CHAPTER - IV

CHANGES IN TECHNOLOGY AND AGRICULTURAL DEVELOPMENTS IN INDIA

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CHAPTER - IV

CHANGES IN TECHNOLOGY AND AGRICULTURAL DEVELOPMENTS IN INDIA

4.1 - HISTORICAL REVIEW -

Indian agriculture around 1850 was almost on the subsistence level. The Indian villages were more or less self-sufficient. Whatever farmers produced was enough only to feed their family and a small surplus was marketed. The growth of production and productivity was stagnant. Daniel and Thornier described the situation in following words-

"Since the 1890s total output of all corps has risen, but total output of food grain has fallen off as the per capita output of both food crops and all crops has declined impassively - The trend in agriculture output over the last 60 years may be characterized as ‘Stagnation.’/ Production per unit of land also remained unchanged. Annual growth rate of production during the period 1901 - 1947 worked out to be - 0.02 percent in case of food grain. Non food grain showed a slight positive trend. Such, backward was the position of Indian agriculture during British rule, which left to us almost primitive agriculture. Further after independence India has to leave a large and productive irrigated land to Pakistan. Extra load on demand of food grain was felt as refugees came from Pakistan in a very large number. In those days farmers used seeds of local varieties and raised the corps under poor agronomic practices. Local farm yard manure was used mainly as nutrient to corps. This resulted in a very low yield per hectare.

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It was under this conditions, that the Indian Government had to develop its agriculture. Indian Government had launched the Grow More Food campaign in 1942 but it miserably failed. The reason was that government could not arouse widespread enthusiasm amongst the Indian farmers.

"This was so because all the aspects of rural life are inter-related and that no lasting results can be achieved if individual aspects of it are dealt with in isolation". After independence the Government of India adopted five year plans for overall development of the country.

4.2) DEVELOPMENTS IN PLANNING PERIOD -

Since planning period Government made concentrated efforts to develop agriculture. A short account is as follows:

(1) FIRST FIVE YEAR PLAN (1950-55) -

Government of India launched the First Five Year Plan in 1950-51 with a great emphasis on agricultural development. Number of measures were taken to eliminate or reduce the exploitation of farmers by the landlords and money lenders. As the result of efforts made by the Government during this plan, the area under different crops increased, with the increase in the overall production of corps in the country. More capital was invested in agriculture than before

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and different measures were adopted to popularise the use of improved farm technology. Government had taken a very bold step to give top priority to agriculture in First Five Year Plan. Main objective was to transform a poor agrarian economy into self generating modern economy in a period of 2-3 decades. The plan was a success, agriculture production increased manifold and food production increased by 20%.

This increase in production was mainly due to the increase in area under different corps, but productivity of land remained unchanged. The financial outlay for agriculture and irrigation was Rs. 600 crores.

(2) THE SECOND PLAN (1956-61)

In the Second Five Year plan, there was a little drift on the emphasis of priorities from agriculture to heavy industries. However this trend changed at the end of this plan and a new approach to agricultural development was made which was based on the selectivity of area and concentration of efforts. The outlay made for agriculture in this plan was Rs. 950 crores.

(3) THE THIRD PLAN (1961-66)

In this plan Rs. 1750 crores were allotted to agricultural sector. Planners called it as a ‘take off stage.’ On the basis of experience of first two plans, a number of new institutions were set up to extend support to development activities in different fields. However implementation of this plan was
disturbed to a large extent by Chinese hostilities and droughts during that period. The Ford Foundation Team of experts (USA) visited India for a couple of weeks during January 1969 to April 1969 and made some very valuable suggestions for meeting the chronic food shortages. The team in their report "India's Food Crisis and Steps to meet it" said "Many factors impede the expansion of food production in India. Among these are inadequate soil and water conservation, too many live stock for available fodder supplies, antiquated equipment and methods of cultivation, a multitude of plant pests and diseases, fragmented holdings, insecurity of tenure, inadequate and costly credit, the lack of effective incentive to encourage the cultivators to increase their production, inadequate programme coordination and many more. These are neither inherent nor insurmountable obstacles to increase food production. The physical resources of soil water and climate are sufficient to yield at least a double, perhaps more than double, the current production with the full use of machines, chemicals and other production of industry".\(^3\)

The team further suggested that selected areas in the country having greatest potentialities for rapid food grains production should be chosen for intensive agricultural development.

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\(^3\) Ford Foundation Team of Experts. "India's Food Crisis and Steps to meet it 1969."
On the basis of the recommendations of the team the “Intensive Agricultural District Programme” was initiated. This also was called as Package Programme. For this only those districts were selected which represented maximum irrigation facilities and minimum natural hazards. The programme was sponsored during 1960-61 with financial assistance from the Ford Foundation.

Few districts were selected by the Government, and provided all the inputs like fertilizers, pesticides, improved seeds and improved tools to those district which were selected. Government also showed demonstration of all these on some of agricultural plots.

All the selected districts (seven districts) survey afterwards showed considerable progress. With these encouraging result, Government of India extended this programme to 15 more districts. In 1964-65 the new policy was put into action, according to it, 114 districts were taken up for an Intensive Agricultural Area Programme. This was based on the fact that planning in agriculture before IADP was not effective as there was a loss of scarce resources. In fact these policies lacked integration. In 1966 Government of India launched a “New Strategy for Agricultural Development”. This was meant for implementing of High Yielding Varieties Programme (H.Y.V.P.) in all those districts which were selected before. With this strategy Government wished to have higher productivity of corps per acre, but with multiple cropping pattern, technique.
Original draft of this plan under the Chairmanship of Ashok Mehta had to be abandoned on account of two years drought, devaluation of rupee and the inflationary recession. Instead of this, three Annual Plans (1966-69) were adopted. 3810 crores of rupees outlay was sanctioned during this period for agriculture development.

