 23 villages from rainfed talukas. Thus total no. of villages is 45 means 2.85 percent villages are covered under study.

The following table shows the geographical distribution of irrigated and non-irrigated regions and number of villages selected for sampling purpose.

**TABLE NO. 1.1**

**DISTRIBUTION OF TALUKAS IN AHMEDNAGAR**

**IRRIGATED & NONIRRIGATED REGIONS**

<table>
<thead>
<tr>
<th>Irrigated Region-A</th>
<th>Non-Irrigated Region-B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Taluka</td>
<td>Number of Villages selected</td>
</tr>
<tr>
<td>---------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>Kopargoan</td>
<td>4</td>
</tr>
<tr>
<td>Rahata + Shirdi</td>
<td>3</td>
</tr>
<tr>
<td>Sangamner</td>
<td>3</td>
</tr>
<tr>
<td>Akola</td>
<td>4</td>
</tr>
<tr>
<td>Rahuri</td>
<td>4</td>
</tr>
<tr>
<td>Newasa</td>
<td>2</td>
</tr>
<tr>
<td>Shrirampur</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>22</strong></td>
</tr>
</tbody>
</table>

(Note : The list of villages is given in annexure)

b) *Farmers* -

It was also felt necessary to study the extent of economic impact of new technology on different sizes of the farms viz. small size medium size and large size. Therefore classification of sample farmers was made according to the holding
of their land. As it was found that acre as land measurement unit is commonly understood by the rural farmers, the classification was made using acre as unit.

There is no clear-cut definition of small, medium and large size farms. However the previous studies if taken into account, it will be clear that, sizes are generally according to the existing conditions and objectives laid down for the study. To cite some examples, A.N. Sadhu and R.K. Mahajan in their study titled "Technological change and agricultural development in India" which was an empirical study of technological impact on agricultural development of two district viz. Marh and Batala in Punjab in 1983 have categorised small size farms having holding of 1 to 4.99 acres, medium size as 5 to 7.49 acres and above 7.5 acres as large size farms. They had taken 150 total samples from two district (75 each).

To cite another example - Dr. Surinder Singh (Punjab University Patiala) when studied "Technological transformation in Agriculture of Rajasthan" in 1989, categorised farms as less than 10 acres as small, 10 to 20 acres as Medium and 20 to 30 acres as large farms. Likewise R.C. Rout in his study of "Impact of new agricultural technology on employment and income in Western Maharashtra" in 1997 categorized small size farms as less than 4 acres, medium size as 4 to 11 acres and large size as more than 11 acres and had 250 samples from five districts of Western Maharashtra. These past studies show that some arbitrariness is inevitable as far as size distribution and total number of sample is concerned.
In this study, therefore, farmers having holding of 2 to 3.99 acres of land are categorised as small size farms. Farmers holding 4 to 6.99 acres are categorised as medium size farms and farmers having 7 acres and more land are categorised as large size farms.

20 samples from each category of farms were purposely selected from both region-A and B. Reason behind selecting equal number of samples for each category is to make the comparison more realistic.

Percentages of sample comes to 1% of the total cultivators in Ahmednagar district. Though in terms of percentage the sample is 1% of the universe in absolute numbers it comes to 120, which fairly represents the universe.

The geographical area covered is the whole district. Hence the number of farmers selected as sample is restricted to 120. Particularly in view of the large area and the total number of farmers under study.

The following table shows the size distribution and number of samples selected.
### TABLE NO. 1.2

**DISTRIBUTION OF FARMS ACCORDING TO SIZE OF FARMS**

<table>
<thead>
<tr>
<th>Category (size)</th>
<th>Holding in Acres</th>
<th>Region - A</th>
<th>Region - B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Size</td>
<td>2 - 3.99</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Medium size</td>
<td>4 - 6.99</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Large size</td>
<td>7 - above</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>TOTAL</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
</tbody>
</table>

**(B) PRIMARY DATA COLLECTION -**

All necessary primary data were collected by using face to face interview method with the help of a comprehensive questionnaire. First the questionnaire containing simple and relevant questions regarding all aspects required for analysis was prepared and tested on few samples. After ensuring its applicability it was finalized and then administered. All questions from questionnaire were explained and asked to the individual farmers and data were collected accordingly.

**(C) SECONDARY DATA -**

Secondary data have been useful in understanding the extent of agricultural development in the country, state and Ahmednagar district. This gave a good theoretical background. All secondary data and statistical information about agriculture pertaining to past ten years ending 2000 collected. Production statistics of important crops, productivity, Various inputs of agriculture, their quantity used by the farmers before 10-15 years, and infrastructure, were collected.

Also magazines on agriculture, periodicals like Indian Journal of Agricultural Economy, Agricultural Review etc, and various past research works on this subject were referred. The information from District statistics office, Zilla Parishad Agriculture Dept. etc. was also used.

