CHAPTER I

INTRODUCTION

1.1 INTRODUCTION

Agriculture is the corner stone of development in developing countries. It is a dominant sector in Indian economy both in terms of its contribution to the total value added as well as a support base for labour. Since most of the people live in rural areas and are employed in agriculture, any change in this sector affects the entire economy\(^1\).

The technological improvements in Indian agriculture since mid-sixties have brought about a revolutionary increase in agricultural production. Interestingly, the growth rate of food grain production particularly in the case of paddy and wheat was much higher than the growth rate of population. The country was facing acute food shortages till eighties. It has now become not only self-sufficient but also a net exporter of food grains. This has been made possible due to the evolution of high yielding crop varieties, increased use of chemical fertilizers, development of irrigation facilities and plant protection measures accompanied by effective Price support programmes.

for farm products. The increased use of purchased inputs in agriculture necessitated the enhancement of their efficiencies though mechanisation. The increase in the use of human and bullock labour and rising wage rates and cost of up-keep of bullocks, further made the case of farm mechanisation still stronger.

1.2 COMPONENTS OF NEW FARM TECHNOLOGY

Once the technical change is in progress in agricultural sector, it brings in changes in the agrarian activities by adopting modern agricultural technology. Modern agricultural technology consisted of bio-chemical and mechanical innovations. The package of new technology measures which helped to improve agriculture includes the adoption of High Yielding Variety (HYV) seeds, fertilizers, pesticides, machinery, irrigation, improved implements and soil conservation. Even though there has been a dramatic increase in output, the new agricultural strategy necessitated assured irrigated, big farms, huge capital and institutional credit and extension services. The components of agricultural technology is considered in terms of (i) irrigation, (ii) chemical fertilizers, (iii) high yielding variety seeds, (iv) plant protection and (v) implements and machineries.
(i) Irrigation

For adoption of improved agricultural technology, the main prerequisite is irrigation. Irrigation helps in increasing production per unit of land, particularly when used in appropriate combination with other inputs. Moreover, optimum utilization of land and resources can be obtained only with assured water supply and multiple cropping could be undertaken only with better irrigation. It is a proven fact that output per acre is higher in irrigated lands than in dry lands in India. Development of irrigation has conferred immense benefits to the Indian rural economy. It has helped directly in promoting the greater utilization of land, enlarging the acreage of the farm, generating demand for additional farm labour and bringing a shift in cropping pattern in favour of new and improved varieties of crops.

(ii) Chemical Fertilizers

Biochemical technology provides the contributions of chemistry and biology. The chemical technology gives chemical fertilizers, pesticides weedicides and herbicides, which help replenish the lost fertility of soil and protect plants from diseases. Biological technology works on the genetics and Physiognomy of the plant, ultimately giving higher yield. The bio-chemical
technology is labour absorbing, land saving and scale neutral. The Intensive Agricultural District Programme (IADP) and High Yielding Varities Programme (HYVP) increased the importance of fertilizers to compensate for the nutritional loss. The use of fertilizers has increased from 1.20 million tonnes in 1966-67 to 22.67 million tonnes in 1999-2000.

The adoption of bio-chemical technology generally proceeds with the use of chemical fertilizers. Higher use of fertilizers leads to higher agricultural production.

(iii) High Yielding Variety (HYV) Seeds

The increasing use of HYV seeds is another aspect of the bio-chemical technology. The high yielding variety seeds not only increase production per unit of land but also the pattern of land-using in character. In the planner’s view point, production of quality seeds will continue to be an important input for crop production strategy. The programme for production of certified seeds will therefore be pursued with added vigour\(^2\). Among the new agricultural

strategies responsible for increasing productivity, adoption of resource input of HYV seed meets with ready response and adoption\textsuperscript{3}.

The High Yielding Variety Programme (HYVP) was started in 1966 under Fourth Plan and the area under HYV rose from a meager, 1.88 million hectares to 15.38 million hectares in 1970-71, 48.05 million hectares in 1981-82, 56 million hectares in 1991-92 and 78 million hectares in 2000-01. The success of HYV seeds technology lies in the availability of water and chemical fertilizers. It is also called water HYV seeds fertilizer technology.