The strategy was as follows:-

(i) To apply scientific technique and knowledge of agricultural production at all stages, particularly in the fields.

(ii) To select a few areas with assured rainfall and irrigation for concentrated application of packages and practices based on improved varieties of seeds, responsive heavy doses of fertilizers and availability inputs and to fix a special targets of production of food grains for such area. In 1969 Expert Committee of the Food Ministry assessed this strategy as “Spear-head of the total agricultural modernization programme for country as a whole.”

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(5) FIFTH PLAN (1974-79) -

Fifth Five Year Plan provided Rs. 8741 crores (22%) out of total plan outlay, for the development of agriculture and irrigation. Fifth plan was remarked that “This plan seeks to correct administrative weakness encountered in implementing schemes for expansion of areas under high yielding varieties of cereals and multiple cropping programmes. The problem of water management has emerged as a key issue in relation to rice. Therefore the plan provided for integrated development of the command area of 50 major and medium irrigation projects. Suitable changes in the cropping patterns of irrigated areas are also being evolved.” Besides this there are no major change in priorities and strategies during this plan.

(6) SIXTH PLAN (1980-85) -

The Sixth plan has also given much importance to rural and agricultural development. A thought was also given to hilly and tribal area development. An estimated outlay for this work was Rs. 24699 crores. This was 25 percent of total outlay of plan budget. The sixth plan also emphasized on implementing water-seed-fertilizer strategy to increase agricultural output.

The major agricultural objectives of the plan were as follows:-

(a) To accelerate the pace of implementation of land reforms.

(b) To extend the benefits of new technology to more farmers.

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(c) To make agricultural growth not only an instrument of maintaining an effective national food security system, but, a catalyst of income and employment generation in rural areas.

(d) To promote a scientific land water use pattern based on conservation of ecology, energy conservation, and employment generation.

Actually this plan was revised twice and was finally published in 1981 due to change in policies of government in the centre. During this period agriculture grew at the rate of 4.3 percent against the target of 3.8 percent. This growth was mainly due to good performance of agriculture and service sector.

The production of food grain in 1983-84 was 152 million tons and was welcomed by the government as a Second Green Revolution. The first Green revolution (1967-68) had introduced, new high yielding varieties of American wheat and dwarf rice varieties.

The first green revolution was confined mainly to Punjab Haryana and Western UP. The Second green revolution (1983-84) spread to eastern and central states including West Bengal, Bihar, Orissa, Madhya Pradesh and Maharashtra. These states have made tremendous progress in recent years.

(7) **SEVENTH PLAN : (1985-90)**

Before formulating programme for agricultural development, planning commission made a thorough evaluation of the weaknesses of Indian
Agriculture. The outlay for agriculture under this plan was Rs. 39770 crores, i.e. 22 percent, out of a total outlay of Rs. 1,80,000 crores of this plan. Under this plan a special importance was given to rice production programme in the eastern region, National Watershed Programme for rainfed agriculture, National oilseed development project, social forestry etc.

During the seventh plan, the following specific programmes were implemented-

(a) A centrally sponsored Special Rice Production Programme was under implementation since 1986 in about 440 selected blocks in North East and Central India, through spread of improved rice production technology.

(b) An integrated watershed concept was adopted in rainfed areas, for enhancing productivity and production grains.

(c) A centrally sponsored National Pulse Development Programme was launched in 1986-87 to increase the area and production of pulses by adopting location specific technology.

(d) National Oilseed Development Programme was also sponsored by the Central Government. Major Oilseeds viz. groundnut, rapeseed and mustard, soyabean and sunflower were covered under this programme.
During last two years of the plan there had been good rains and the production was good. Anyway, Seventh Plan was largely successful as the targets were broadly fulfilled.

Even though all the progress made during the first seven plans, following weaknesses were noticed-

(i) There were considerable fluctuations in the output of food grains. This was mainly due to uncertain rainfall in almost all parts of the country.

(ii) There was a high output in some of the areas which were progressive. This gave rise to problem of storage and distribution.

(iii) Desired balanced growth of agriculture was not achieved, and as such yields in some of the regions were very low. Use of modern inputs was thought to be useful for a rise in agricultural productivity in these areas.

(iv) In the less developed areas, marginal and small farmers have very low income and low rate of wages. They could not afford to use modern inputs. The way to lift up these poor people was to encourage them to use modern inputs to increase their crop production.

(v) There also occurred another type of imbalance in the form of disparities in growth between food grain and non-food grain. This type of growth partially reflects regional imbalance. Break through in dry land farming would help to raise the output of millet, pulses and oilseeds and thus to correct inter-crop imbalance.
(vi) Major problem was created by the tremendous growth of rural population and deforestation. This points out to the necessity to check rapid growth of rural population and to restore ecological balance through a forestation, for achievement of water and soil conversation, for raising crop productivity and also for meeting the growing rural requirements of fuel and fodder.

(8) **EIGHTH PLAN : (1992-97)**

Eighth Plan for agricultural development aimed at generating surplus for exports in food grains and attaining self sufficiency in respect of pulses and oilseeds. This plan expected agriculture to grow at an average annual rate of 4 percent. The outlay for agricultural and allied activities, irrigation and food control was Rs. 54992.5 crores (12.67 percent) out of the total outlay. In order to attain a desired growth in agriculture, special efforts were made for enhancing the productivity and reducing the instability of production. Since about two third of the area was still unirrigated and largely rainfed, greater stress was laid on dry land farming. Efforts were made to spread the benefits of the green revolution to other parts of the country, particularly to the eastern regions which have adequate rainfall and fertile soil. Plan aimed at investment in expansion of irrigation potential and improved efficiency of irrigation system to reduce water wastage.
The Indian economy, on the eve of the launching of the Ninth Five Year Plan (on 1st April 1997) was on a reasonably sound footing. The G.D.P. growth presented healthy trend at 7% in 1995-96 and was expected to be sustained in 1996-97. Agricultural growth had slowed down. Nevertheless, food grain buffer stock was comfortable. The agricultural exports declined.