(D) ANALYSIS AND INTERPRETATION OF DATA -

All primary data collected were compiled and analyzed by using simple Tabulation method, costing techniques, etc. Simple calculations like averages etc. were made on electronic calculators. Complicated calculations like finding regression coefficient and coefficient of correlation were done by using Computer Softwares. Important statistical tests like Z-Test, t-test were applied wherever necessary. Important index numbers and ratios were worked out.
Cobb-Douglas type production function was used for economic analysis. Results of this functions for both the region-A and B and for all categories of farms were obtained using computer software.

(E) ANALYTICAL PROCEDURE -

(1) RESOURCE USE PATTERN -

Per acre input use and output produced per acre for both the regions A and B have been worked out for different size farms for the year 1999-2000, in order to know the differentials in costs and returns of both irrigated and rainfed areas.

(2) ESTIMATION OF PRODUCTION COSTS AND RETURNS -

The costs and returns from aggregate crop production activity on per acre basis and farm as a whole were estimated. The simple method of tabular analysis was followed in estimation of costs and return of individual farms.

COST CONCEPT -

Cost concepts, viz. Cost-A, Cost-B and Cost-C have been used. These concepts have been approved and prescribed by Farm Management Studies. After independence Farm Management Studies were recognized as necessary input for formulating national agricultural policies. Farm Management Studies was initiated as early as First Five Year Plan. These concepts were used in number of studies carried out by Punjab Board of Economic Inquiry, The Gokhale Institute of Politics and Economics, College of Agriculture Pune, Government Agricultural College, Kanpur etc.
Cost-A contains all paid out costs like hired labour, maintenance expenses, cost of material inputs, depreciation, land revenue etc.

Cost-B contains input costs like rental value of owned land, interest on owned capital for which the farmers do not incur any cash expenses.

Cost-C is final cost when added input value of family labour.

(3) LABOUR UTILIZATION -

Per acre per farm human labour in terms of man days were measured. The male labour day of 8 hours was considered as one man day and female labour day as 0.60 man day. Women labour are generally paid less wages and working hours are also less as compared to male labour. The bullock pairdays labour utilization for crop production was worked out for different size farms for both region-A & region-B.

The off farm employment of male and female workers was also studied. Farm employment comprises employment for crop production, Live stock production and other farm work, where as off farm employment comprises labour hired out.

(4) TECHNOLOGY ADOPTION INDEX -

Technology adoption index was prepared in order to measure the extent of use of new technology for crop production.

Two factors were considered. First the weightage was given by taking number of items adopted from the eight items (components) of new technology.
viz. new crop pattern, new Chemical Fertilizers, High Yielding Seeds, drip irrigation and sprinklers, green house, genetically modified seeds, and crop protection and mechanisation. Secondly scores were allotted to farms on the basis of proportion of area of farm covered under new technology, e.g. if complete farm area was under new technology then 1 point was given likewise if area is 3/4th then .75 point was given, and if it is half then .50 point was given and below that .25 point was given. Further multiplying these scores with weightage, index was obtained, and converted into percentages at individual farm level. Index for all categories of farms both irrigated and rainfed area was calculated. For group average the tool of geometric mean has been used. (Details of formula and calculations of technology adoption index has been given in Appendix-1).

(5) **Production Function Analysis**

Technological change is one of the major forces leading to changes in output, employment and personal income distribution. The analysis of technological change can be carried out most conveniently by the use of theory of production. The production function shows the transformation motion of a set of inputs into output. Production function can be written as follows for a group of homogeneous farms.

$$ Y = f(x_1, x_2, \ldots, x_n) $$

Where $Y$ is output of farms having input set as $x_1, x_2, \ldots, x_n$.

Evidences from many previous studies have indicated that Cobb-Douglas type is the most appropriate form of production function, since it allows diminishing,
increasing or constant returns. Further more it completely disregards the existence of the third stage of production which is characterized by negative marginal productivity.

In general form the Cobb-Douglas production function can be written as:

\[ Y = a \cdot X^{b_1} \cdot X^{b_2} \cdots X^{b_n} \]

Where 'Y' is the dependent variable, \( X_1, X_2, \ldots, X_n \) are the independent resources variables, 'a' is constant representing intercept of the production function, and \( b_1, b_2, b_n \) are the regression coefficient of the respective resource variables. The regression coefficients, so obtained are also elasticities of production, which remain constant throughout the relevant ranges of inputs and individually they indicate the percentage change in output per unit percentage change in the concerned input.

The sum of elasticities i.e. \( b_1, b_2, \ldots, b_n \) indicates the nature of returns to scale. It is a non-linear production function and becomes linear production function when the variables are transformed into logarithms.

Thus

\[ \log Y = \log a + b_1 \log X_1 + b_2 \log X_2 + \cdots + b_n \log X_n \]

In this logarithmic form function becomes easy for calculations. In the Cobb-Douglas function if the value of 'b' lies between 0 and 1, it means that 1 percent increase in any input, holding other variables constant, would increase the output by less than 1 percent. Returns to scale can be estimated directly from \( b_1 \) values. If \( \Sigma b_i > 1 \), it implies increasing returns to scale. If it is exactly one, it indicates constant returns.
to scale, and a value less than one indicates decreasing returns to scale (Details of Cobb-Douglas function are given in Appendix at the end).