(iv) Plant Protection

The possible loss in crop yield could be averted with plant protection measures. Though the application of plant protection chemical does not increase productivity, it helps to maximize yield preventing crop losses. But the new variety of seeds are prone to pests and chiseases. A major breakthrough in plant protection was achieved in 1949 through the import of Dichlorodiphency Trichloroethane (DDT) and Benzene Hexachloride (BHC). The consumption of pesticides in India is insignificant compared to developed

countries and the usage is high only in states like Andhra Pradesh, Punjab, Haryana and Uttar Pradesh.

(v) Implements and Machineries

Farm mechanization is another essential input for the process of adoption of modern technology in agriculture. Assured irrigation at appropriate time and quantity, uniform application of fertilizers, a seed bed preparation of a good quality and early harvesting and threshing to sow the next crop with well adopted machinery and implements, can only lead to timely farm operations of satisfactory quality. Mechanization reduces labour demand for individual operations, which are mechanized. The evidence from Punjab shows a decline in labour input per cultivated hectare, when the change is made from traditional technology and technique to HYV technology and mechanized technique. Mechanization therefore contribute to meeting these peak power needs with better land preparation and higher cropping intensity leading to substantially bigger harvest, which in turn requires more labour during post harvest slack periods for threshing, transport and even quadruple the number of field operations.\(^4\)

1.3 NEW FARM TECHNOLOGY AND MECHANISATION IN AGRICULTURE

Mechanisation refers to the use on a much wider scale of tractor and other associated equipment and machinery (including farrow tillers, thresher harvesters). Modern assured means of irrigation refers to application of chemical fertilizers (and other crop nutrients) in greater quantum. Mechanisation of various farming operations refers to sowing of High Yielding Variety (HYV) seeds and adoption of crop protection measures consisting of use of insecticides/pesticides/weedicides. The use of new farm technology and inputs modernises agriculture in an amazing breakthrough achieved in the form of higher crop productivity.\(^5\)

There is a great impact of Green Revolution\(^6\) on the power structure at various levels and the issue of taxation of agricultural incomes. In the year 1966, the implementation of technological change in High Yielding Varieties Programme (HYVP) in all districts selected under Intensive Agricultural District Programme (IADP) scheme was introduced. The strategy was

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concerned with higher productivity of crops but with multiple cropping. The HYVP had assumed ‘crucial importance’ in the Planning Commission’s agricultural development strategy. The most interesting feature of the new agricultural strategy was that the movement for scientific agriculture and programmes for research and extension received fresh stimulus. Technological change or the new strategy proposes to make a new technological breakthrough in India which comprises the introduction of new and HYV of improved seeds, increased application of the recommended dose of fertilizers and extension of the use of pesticides that can save crop from destruction by insects. This technological change brought spectacular changes in the agriculture production of our country. The increase in production of food grains recorded after 1966-67 is described as Green Revolution. The rapid introduction of HYV of paddy and wheat and their multiplied effects on other crops justify the name Green Revolution.

The new agricultural strategy technology adopted since the mid sixties has helped in revolutionizing Indian agriculture. Technological change in agriculture is characterised by the use of pesticides, irrigation, machinery, improved implements, soil conservation and the like. The successful adoption of these components of new strategy has resulted in the increase of agricultural
production. The introduction of above mentioned components of new agriculture strategy depends upon factors like irrigation, size of farm, availability capital, institutional credit, and extension services.

Modern agricultural technology may be divided into two main categories.

(i) Mechanical technology and

(ii) Bio-chemical technology.

(i) Mechanical technology is concerned with the instruments of production both motion and stationary. Generally, this is based to scale cost reducing and capital intensive. It requires higher doses of fixed capital.

(ii) Bio-chemical technology provides the contributions of chemistry and biology. The chemical technology gives chemical fertilizers, pesticides, weedicides, herbicides and the like which help replenish the lost fertility of the soil and protect plants from diseases and pests. Biological technology works on the genetics and physiognomy of the plant, ultimately giving higher yield. The bio-chemical technology is labour-absorbing, land saving and scale neutral.
Mechanical technology, though treated as capital intensive, may also be land saving and labour absorbing as timely field crop operations lead to multiple cropping in a single year. In the same way, the bio-technology which is labour absorbing may also be labour saving as is possible by using herbicides and weedicides. Yet historically the dominant factor for saving labour has been the progress of mechanisation and the dominant factor for saving land has been the biological innovations. Agricultural mechanisation\(^7\) embraces the use of tools, implements and machines for agricultural land development, crop production, harvesting, preparation for storage, storage and on-farm processing. It includes three main power sources: human, animal and mechanical. The manufacture, distribution, repair, maintenance, management and utilization of agricultural tools, implements and machines is covered under this discipline, with regard as to how to supply mechanisation inputs to the farmer in an efficient and effective manner.