The Ninth plan aim at a growth of 6.5 percent per annum, during the plan period. The rate of growth achieved in 1996-97 estimated at 7.5 percent.

The 6.5 percent growth scenario in the Ninth Plan assumes an agricultural growth rate of 3.9 percent against actual achievement of 4 percent in Eighth Plan. The share of agriculture was 23.9 percent in 2001-02.

(4.3) **GREEN REVOLUTION**

Since the mid-1960's, the traditional agricultural practices were gradually being replaced by modern technology and farm practices in India. Actually the new technology was tried in 1960-61 as a pilot project in seven districts. This was called as Intensive Agricultural District Programme (IADP). Thereafter the high yielding varieties programme was also implemented. This strategy was extended to cover entire country. This strategy has been called by various names viz. Modern Agricultural Technology, or Seed-Fertilizer-Water technology or simply green revolution.

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Traditional agriculture heavily depended upon local seeds, which they saved from last year's production. Use of farm side manures had been the only source of nutrients to crops. Primitives tools and implements had been in use. Modern technology consists of high yielding seeds, chemical fertilizers, pesticides, machinery, extensive irrigation etc.

As a result of green revolution, area under improved seeds increased to 75 million hectares in 1995-96 which was only 15 million hectare in 1970-71. Farmers started taking even three crops during the year. Some of the corps like wheat revolutionised the production. Moreover in modern technology, supplies of seed, fertilizers, pesticides, machineries have to be manufactured. Therefore with the growth of agriculture, the industries which supply various components of new technology to agriculture also have grown fast; during last four decades.

Due to green revolution Indian agriculture had undergone very significant changes, both in the quantitative and qualitative ways. The high-yielding variety of seeds (known as H.Y.V.) invented by Dr. Norman Borlaug, introduced in such a way that entire stagnant agriculture came to the juncture of a massive overhauling. Through the introduction of H.Y.V. wheat seeds of Mexico, rice seeds like Tuichung and I.R. varieties from Philippines seeds of Green Revolution were sown in India.

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Publisher: Central Educational Enterprises, Patnatola Lane Kolkata-9

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(4.4) **GEOGRAPHICAL SET UP -**

Geographical conditions play a key role in the agricultural production of any region, therefore a short account of it has been taken here.

India has a total area of 32,87,263 sq.km. and is 7th largest country in the world. The salient features of the geographical identity of India is the diversity of its physiography, climate, forests, mineral resources, human resources and culture. All types of global geographic conditions exist in India and She is called as 'Epitome of Globe.” Unity exist here inspite of diversity. Indian civilization is ages old.

India is bounded by 8°4' north latitude on its south and 37° 6' north latitude on its north and 68°7' East longitude on its west and 97°25' East longitude on its east.

From north to south and east to west the farthest extensions are 3200 Kms and 2900 Kms, respectively. It has a combined costal length of 7500 Kms.

It has in the north, Himalayan ranges, Pakistan in the west and northwest, Tibet Nepal and Bhutan in the north and northeast, Myanmar in the east central and Bangladesh in the east. India has an international boundary of about 15200 km. In three sides there are oceans viz. Bay of Bengal in Southeast, Indian ocean in south and Arabian Sea in the Southwest. It has 25 states and 6 union territories.
India has famous mountains like Himalaya, Arawali ranges, Satpuola ranges, Western hills and deccan plateau, Nilgirist etc. Rivers are classified as Himalayan rivers, Peninsular rivers, coastal rivers and inland basin rivers.

**CLIMATE -**

India is perhaps the only country in the world where such a wide variation of climates occur in close proximity. Almost every type of climate is prevailing in India simultaneously. Extreme dryness on one end, high precipitation (rainfall) on the other and scorching sultry heat in one extremity while moist dampness in the other region. Large latitudinal extent and unique physiographic variations bring such differences of climate from one region to another.  

**RAIN FALL -**

The Western part of India remains dry throughout the year. Here the annual rainfall is one of the lowest i.e. less than 30 cm per year. Rainfall increases towards east and south. In the extreme north east, rainfall even exceed one thousand centimeters. India receives most of its rainfall from outburst of monsoon. As these outburst are entirely controlled by external forces, distribution of rainfall is uneven. The volume of rainfall is also not certain.

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\[^{8}\] "Economic Geography – A study of resources" 2001 page 430-431 by P.K.Roy  
Publishers : Central Educational Enterprises Patuatota lane Calcutta-9
**TEMPERATURE -**

Due to proximity to Tropical region south India experience highest temperature average. Temperature varies very little in this region. Further north, pronounced cold is experienced. In extreme north, the winter becomes chilly and severe. From March to May the temperature gradually goes up, but June onwards due to the outburst of southwest monsoon, moderating effect of rainfall brings down the temperature considerably. Compared to costal areas, the interior regions have to face severe heat.

**SEASONS -**

For six months India remains under monsoon, either incoming or retreating. Other six months may be divided into cold weather and hot weather seasons. Cold weathers occures in December to February. Hot weather prevails from March to May Southwest monsoon remains from June to September and retreating Southwest monsoon from October to November.

**SOIL -**

India has the largest cultivable land in the world. Much diversity occures in soils of India. In the post independence era agriculture occupies important share in G.N.P. with the growing importance of agriculture quality of soil is also gaining importance day by day.
Soils of India are broadly divided into two groups. (1) Residual soil and (2) Drift Soil. Residual soil is mostly found in the peninsula region. After the washing away of soluble minerals, decomposed organic matter has altered the original fragmented rocks to soil. Drift soils are mainly laid down by flowing of water North Indian Plain is good example of this type of soil formation.

According to variant of texture, structure, colour, constituent minerals soils are subdivided into eight broad groups.