(F) **SPECIFICATION OF VARIABLES** -

Following input variables have been used for estimation and calculation in Cobb-Douglas production function, for studying resource productivity. A brief description has been given below -

1. **LAND** ($X_1$)

   Land and its area used in agricultural production process is a prime important natural factor. This factor can be used in its physical units or in monetary terms. In this study area under crop in acres has been used as variable factor.

2. **HUMAN LABOUR** ($X_2$)

   Human labour is another important factor in farm production process. Such as labour used was calculated in man days. One day of eight clock hours. In practice, many times farmers may work more or less than eight hours time. As such the value of all labour was taken as a wages in monetary value. The owned labour value was worked out according to prevalent rates of wages. Human labour includes, owned labour as well as hired labour, Moreover it includes temporary and permanent labour.
(3) **Fertilizers and Manure (X₃)**

Chemical Fertilizers and manure is another important explanatory variable. In this study this variable is taken in monetary terms as actual amount spent on fertilizers and manure.

(4) **Technology Adoption Index (X₄)**

This score in percentage was computed for individual farm by the method as explained in earlier paragraph and was used as a variable.

(5) **Other Working Capital (X₅)**

Other working capital has been defined as expenditure on other inputs like seed cost, irrigation charges, cost of insecticides and pesticides, and miscellaneous expenditure. All these inputs were aggregated into only one variable for the simple reason, that each of these items individually may have a small association with production and inclusion of all these as a separate variable would greatly reduce degrees of freedom.

(6) **Annualized Fixed Capital (X₆)**

Annualized fixed capital and depreciation is considered together. This includes annual depreciation and maintenance of machinery, rent on land leased in (if any). It also includes depreciation on irrigation structures like pipe fittings etc. Depreciation was charged on cost of assets by simple straight line method, at 10 percent.
(7) **Farm Power Cost (X₂)**

This power is used on farm, by bullock labour, tractor, other machines and electricity. This includes machinery power in terms of rupees as hire charges for machinery, tractor, thresher and hire of bullock pair along with owned bullocks and machinery.

(8) **Value of Crop Output (Y)**

This is dependent variable in terms of rupees. This is rupee value of all farm output, including all crops taken in the year. Such value of output was estimated at the prevailing market prices (whole sale) of each kind of crop like wheat, jowar, bajra, sugarcane onion and vegetables etc.

(G) **Estimation of Function -**

Production function analysis has been used for estimation of resources productivity and determination of the optimal allocation of capital among the various categories of inputs. This analysis has been undertaken for farms as a whole for each of the three size groups i.e. small, medium and large, under irrigated region-A and rainfed region-B separately. Estimations and calculations were carried on using Software programme on Computer.

Values of $R^2$ (Coefficient of multiple determination) and standard errors of regression coefficient, students t-Test, has also been found by judging significance of regression coefficients.
SCOPE -
Entire Ahmednagar district has been taken for study on micro level. Data of past ten years have been compiled which gives a detail idea about agricultural progress made by the district. Changes occurred during last decade in use of various inputs and output have been given, which is a base of further research. The time span of the study has been ten years from 1991 to 2000.

The main emphasis was given on the study of economic development of farmers through adoption of new agricultural technology.

UTILITY -
This study would be of great importance to know whether the new agricultural technology is profitable to the farmers and whether it has added to the income and employment opportunities to the farmers in Ahmednagar district. The study will be of immense use to the researchers as it created a base for further studies of this kind. It would be useful as a guide line.

Moreover the findings of the study would be helpful to planners and decision makers to formulate effective policy measures for development of agriculture in other regions having similar agro-climatic conditions.

LIMITATIONS -
(1) Generalizations were made on the basis of sample survey of Ahmednagar district only.
(2) Inferences were drawn on the basis of primary data collected from samples of Ahmednagar district area.

(3) Individual crop productivity was not considered, separately.

(4) Uneconomic holdings have not been considered.

[1.7] PLAN OF THE THESIS

CHAPTER - I
Gives an outline of the study. Rationale, research methodology objectives, and hypothesis has also been given in this chapter.

CHAPTER - II
Elaborates a brief resume of the related studies conducted in the past and other related literature.

CHAPTER - III
Includes, a theoretical discussion on agricultural technology, new developments in technology, and its social and economic implications.

CHAPTER - IV
Contains a 10 years statistical summary of agricultural developments taken place in India. Increase in irrigation potential, crops outputs, consumption of various inputs during last 10 years have been shown.

CHAPTER - V
Gives a summary of agricultural developments made during last 10 years, in Maharashtra. Land use pattern for cropping, crops, their output, use of inputs irrigation potentials created by government, etc. have been given.
CHAPTER - VI
Contains a detailed discussion of Ahmednagar district, its land utilization, crop pattern, irrigation facilities, farm productivity, etc. It gives a clear picture of progress made by the agricultural sector during last ten years, from 1991-2000.

CHAPTER - VII
This chapter consist of classification, analysis and interpretation of primary data of Ahmednagar district.

CHAPTER - VIII
Contains summary of findings and conclusions. At the end of the thesis, Appendix-I and bibliography has been given.

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