Hand tool technology – using human muscle as the main power source.

Draught animal technology – animal muscle as the main power source.

Mechanical power technology – main power from sources other than muscular power.

1.4 NEED FOR NEW TECHNOLOGY IN AGRICULTURE

Farm power - consisting of manual labour, agricultural tools, draught animals, tractors, implements, equipment and machinery – is an essential farm input. In almost any agricultural production system the annual expenditure on farm power, whether on labour, draught animals, or fuel and depreciation of machines, largely exceeds the costs of other inputs such as agro-chemicals and seeds. In many developing countries, agricultural production and food security are adversely affected because of insufficient use of farm power, low labour productivity or labour scarcity. The need to improve agricultural labour productivity is increasingly recognized. In the case such as pump sets for irrigation, the need for machinery is undisputed. Rather than agricultural mechanisation, it would be preferable to use the term Farm power or labour productivity enhancing technology to recognize not only the importance of manual labour and hand tools, draught animals and mechanical power, but also
other issues related to the labour scarcity, such as cropping and farming systems.\textsuperscript{8}

Finding solutions to environmental problems in agriculture requires agricultural tools and machinery, for example, the soil tillage and pesticide application, the latter also addressing health concerns. Similarly, machines are required to assist with post-harvest loss reduction and on-farm processing. Thus, it is now recognized that agricultural mechanisation is crucial in the fight against hunger and poverty and at the same time to address environmental and health concerns.

The term mechanisation is unfortunately often very narrowly perceived while its real purpose, namely, enhancing productivity of land and labour is often not well understood. In fact an agricultural mechanisation strategy ought to be part of an agricultural technology strategy, which is to be part of an overall agricultural development strategy. In this context, three principal purposes of mechanisation may be summarized as follows:

\textsuperscript{8} Ibid., pp.2-3.
1.4.1 Increase in labour productivity

The introduction of machinery to substitute labour ("labour-saving") is a common phenomenon associated with the release of labour for employment in other sectors of the economy or to facilitate cultivation of a larger area with the same labour force.

1.4.2 Increase in land productivity

The purpose of mechanisation is here to produce more from the existing land. Machinery is a complementary input, required to achieve higher land productivity, for example, through the introduction of pump sets, or faster turn-around-times to achieve higher cropping intensity. In labour surplus economy, net labour displacement or replacement should be avoided.

1.4.3 Decrease in cost of production

Introduction of farm mechanisation may lower production costs or offset increased costs of draught animals or labour.
1.5 IMPORTANCE OF MECHANISATION

Mechanisation\(^9\) involves judicious application of inputs by using agricultural machinery/equipment e.g. hand tools, bullock drawn equipment, power driven machines including the prime movers for performing various operations required for crop production activities. Mechanisation ensures reduction of drudgery associated with various farm operations as also economizes the utilization of inputs and thereby harnessing the potential of available resources.

a) Traditionally, Indian farmers have been using animal and human power. These sources have limitations and have been proved ineffective to achieve multiple crops. Even with limited land resources, multiple cropping is considered to be the best way of increasing productivity.

b) Draught animals are easily available as progenies of local milk animals and this perpetuates the use of draught animal power as a major power source for operations. In the sloping hill regions and on small farms, these draught animals will continue to be the main power source, besides human power. However, the number of these animals is on the decline. With the

\(^9\) www.agri.mechanisation.
use of mechanical power in agriculture, the use of draught animal power has declined.

c) Mechanisation enables timely field operations and effective application of various inputs. Tilling, sowing, irrigation, plant protection and threshing have been successfully mechanised and widely used by Indian farmers.

d) The farmers practicing dry land agriculture, work under unpredictable weather conditions and for them timeliness is very important. This calls for quick time-bound operations of tilling and ploughing, which cannot be done depending entirely on human or animal power. The use of machine is a must for modernization of agricultural operations.

e) Human labour is the largest cost item in the cost structure. An implication is that even a relatively small increase in the wage would have a large impact on the economies of crop. As a result, farmers are likely to be very sensitive to wage increases and this may be an important reason for the move towards mechanisation and other labour saving technologies\(^\text{10}\).