(1) **ALLUVIAL SOIL** -

Alluvial soil is most important for agriculture as fertile agricultural fields. All large river basins are alluvial soils. They have gray to light gray colour. This type of soils are widespread in Uttar Pradesh, Bihar, West Bengal, Punjab Rajasthan Assam Orissa and Madhya Pradesh, Tamil Nadu, Andhra, Kerala and Karnataka.

(2) **BLACK COTTON SOIL** -

Such soils are in Deccan region. They occur in the states of Maharashtra, Gujarat, Madhya Pradesh and Andhra. This soil generally develops in granite.
(3) **RED SOIL** -

This type of soil occurs in areas of Karnataka, Tamilnadu, Orissa, Central India and West Bengal. This soil has ferrous structure.

(4) **LATERITE OR LATERISTIC SOIL** -

It is red brown coloured complex type of soil. Requires more amount of water and is not very good for agriculture. Soil layers are not thick. Such land is found in margins of Deccan, Central India, Maharashtra and Karnataka.

(5) **ARID SOIL** -

This occurs in vast dry tract of northwest India. Where rains are very scanty. Rajasthan Punjab and Gujarat Partly have such soil. Not very favourable for agriculture.

(6) **FOREST SOIL** -

Such soils develop due to thick forests. This is in the areas of Himalayan and other high altitude areas. These soils are primary and premature. They contain minerals but are not good for agriculture.

(7) **PEATY SOIL** -

Such soils are saline and occur near coastal areas. These soils are in eastern and western coats of India.
(8) **ALKALINE SOIL** -

Such soils are those which have been deteriorated by intense agriculture. They have more alkali content, but nitrogen and organic matter is low.

(4.5) **POPULATION** -

According to census 2001 Indian Population stood at 1027.015 million (102.7 crores). As per census 1991 the population was 84.393 crores. The growth rate of Indian population is quite high.

According to 2001 census total population was 10,27,015,247 having males 531,277078 and females 495,738,169. Sex ratio was 933 females per 1000 males, which was 927 in 1991. Sex ratios vary state to state.

Literacy rate has gone up from 52011 in 1991 to 65.3 percent in 2001. The percentage of cultivators and labourers in agriculture was 67.2 and 38.4 percent respectively in 2001. The corresponding percentages in 1991 census were 66.8% and 38.4%

This shows that number of cultivators have increased during last ten years but there is no increase in labourers number. This may be due to widespread unemployment in the country.
Increased population creates problems in almost all sectors including agriculture. Growing population causes, increase in the dependence on agriculture; moreover, there is danger of more fragmentation in agriculture which ultimately reduces the output and thus development suffers.

(4.6) **LAND UTILIZATION PATTERN**

Land utilization pattern study gives an idea about the use of land to which it is put to. Land is a fixed natural resource and cannot be increased or decreased. Land has alternative uses and is scarce.

Table No. 4.1 gives details about the use of land pattern.
### TABLE 4.1

**PATTERN OF LAND UTILISATION IN INDIA**

<table>
<thead>
<tr>
<th>Year</th>
<th>Total area reported</th>
<th>Forests</th>
<th>Not available for cultivation</th>
<th>Permanent Pastures Grazing lands</th>
<th>Under Tree Crops &amp; Groves</th>
<th>Culturable waste land</th>
<th>Fallow lands</th>
<th>Current Fallow Lands</th>
<th>Net sown area</th>
<th>Area sown more than once</th>
<th>Total cropped Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990-91</td>
<td>304862</td>
<td>67805</td>
<td>40476</td>
<td>11404</td>
<td>3818</td>
<td>14895</td>
<td>9662</td>
<td>13703</td>
<td>142999</td>
<td>42743</td>
<td>185742</td>
</tr>
<tr>
<td>1992-93</td>
<td>304845</td>
<td>68277</td>
<td>40912</td>
<td>11074</td>
<td>3755</td>
<td>14573</td>
<td>9675</td>
<td>14155</td>
<td>142717</td>
<td>42983</td>
<td>185704</td>
</tr>
<tr>
<td>1993-94</td>
<td>304881</td>
<td>68392</td>
<td>40904</td>
<td>10966</td>
<td>3696</td>
<td>14409</td>
<td>9836</td>
<td>14376</td>
<td>142419</td>
<td>44176</td>
<td>186595</td>
</tr>
<tr>
<td>1994-95</td>
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<td>11034</td>
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<td>13831</td>
<td>142197</td>
<td>45274</td>
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<tr>
<td>1996-97</td>
<td>304877</td>
<td>68750</td>
<td>41542</td>
<td>11040</td>
<td>3567</td>
<td>13944</td>
<td>9892</td>
<td>13323</td>
<td>142819</td>
<td>46724</td>
<td>189542</td>
</tr>
</tbody>
</table>

Publisher: Central Statistical Organization, Ministry of State & Programme Implementation Stat. Abstract India 2000: Pg. No. 20-21 Table 3.1
According to the table 4.1, land area reported shows nearly constant trends except few thousand hectares there is no change.

Area under forest during 1991-97 has grown by almost 945000 hectares. This is due to various programmes undertaken by Government for aorestation. This is encouraging result as the rains received and area under forests has a high positive correlation. Before independence and a few years latter forests cuttings (deforestation) has done lot of damage to natural rain cycle.

Area not available for cultivation (column 4) has increased, in 1997 over 1991 this is a matter of concern. This is solely an impact of fast urbanization in India especially around bigger cities. Non-Agricultural permission is granted to big builders and developers. Consequently agricultural area declined. Moreover dams construction, road construction etc. also increases non-agricultural lands.

Permanent pastures and grazing lands are important as they provide feed for cattle's. (Column 5) there is reduction noticed in 2000 compared to 1991. This may be due to allotment of lands to the landless and adivasis (aborigin backward) people.
Reduction in land under miscellaneous trees crops and groves is found decreased (column 6). This is because of land development (agricultural) programmes. Such land many times is brought under cultivation. Culturable waste land seems to be constant. This type of land can be cultured and brought under cultivation, but many often expenditure for this is excessively high, hence land remains as it is, or unchanged (column 7).

Fallow lands (column 8) other than current fallows, include both lands which are kept fallow for shortage of irrigation or some other difficulties like credit or current capital. Moreover many often small holders have to migrate to nearby town ship for their living and therefore their holding remain fallow under this category. Such fallows are defined as the lands remained uncultivated continuously for more than five years.

Current fallow lands are those which are temporarily (less than 5 years) kept fallow. Area of such land in India is found reduced in 1997 over 1991. (Column 9). This is encouraging, this is impact of new agricultural technology, which makes possible for the farmers to sow their land more than once even during three seasons. The harvesting done by machines and it gives opportunity to the farmers to prepare their land quickly for next crop. There is a shrinkage in net sown area (column 10). This is due to land put to non-agricultural use like houses, roads or any other use. Moreover it is also numerical effect, as the land sown more than once is excluded from it.
Area sown more than once (column 11) has shown a very encouraging growth from 42743 thousand hectares in 1991 to 46724 thousand hectares in 2000. This shows a positive change in cropping pattern. This can be said to be the wide spread impact of new agricultural technology in India since green revolution. New agricultural inputs like HYV, mechanization, plant protection etc. encourage farmers to take production of crops more than once or twice or thrice during the year (cropping pattern). Total areas sown or cropped has increased (column 12) by about 3801 thousand hectares. This is due to new technology used as well as some lands from forests, and grazing land have been brought under cultivation. Moreover it is an impact of land development and soil conservation programmes. The landless persons also started sowing and therefore such area increased in India.

CONCLUSION -

The study of table 4.1 reveals that the land utilization pattern has an encouraging and satisfactory upward trend during the last decade.

(4.7) MAIN CROPS AND THEIR PRODUCTION -

To measure the impact of new technology in agriculture, it becomes necessary to study the growth in production of crops, and growth in productivity i.e. yield per unit of land (hectare/area). The first part of this section (4.7) describes the production of main food corps in India from 1981 to 2000. The second part studies, the area under some crops and growth in
production of those crops. In fact, span of period for this study work is 1991-2000; but as the data of two decades would give a more clear picture of development, it has been used here.

The major and commonly grown corps in almost all states of India are as follows:

(1) **RICE**

Rice is the most important food grain product in India. It is part of the food (and main food in some states) of majority of people in India. Production of rice was 53.6 million tonnes in the year 1980-81 it increased to 74.3 million tonnes in 1990-1991 and further 89.5 million tonnes in 1999-2000. This shows a percentage growth rate of 36.61 percent and 66.97 percent respectively in 1991 and 2000; over 1980. This is quite satisfactory growth and shows a significant positive impact of new agricultural technology.

Cultivation of rice in India is mostly concentrated in eastern and southern regions. Though rice is cultivated more in the eastern states due to heavy consumption, these became deficit areas, whereas Punjab and Haryana, inspite of their less production, became surplus due to low consumption.
(2) **WHEAT** -

In order of importance, wheat is next to rice. Production of rice in 1980-81 was 36.3 million tonnes it grew to 55.1 million tones in 1990-91 and 75.6 million tones in the year 2000. This shows almost more than double production over 1980-81. This is tremendous growth. Main states which are ahead in production are Punjab, Haryana, Rajasthan, Uttar Pradesh, Madhya Pradesh, Bihar, Gujarat and Maharashtra, Uttar Pradesh alone accounts for 30 percent of total wheat production in India. Punjab is leading in all aspects, contributing 15 percent of Indian wheat production. Yield of wheat production in Haryana (canal irrigated) is the highest in India.

(3) **JOWAR** -

Jowar is third important crop. Production of Jawar was 11.68 million tonnes in 1991 and in 1992-93 it was 12.80 million tonnes. In 1996-97 production was 10.93 million tons. Thereafter slight decline is observed and in 1999-2000 production came down to 8.86 million tonnes.

Some of the crops have fluctuating production per year. Jowar is mainly a kharif crop which requires less amount of water. Once kharif season suffers, then rabi season has always less production of Jowar than kharif jowar. During the last couple of decade the tendency or trend towards cash crops is growing fast. Jowar comparatively is a cheaper crop (food) therefore, no special efforts have been taken to increase its production on the national level. However yield per hectare shows increase over 1960-61.
Major jowar producing states are Maharashtra, Madhya Pradesh, Andhra Pradesh, Karnataka, Rajasthan and Gujarat.

(4) BAJRA -

Bajra Production stands fourth in terms of volume and area under cultivation. In 1991 production was 6.894 million tones. In 1995-96 it was 5.381 million tons. In 1996-97 it grew to 7.865 million tons. But in 1999-2000 it came down to 5.657 million tons. Crop production shows fluctuations in yearly production, but overall average is nearly constant. Bajra is also a kharif crop mostly dependent upon rains. Therefore, whenever there are less rains there would be fall in production in that year. Moreover being cheap price food; no much emphasis is given on production of this crop. Bajara is popular diet in north western part of India viz states like Rajasthan, Gujarat and Maharashtra.

(5) MAIZE -

Maize is essentially a North Indian food crop, covering the states of Uttar Pradesh, Punjab, Harayana, Rajasthan, Madhya Pradesh, Bihar and Andhra Pradesh.

Production of maize during 1991 was 8.962 million tones, it slightly grown upto 1995-96 which was 9.534 million tons. There after it constantly continued to grow upto 11.473 million tons in 1999-2000. It means almost one
and half times more during the decade. The reason for such growth is the use of new agricultural technology. Second reason that maize is used as fodder crop for cattle’s in many states. The third reason is that it is a raw material for several products of confectionaries, and has higher selling price than jawar and bajra comparatively.