f) For paddy and sugarcane, transplanting process is arduous and also time consuming. As a result, the cost will mount up. Engine operated

g) Control and removal of weeds is an essential task in agriculture and more so in irrigated and rain fed areas, where the weeds spring up in large areas, say, 20 to 60 per cent. The usual and most versatile implement used in this connection is khurpi, but it takes 300-700 man-hours to cover one hectare. Tractor operated weeder and cultivator accomplishes this purpose quickly and more economically also.

h) Threshing of paddy is normally done by employing bullocks. This is a slow-motion process with prolonged effort. In this method, damage to grains is inevitable. Mechanised thresher operated by 5-15 High power engine or electric motor service this purpose very well with economy in time, energy and cost.

i) The jobless are migrating in ever increasing number from villages to towns. This creates a shortfall in the availability of rural labour for field operations. Thus human labour becomes dear and costly.

All these pave the way for progressive replacement of human labour by machine power. It should be recognized that the current agricultural development carries a built-in factor, which accelerates the process of
mechanisation. As labour wages are steadily rising, it is imperative to introduce mechanization, if we are to remain globally competitive.

1.6 INDIAN AGRICULTURE - A REVIEW

The developmental plans in India have stressed the need for a revolutionary change in agriculture which can be brought about by the introduction of New High Yielding Variety (HYV) improved seeds, application of suitable doses of fertilizers and extensive use of pesticides. The Green Revolution led to a large increase in production of food grains after 1966-67.

The revolution has brought about self-sufficiency in food grains in agriculture, reduced our dependence on foreign countries for food grains and generated progress in agriculture. The revolutionary change has attempted to break the chain of the vicious circle of poverty in Indian agriculture and paved the way for success, mainly in the production of food grains.

The review of agricultural development in India since Independence will show the telling impact of the new agricultural strategy. Indian agriculture during the 19th Century was almost of subsistence type. Production of food grains was mainly for consumption purposes and there has been very little rise in output. Indian agriculture is rich in resources but low in productivity. With
2.5 per cent of world's surface area, the country cultivates 163 million hectares which is approximately 12 per cent of the world scene. Indian paddy productivity is just 40 per cent of the Chinese yields, approximately one-third of the Korean yields and around 55 per cent of Indonesian yields.\textsuperscript{11}

Agricultural development has received priority after independence in our Five Year Plans.\textsuperscript{12} Efforts were made to overcome the technical constraints, institutional drawbacks, poor extension services and the like. In the First Five Year Plan, agriculture received top priority. The agricultural development programme included the extensive cultivation and the community development programme. The community development projects (each covering 100 villages) were stated in 1952. The main objective was to mobilize rural dwellers for labour intensive agricultural productivity projects supported by certain land reforms, new village co-operatives, in which the state would be a partner, and national extension services. However, land reforms and institutional changes were insufficient to cater to the requirements of the rural masses for intensive cultivation.


The Intensive Agricultural District Programme (IADP) also known as the Package programme was initiated in the year 1956-61. Seven districts were chosen initially for implementation of this programme. This had been a conscious effort to improve agriculture through institutional and agrarian reforms and by strengthening of agricultural infrastructure. From 1960-61, the emphasis shifted to measures increasing agricultural productivity through the adoption of improved methods and use of modern inputs. Technology was recognised as a measure to increase agricultural productivity. The IADP with improved seeds, improved farm tools, fertilizers and pesticides demonstrates the most effective way to increase agricultural production by the application of scientific knowledge which could be extended to areas with basic inputs. The seven districts in which the programme was implemented made considerable progress and then it was extended to 15 districts comprising the first group of seven districts selected in 1960-61 and the second groups of eight districts in 1962-63. In 1964-65, 114 districts were chosen for Intensive Agricultural Area Programme (IAAP) which was intensive agricultural development of a selected area.
The “new strategy” for agricultural development initiated in 1966 called for an effective implementation of IADP and IAAP with the use of High Yielding Varieties. The HYVP assumed crucial importance in the agriculture development strategy. The HYV strategy aims to increase productivity of crops per acre through multiple cropping.