(6) OTHER COARSE CEREALS -

Other coarse cereals like ragi, barley and small millet are included in this category. Most of these crops show no significant changes, owing to less use of them compared to other cereals.

(7) PULSES -

India produces several varieties of pulses. Pulses contribute a substantial amount of protein in the regular diet of the average Indian. Major varieties are Tur, Gram, Mung, Udid, Masure, Matar. Proportion of land sown under each of these and production varies from state to state. Production of total pulses was 14.265 million tones in 1991. In 1995-96 it was 12.310 million tons and in 1999-2000 it was 13.349 million tons. Thus during last decade the production ranges form 12 to 14 million tons. However production of pulses in 1999-2000 if compared with production of 1980-81 which was 10.6 million tons shows increase of 2.8 million tons only.
(8) **OIL SEEDS** -

Important oilseeds produced in India are groundnut, sunflower, soyabean, sesamum, rape and mustard seeds and linseed, caster seed (non food) etc. Crop of oilseeds is also one of the cash corps. It is grown in all parts of the country. Apart from direct consumption, it is also used as a major constituent in various industries, ranging from chemicals to medicines. Groundnut alias peanut is the major source of Indian Oil output. This edible oil is mostly used for manufacturing, vanaspati Ghee, Cosmetics and medicines.

During decade of 1991-2000, production shows yearly fluctuation and had been in the range of 7.5 million tons to 8.5 million tons. It remained more or less constant compared to 1980-81 production. Main reason of such stagnation is competition from other cash crops like sunflower.

Production of oilseeds altogether shows a rising trend during last decades. In 1980-81 it was 9.4 million tons, it grew to 18.6 and 20.9 million tons in 1990-91 and 1999-2000 respectively.

(9) **SUGARCANE** -

India ranks second in the world sugarcane production after Brazil. This is first ranking cash crop in some of the states like Maharashtra. Production progress of sugarcane is very satisfactory. Production seems continuously growing since 1960-61 onwards. In 1970-71 production was 126.4 million tons; in 1980-81 it became 154.2 million tons and in 1990-91 it was 241 million tons and at the end of 2000 it grew upto 299.2 million tons.
This growth is mainly due to increase in number of sugar factories in the country. The crop remains in the field for more than 14 months, in which it is harvested twice.

(10) COTTON -

At present India secures fourth position in cotton production. Production of cotton has risen nearly fivefold since 1950. Cotton is regarded as one of the most lucrative cash crops in India. It is raw material for cotton mills, and also earns a lot of foreign currency through export. After partition good quality cotton growing areas went to Pakistan.

Cotton crop shows a satisfactory growth during last two decades. In 1980-81 it was 7 million bales, which grew to 9.8 and 11.6 million bales in 1990-91 and 1999-2000 respectively.

(4.8) CROPPING PATTERN -

Amount of production in physical units (quintals, tonnes etc.) gives, only an idea about increase or decrease in physical quantity of the yield, without any knowledge of increase or decrease in the relative sown area under those crops. Therefore it would be more appropriate to compare the changes in both the variable.

Table No. 4.2 has been prepared taking 1980-81 as the base year for this purpose. The table serves three purposes.
(a) It shows changes in cropping pattern (change in area sown)

(b) It compares the area and production.

(c) Relative changes in magnitude (Decadal) can be studied with index numbers.

(a) When technology in agriculture changes, it may cause a change in cropping pattern also. Due to the use of time and labour saving machines, it becomes possible for farmers to grow crops more than once or twice during the year. This happens because all the components of new agriculture technology, are highly efficient. viz. mechanization, which saves time of cultivation, harvesting etc. Farm works are done more quickly than labourer and animal draught power. Thus land is quickly made ready for next crop. Likewise most of the H.Y.V. seeds have comparatively much short period of growth and harvesting. New chemical fertilizers used in scientific way with proper doses, restore the productivity and genetic ability of the soil in a very short time. All these advantages together encourage farmers even to take three crops during all three seasons i.e. kharif, rabi and summer. From the observation of table 4.2 it can easily be concluded that food crop sown area increased and production also increased. Simultaneously for some crops the area decreased but production increased as the productivity increased. This is the economic impact of change in agricultural technology. The impact is necessarily economic since the growth in production means growth in real income of the farmers. Thus it may be concluded that cropping pattern changed in favourable direction.
## TABLE - 4.2

**COMPARATIVE CHANGES IN AREA AND PRODUCTION AND RELATIVE INDEX NUMBERS IN INDIA. DURING 1980-81 TO 1999-2000.**

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Total Food grains</td>
<td>(100)</td>
<td>126.70</td>
<td>128.20</td>
<td>123.10</td>
<td>(100)</td>
<td>129.6</td>
<td>176.4</td>
</tr>
<tr>
<td>2.</td>
<td>C.Cereals</td>
<td>(100)</td>
<td>41.80</td>
<td>36.32</td>
<td>30.80</td>
<td>(100)</td>
<td>29.02</td>
<td>32.7</td>
</tr>
<tr>
<td>3.</td>
<td>All pulses</td>
<td>(100)</td>
<td>22.50</td>
<td>24.70</td>
<td>21.20</td>
<td>(100)</td>
<td>10.6</td>
<td>14.3</td>
</tr>
<tr>
<td>4.</td>
<td>Rice</td>
<td>(100)</td>
<td>40.10</td>
<td>42.70</td>
<td>45.00</td>
<td>(100)</td>
<td>53.06</td>
<td>74.3</td>
</tr>
<tr>
<td>5.</td>
<td>Wheat</td>
<td>(100)</td>
<td>22.30</td>
<td>24.20</td>
<td>27.40</td>
<td>(100)</td>
<td>36.3</td>
<td>55.1</td>
</tr>
<tr>
<td>6.</td>
<td>All oilseeds</td>
<td>(100)</td>
<td>17.60</td>
<td>24.10</td>
<td>24.40</td>
<td>(100)</td>
<td>9.4</td>
<td>18.6</td>
</tr>
<tr>
<td>7.</td>
<td>Groundnut</td>
<td>(100)</td>
<td>6.80</td>
<td>8.30</td>
<td>6.90</td>
<td>(100)</td>
<td>5.0</td>
<td>7.5</td>
</tr>
<tr>
<td>8.</td>
<td>Rape &amp; mustard</td>
<td>(100)</td>
<td>4.10</td>
<td>5.80</td>
<td>6.10</td>
<td>(100)</td>
<td>2.3</td>
<td>5.2</td>
</tr>
<tr>
<td>9.</td>
<td>Sugarcane</td>
<td>(100)</td>
<td>2.70</td>
<td>2.70</td>
<td>4.20</td>
<td>(100)</td>
<td>154.2</td>
<td>241</td>
</tr>
<tr>
<td>10.</td>
<td>Cotton (bales)</td>
<td>(100)</td>
<td>7.80</td>
<td>7.4</td>
<td>8.8</td>
<td>(100)</td>
<td>7</td>
<td>9.8</td>
</tr>
</tbody>
</table>

Foot note: 1. C.Cereals = Coarse cereals i.e. Jawar Bajra, Maize, ragi etc.
2. Total food grains = Total of serial No. 2 to 5
3. All oilseeds includes groundnut.
4. Cotton is shown in bales of 140 kg@ (in million)
5. Figures in bracket are index number at base year 1980-81

Source: State of Indian farmer, A millennium study, Crops & Cultivation Vol.9 Page No. 244-245, Table 2.1 and 2.2
(b) **COMPARATIVE GROWTH IN AREA & PRODUCTION**

Table 4.2 shows growth in area and growth in production. The numbers in bracket are index numbers at the base year 1980-81. Crop wise analysis is as follows:-

(1) **All Foodgrains:**

Index shows 1.65 percent growth in areas sown in 1990-91 over base year and there is drop of about 2.85 percent during 1991-2000 decade. However it is encouraging to note that inspite of decrease in area the production index shows a continuous growth since 1980 onwards. Production in 1990-91 increased by 36.11 percent and further 61.18 percent in 1999-2000. This was a significant growth inspite of reduction in area sown. This means there is significant increase in productivity in last two decades; which may be attributed to the new agricultural technology and its spread during these two decades. This was the status of total cereals.

(2) **Coarse cereals:**

Coarse cereals include corps like jowar, bajra maize etc. Area under these crops has a declining trend from index 100 it declined to 86.88 in 1990-91 and further declined to 73.68 (i.e. decrease of 6.38 percent) in 1999-2000. Production shows growth of 10.26 percent over the base year. This slight increase was owing to use of HYV seeds. The market prices of coarse cereals are far less compared to other corps (especially cash crops) hence, due to poor monetary returns, farmers become indifferent towards such corps. Moreover
these being kharif corps depend upon rains therefore production in any way is less than other rabi crops.

(3) Pulses:

Area under pulses decreased by 5.88 (from 100 to 94.22) percent while the production shows high rise of 143.90 (43.9 percent) in 1990-91 and 26.41 in 1999-2000. As the production increased inspite of decrease in area, it shows the success of new HYV seeds and impact of new technology. Rise in production also makes a gesture towards the higher returns in monetary terms for pulses. The prices of pulses compared to cereals are quite high, during the post green revolution period.

(4) Rice:

Crop of rice shows increase in area as well as increase in production the area in 1999-2000 increased by 12.21 percent and production increased by 66.97 percent. This is an excellent progress. New yielding variety of rice give more production. The prices of rice in the market are much higher than other cereals therefore there is a rising trend both in area and production in case of this crop. Export is also an important cause for such progress. The steady upward trend in the output of rice signifies a breakthrough in this crop.
(5) **Wheat:**

Area under wheat crop continued to rise since 1980-81 till 1999-2000. In 1999-2000 the rise was 22.86 percent this was 108.26 percent over the base years. Not only during last two decades but since the beginning of green revolution the wheat crop shows a very significant growth. This spectacular performance in wheat production has earned a nickname “Wheat revolution”. This crop has a maximum positive impact of new agricultural technology; during post green revolution period.

(6) **All Oil Seeds:**

Area under all oilseeds has been showing upward trend. In 1990-91 growth was 36.93 percent and in 1999-2000 it was 38.63 percent. Production growth during corresponding period was 97.87 percent and 122.34 percent over the base year 1980-81. Taking into account the impact of new technology, and profitable returns on oilseeds the increase is justifiable. Oilseeds are cash crops. They are raw material for several edible oil factories, cosmetic and soap factories and some other industries. Owing to its use and demand the cropping pattern shows changes. The area under coarse cereals and pulses seemed to have been replaced by oilseeds.

(7) **Ground Nut:**

Crop of groundnut separately considered shows fluctuations and slight increase both in area as well as production.
(8) **Rape Seed & Mustard:**

India leads other countries in the production of this crop. In many of the states U.P. and Punjab and some in south use oil of rape seed and mustard for cooking.

Tremendous growth in the area as well as production is observed. Growth in area was 48.78 percent while production increased by almost more than double i.e. 160.86 percent, in the last decade only.

(9) **Sugarcane:**

Area under sugarcane increased by 55.55 percent in 1999-2000 over the base year and production also increased by 94.03 percent. This continuous growth may be attributed to the increased number of sugar factories in India. It's residue is also a raw material for factories who produce by products like paper and alcohol in the country. Moreover it is a cash crop and generally grown in cooperative sector, which has its organized way form cropping to marketing.

(10) **Cotton:**

Area under cotton shows 12.82 percent growth against 65.71 percent growth in production in 1999-2000. This is an export oriented cash crop, therefore shows an upward trend in area and production.
Productivity in agriculture means productive capacity of land when combined with other factors or resources. Productivity increases when resource efficiency increases. Resource efficiency of land increases when inputs are scientifically used according to new agricultural technology. These inputs are irrigation, H.Y.V. seeds, chemical fertilizers, plant protection measures, and labour input.