More recent trends indicate that starting from mid 80s, there is hardly any growth in the cropped area under HYV (a total of mere 37.38 per cent between 1985-86 and 2001-2002). Whatever limited research effort we have is not bringing out the desired results because of the serious problem in effecting proper linkage between research and extension. The area under HYVP which was 1.89 million hectares in 1966-67 had increased to 9.2 million hectares on the eve of Fourth Five Year Plan. In 1989-90, the area under HYVP increased to 26.53 million hectares which account for 31.6 per cent of the gross cropped area.\(^\text{13}\)

The area under the fertilizers used in 1990-91 was 5,86,292 tonnes in Tamil Nadu.\(^\text{14}\)


Of the Annual Plan period (1966-69) total outlay of Rs.15,779 crores, 23.3 per cent was spent on the agricultural and irrigation development during the Fourth Five Year Plan.\footnote{M.L. Jingan, “Agricultural Development and Policy under the Plans”, \textit{The Economics of Development and Planning, 26\textsuperscript{th} Revised Edition}, Konark Publishers Private Limited, Delhi, Chapter 66, 1993, pp.682–683.}

The Fifth Plan sought to tackle the problem of water management especially with regards to paddy through integrated development of command areas of 50 major and medium irrigation projects. Suitable changes in the cropping pattern of irrigated areas are also being evolved.\footnote{Singh. Tarlok, \textit{Planning for Agriculture}, C.N. Valik (ed.) “Agricultural Development of India, Policy and Problems”, Oriented Longman, New Delhi, 1979, p.39.}

The Sixth Plan’s objectives include speedy implementation of land reforms, spread of new technology to more farmers and regions, using agriculture as a catalyst of income and employment generation in rural areas, promoting scientific land water use patterns based on consideration of ecology, energy conservation and employment generation. An overall view of recent trends in area under High Yielding Varieties shows that the annual growth rate between 1980-81 and 1987-88 was 3.5 per cent.\footnote{S.K. Ray, \textit{Indian Economy}, Prentice Hall of India, New Delhi, 1989, p.123.} Agricultural
production which suffered a setback during 1991-92 due to irregular monsoon in 1991 was unexpected. No records show high growth rate in 1992-93. Food grains production was targeted at 183 million tonnes during 1992-93.

The perspective of agricultural development in the next two decades is summarized by the planning commission as shown in the following Table 1.1.

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# TABLE 1.1

## AGRICULTURAL PERSPECTIVE IN INDIA

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<tr>
<td>1. Land (m.ha.)</td>
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<tr>
<td>(i) Net Sown Area</td>
<td>140.9</td>
<td>140.0</td>
<td>141.0</td>
<td>141.0</td>
<td>141.0</td>
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<tr>
<td>(ii) Gross Cropped Area</td>
<td>176.4</td>
<td>182.2</td>
<td>190.6</td>
<td>197.2</td>
<td>203.4</td>
<td>202.3</td>
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<td>(iii) Cropping Intensity</td>
<td>125.0</td>
<td>130.0</td>
<td>135.0</td>
<td>140.0</td>
<td>144.0</td>
<td>143.0</td>
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<tr>
<td>(iv) Gross Cropped area under foodgrains</td>
<td>126.7</td>
<td>1270</td>
<td>130.0</td>
<td>132.6</td>
<td>135.8</td>
<td>134.7</td>
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<td>2. Irrigation (m.ha.)</td>
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<tr>
<td>(i) Foodgrains</td>
<td>44.2</td>
<td>53.8</td>
<td>62.3</td>
<td>70.2</td>
<td>77.7</td>
<td>78.3</td>
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<tr>
<td>(ii) Other than foodgrains</td>
<td>16.3</td>
<td>21.9</td>
<td>27.0</td>
<td>31.8</td>
<td>36.3</td>
<td>37.4</td>
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<td>(iii) Total</td>
<td>60.5</td>
<td>75.7</td>
<td>89.3</td>
<td>102.0</td>
<td>114.0</td>
<td>115.7</td>
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<td>3. Fertilizer (m. t.)</td>
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<tr>
<td>(i) Foodgrains</td>
<td>6.2</td>
<td>9.4</td>
<td>12.8</td>
<td>16.6</td>
<td>21.0</td>
<td>20.0</td>
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<tr>
<td>(ii) Other than foodgrains</td>
<td>2.1</td>
<td>4.1</td>
<td>5.5</td>
<td>7.1</td>
<td>9.0</td>
<td>8.9</td>
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<td>(iii) Total</td>
<td>8.3</td>
<td>13.5</td>
<td>18.3</td>
<td>23.7</td>
<td>30.0</td>
<td>28.9</td>
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<td>4. Product-mix</td>
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<tr>
<td>(i) Cotton (m.bales)</td>
<td>8.5</td>
<td>10.5</td>
<td>14.0</td>
<td>18.0</td>
<td>23.0</td>
<td>23.1</td>
</tr>
<tr>
<td>(ii) Sugarcane (m.t.)</td>
<td>170.3</td>
<td>235.0</td>
<td>275.0</td>
<td>335.0</td>
<td>408.0</td>
<td>379.1</td>
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<tr>
<td>(iii) Foodgrains (m.t.)</td>
<td>145.5</td>
<td>172.5</td>
<td>210.0</td>
<td>245.0</td>
<td>285.0</td>
<td>287.0</td>
</tr>
<tr>
<td>(iv) Oilseeds (m.t.)</td>
<td>13.0</td>
<td>17.5</td>
<td>23.0</td>
<td>29.0</td>
<td>37.0</td>
<td>38.0</td>
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<tr>
<td>5. Population (million)</td>
<td>762.0</td>
<td>844.0</td>
<td>925.0</td>
<td>1006.0</td>
<td>1102.0</td>
<td>1638.5</td>
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The target fixed for the growth of agricultural output during the Seventh Five Year Plan period (1985-1990) was 4 per cent per annum and the target for foodgrains output was 3.7 per cent per annum. To achieve these targets,
efforts were to be made to irrigate an additional area of 11 million hectares during the Seventh Five Year Plan period. The consumption of fertilizers was increased from 8.3 million tonnes in 1984-85 to 28.9 million tonnes in 2007-2012.

The major programme thrusts in the Seventh Plan are:

- Special Paddy Production Programme in the Eastern Region.
- National Oilseeds Development Project.
- Development of Small and Marginal Farmers and Social Forestry. ¹⁹

The Eighth Five Year Plan (1992-1997) aimed at consolidating the gains from the base built over the years in agricultural production; sustaining the improvements in productivity and production to meet the increasing demands of the growing population; enlarging the incomes of farmers, and realizing the country’s potential by stepping up agricultural exports. While the production of several commodities has shown significant increases, a cause for major continuing concern is that the growth rates in agricultural production is highly skewed in terms of geographic areas as amongst crops. Rapid improvement in

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productivity and production of a few of the agricultural crops, since the introduction of high yielding varieties technology from the mid-sixties, had been conspicuous only in small pockets of well endowed irrigated areas. Efforts to concentrate on productivity of principal crops in these regions through programmes initiated in the Sixth and the Seventh Five Year Plans had to be further intensified. Appropriate technologies designed to meet the specific location problems, needed to be generated.

Yield growth is likely to be the primary contributor to enhance production in the Ninth Five Year Plan (1997-2002). Apart from irrigation facilities, adequate availability of fertilizer, HYVs and pesticides is of crucial importance. In this regard, it must be mentioned that in the Eighth Five Year Plan there had been only a small increases in fertilizer consumption. Fertilizer consumption, which was 13.5 million tonnes in 1991-92, increased to 18.3 million tonnes in 1996-97. Moreover, in recent years, the imbalance in nutrient use had aggravated. The (Nitrogen Phosphorus Potassium) N:P:K ratio, which was 6:2, 4:1 in 1990-91, worsened to 9:9:2, 9:1 in 1996-97. The recommended ratio is 4:2:1. Such a lop-sided use of nutrients was likely to adversely affect long-term productivity of land. Not only that, coverage of HYV had to be increased substantially across regions and crops. The challenge was to
introduce HYVs in the crops in which HYV was presently not available and to replace the old generation of HYVs with new the generation HYVs in the crops in which HYVs were already there. New HYVs should also be made more region-specific. In recent years, the pace of introduction of new HYVs had slackened, which needs to be reversed. This required a significant increase in expenditure on agricultural research and extension services.  

The Tenth Five Year Plan (2002-2007) envisages an overall GDP growth rate of 8 per cent per annum. The National Agricultural Policy has envisaged:

- Growth that is based on efficient use of resources and conserves our soil, water and bio-diversity;
- Growth with equity, therefore, growth which is widespread across regions and benefits all farmers;
- Growth that is demand-driven and caters to domestic markets as well as maximizes benefits from exports;
- Growth that is sustainable technologically, environmentally and economically; and
- Growth rate is excess of 4 per cent.

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The strategy to achieve the desired growth rate, exceeding 4 per cent, in the sector during the Tenth Plan, would be a regionally differentiated one based on agro-climatic conditions and land and water resources of different regions. Thrust would be given for the development of the eastern and north-eastern regions together with other eco-fragile regions, hill areas, coastal areas, etc, by further expanding the On-Farm Water Management Scheme which has been introduced to exploit the rich ground water potential. The Technology Mission on Horticulture has become operational in the north-eastern region and backward and forward linkages are to ensured.21

In Eleventh Five Year Plan (2007-12), a slight improvement in almost all variables namely land under cultivation, irrigation, fertilizer and product mix were found during that period. Agriculture, being on top agenda of Eleventh Plan (2007-2012) has been targeted with 4 per cent growth rate. The roadmap of agricultural growth envisages expansion of cropped area by about 5 million hectares during the Eleventh plan.

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21 Ibid.
1.7 TECHNOLOGICAL CHANGE IN INDIAN AGRICULTURE

“A country is poor because it is poor”. This is one of the modern concepts prevailing in the field of economics. This statement appears to be a strange mixture of words, but has a subtle sense concealed in it.

A country having even enormous natural resources cannot produce wealth without availing of the techniques, provided by science and technology. Scientific discoveries, technological innovation and invention play a crucial role in the production of goods. In a world, highly competitive in cost and quality, the use of latest technology alone can enhance the prospects of the goods being sold in the market. A poor country not able to have the high cost technology has to remain only poor. Buy or borrow the required technology is the only means for enlistment.

No field of activity is exempt from the impact of technological advancement. Verily, Indian agriculture is no exception. The post independence era has witnessed tremendous changes, in the form of improvement and progress, in the field of agriculture. Conspicuous among them is the introduction of mechanization, assisting and substituting human or animal power in the process of cultivation.
The Indian economy is linked to agriculture, which is the major vocation to two-thirds of the labour force. The country's progress largely depends on the development of agriculture. In this respect, the slogan “our land is our future” holds good for us in its fullest implication.

The need for steep rise in the production of food grains is compelling our attention and action. Its priority cannot be ignored and it is second to none. In effect, what need to be achieved is that every hectare of land should be made to feed more mouths. This must be the aim and theme of our agricultural movement.

The increase in production of food grains thus far achieved was possible as a result of the farm mechanisation, adoption of quality seeds, higher dose of fertilizer and plant protection chemicals, coupled with assured irrigation and credit facilities.

“Though the concept of agricultural mechanisation is broad and complex, it refers to the extensive and intensive use of improved production technology and inputs for the maximization of production”.
“Employment of improved tools, implements and machines associated with enlightened management practices between farm workers and agricultural materials such as soil, water, plants, animals and fish, their produce and by-products is farm mechanisation”. It is not exactly automation. It is to assist or substitute human labour in such a manner as to improve the efficiency and speed up operations with the objective of ensuring increase in productivity and reduction in cost, energy and time.

Change in technology has been fundamental to post-green revolution and agricultural growth in India as well as many other developing countries.

Mechanisation, in the first instance, helps to transcend the limits of manual capacity. What cannot be performed by human limb is easily done by machines. In short, mechanisation provides new dimensions to production capacity by which productivity expands by leaps and bounds. In addition, sophistication, refinement and varieties are rendered possible. All these are obtained with the use of minimum energy and time. If we are to remain globally competitive, the latest form of farm mechanisation should be employed by us.
1.8 PADDY CULTIVATION IN TAMIL NADU

Paddy occupies a prominent place in Indian agriculture. The area under paddy in the country is the largest, accounting for about one-third of the world’s area under the crop. Since Independence, the Indian Government has been emphasizing the importance of agricultural development. The New Agricultural Strategy (NAS) was initiated in 1966. Accordingly, policies were formulated to utilize and promote high yielding varieties of foodgrains in all districts selected under the IADP and IAAP schemes. The NAS was first introduced in the karif season of 1966. It also came to be known as the High Yielding Varieties Programme (HYVP). The persistent efforts made by the Indian agricultural scientists since the introduction of HYVP resulted in the evolution of numerous high-yielding varieties of principal crops and new farm practices. Under HYVP, varies improvement helps picking into the seed and ability to yield more for a given situation. The implementation of HYVP has brought about an increase in paddy production. Paddy is the most important food crop of Tamil Nadu. The introduction of High-Yielding Varieties Programmes in the mid-60s, brought about a significant increase in production and productivity of food grains in the State. The locally improved varieties of paddy like ADT-27 and Co-29 were less responsive to fertilizer and liable to
lodge. On the other hand, varieties like IR5, IR8, IR20 and IR22 introduced from 1966-67 were more fertilizer-responsive.

Tamil Nadu has achieved the position of being the premier paddy producing state in India. For the first hundred years, paddy had its own place in the rotation of crops in the economy of Tamil Nadu. At present, paddy is grown in Tamil Nadu in 18,45,553 hectares and the percentage of the area under paddy works out to 4.4 per cent of the total area under paddy in India. The annual paddy production in Tamil Nadu is about 56,65,206 tonnes. At present, paddy yield has registered 3072 kg/hectare in the state in 2009-2010.\footnote{Director, Department of Economics and Statistics ‘Statistical Hand book of Tamil Nadu’2011,p.71}

The agricultural economy of Tamil Nadu is dominated by food grains which occupied 30,34,124 hectares out of 55,71,718 hectares of cropped area, In the past years:

1) The annual average increase took an upturn.

2) The pace of growth in the latest five year period was as good as that in all-India.

3) The State’s share in foodgrains production at the all India level had been maintained around 4.9 per cent.
1.9 STATEMENT OF THE PROBLEM

In the agriculture sector while some economists consider modernization of Indian agriculture to be necessary and desirable, others think that the economic and social conditions in India are entirely different from the advanced countries, where mechanisation is found to be profitable. Here people mostly stick on to tradition and traditional method of agriculture. Even though, science has gained importance and developed a lot, since most of the agriculturists are illiterate or some lacking in the awareness of technology and its change, there was not much influence of technology till late 1980's. But now thanks to mass media like T.V. the benefits of technology in agriculture are known by the people. Technology change or the new strategy proposes to make a new technological breakthrough in India which comprises the introduction of new and high yielding variety of improved seeds, increased application of the recommended doses of fertilizers and extension of the use of pesticides. The agricultural sector was the main sector in the economy of the primitive society and agricultural technology has a long history. Agricultural surpluses came largely through expanding food production due to improvement in agricultural technology. A highly developed agricultural technology leads to more agricultural surplus, leading to capital accumulation.
Hence, there is a need to study the nature of the problem. The present study attempts to a step towards this direction, analyze the impact of new agricultural technology with special reference to paddy cultivation in Thoothukudi of Tamil Nadu. Thoothukudi district is one of the important paddy cultivation centres in Tamil Nadu.

**1.10 OBJECTIVES OF THE STUDY**

The specific objectives of the study are:

1. To study the impact of new agricultural technology on cost and returns structure of farms cultivating paddy in the study area.

2. To scrutinize and compare the net return distribution and extent of inequality in the net return distribution of farms adopting New Technology and Traditional farms in the region under the study.

3. To analyse and compare the yield determinants, yield gap and yield constraints of paddy cultivation under new Technology and Traditional farms.

4. To estimate and analyze the input demand elasticities and supply responsiveness for new Technology and Traditional farms in the study area.
5. To investigate the labour absorption capacity of new technology and traditional farms in the study area.

6. To probe the returns to scale of new technology and traditional farms in the study area.

1.11 LIMITATIONS OF THE STUDY

The present study is based on survey method by direct personal interview with a well designed schedule. The respondents did not maintain adequate farm records and accounts and they were able to furnish the particulars in view of long association with farming activities. Therefore, it suffers from a certain degree of recall bias. The findings of this study are based on data limited to rabi season of the agricultural year 2011-12. Kharif season was not taken into account for the reasons that the utilization of paddy was not found common in all places during this season. Therefore, the findings cannot be generalized for the crop as a whole.
1.12 SCHEME OF THE WORK

The report of the present study “Impact of the New Agricultural Technologies in Thoothukudi District (Tamil Nadu) – An Economic Evaluation” has been organised and presented in seven chapters.

Following the introductory chapter, Second chapter reviews the earlier studies relating to cost of production, yield gap and yield constraints and studies based on profit function approach.

The third chapter is devoted to the description of the study area, database and methodology.

The fourth chapter discusses the impact of new technology on cost and return structure of small and large farmers cultivating paddy. It also deals with the nature of distribution of net return and extent of inequality in net return of new technology and traditional farms.

The fifth chapter identifies and compare determinants of yield, yield gap and yield constraints of new technology and traditional farms of paddy cultivation in Thoothukudi district.
The sixth chapter analyses the impact of new technology an input demand elasticities, supply responsiveness, labour absorption and return to scale of paddy cultivation.

The seventh chapter presents the summary of major findings, suggestions and policy implications.