Economic impact of new agricultural technology could best be assessed studying the yield of crop per hectare. If yield per hectare increases total production of that crop increases, such increase would mean augment to the real income of farmer and consequent economic uplift. Because the farm output is the returns on investments made by farmers in his agricultural enterprise.

Table No. 4.3 gives summary of changes in productivity of principal crops in India from 1980-81 to 1999-2000. The period of two decades would give a better and broader outlook.
### TABLE 4.3

**CHANGES IN PRODUCTIVITY OF PRINCIPAL CROPS**  
*(1980-81 to 1999-2000)*

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Food grains</td>
<td>1023</td>
<td>1380</td>
<td>1697</td>
</tr>
<tr>
<td>Coarse cereals</td>
<td>695</td>
<td>900</td>
<td>994</td>
</tr>
<tr>
<td>Pulses</td>
<td>473</td>
<td>578</td>
<td>630</td>
</tr>
<tr>
<td>Rice</td>
<td>1336</td>
<td>1740</td>
<td>1990</td>
</tr>
<tr>
<td>Wheat</td>
<td>1630</td>
<td>2281</td>
<td>2755</td>
</tr>
<tr>
<td>All oilseeds</td>
<td>532</td>
<td>771</td>
<td>856</td>
</tr>
<tr>
<td>Groundnut</td>
<td>736</td>
<td>904</td>
<td>982</td>
</tr>
<tr>
<td>Rape &amp; mustard</td>
<td>560</td>
<td>904</td>
<td>774</td>
</tr>
<tr>
<td>Sugarcane (Tonnes/ha)</td>
<td>58</td>
<td>65</td>
<td>71</td>
</tr>
<tr>
<td>Cotton (bales)</td>
<td>152</td>
<td>225</td>
<td>226</td>
</tr>
<tr>
<td>Tea</td>
<td>1491</td>
<td>1794</td>
<td>NA</td>
</tr>
<tr>
<td>Coffee</td>
<td>624</td>
<td>732</td>
<td>947</td>
</tr>
<tr>
<td>Rubber</td>
<td>788</td>
<td>1076</td>
<td>1576</td>
</tr>
<tr>
<td>Potato (Tonne/ha)</td>
<td>13</td>
<td>16</td>
<td>19</td>
</tr>
<tr>
<td>Jute &amp; Mesta</td>
<td>1130</td>
<td>1634</td>
<td>1779</td>
</tr>
</tbody>
</table>

Foot note:  
1. Yield of sugarcane in Tonnes per hectare.  
2. Yield of cotton is in bales.  
3. N.A. – Not available

Source: “Agriculture Statistics at a glance 2000”  

Table No. 4.3 gives a very clear picture of the upward trend and positive impact of new agriculture technology on the productivity of principal corps in India during last two decades. Almost all crops show an increased yield per hectare (upward trend). Per hectare yield of total foodgrain has increase from
1023 (in 1980-81) to 1697 kg in 1999-2000 likewise coarse cereals, pulses rice wheat oilseeds, and other crops like cotton, sugarcane, rape & mustard tea, coffee, rubber, potato, jute and mesta show an upward trend in productivity. Productivity of rice and wheat is more prominently noticed.

**INTENSITY OF CROPPING**

Technological changes shift the agriculture from subsistence to intensive agriculture. The following table No. 4.4 gives an idea of changes in area in percent and intensity of cropping.

Where, Cropping Intensity = Gross Cropped Area x 100.

\[
\text{Net sown area}
\]

**TABLE 4.4**

**CHANGE IN AREA PERCENTAGE AND CROPPING INTENSITY**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A. At Food Grains</td>
<td>73.9</td>
<td>68.9</td>
<td>63.7</td>
<td></td>
</tr>
<tr>
<td>B. All Non Foodgrain</td>
<td>26.1</td>
<td>31.1</td>
<td>36.3</td>
<td></td>
</tr>
<tr>
<td>Gross Cropped Area (A+B)</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>C. Gross Cropped Area (Million Hectares)</td>
<td>172.6</td>
<td>185.7</td>
<td>192.6</td>
<td></td>
</tr>
<tr>
<td>Net Sown Area (Million Hectares)</td>
<td>140.0</td>
<td>143.0</td>
<td>142.6</td>
<td></td>
</tr>
<tr>
<td>D. Cropping Intensity</td>
<td>123</td>
<td>130</td>
<td>135</td>
<td></td>
</tr>
</tbody>
</table>

Note: **Crop Group A** - includes all foodgrains viz. Rice, Wheat, coarse cereals and pulses.  
**Group B** – includes all non food and commercial crops like oil seeds Cotton, Jute, Mesta, Sugarcane, Tobacco, Spices, Fruits, Onion, Potato vegetables etc.
Table 4.4 is constructed and compiled from data given in –

Source: (1) Agricultural statistics at a glance 2002.
Published by: Ministry of Agriculture, Govt. of India, New Delhi and
(2) Academic Foundation –“Crops & Cultivation” Volume – 9 Table

The above table gives a good idea about gross cropped area, net sown
area and intensity of cropping. All of these variables show an upward trend, as
continuous increase in cropping intensity is noticed from the table (4.4).

[4.10] **COMPound Growth rates** –

Table No. 4.5 depicts the compound growth rates of area, production,
and yield of principal crops in India. Contents of table give a birds eye view of
shows a very distinct deceleration in the growth rate of crop output during the
1990's compared with the 1980's. The growth rate for all crops taken together
decelerated to 1.96 per annum during 1990-91 to 2000-01 compared with a rate
of 3.19 percent per annum during 1980-81 to 1990-91.

Deceleration in the yield growth rate was noticed, in case of various
crops. The yield growth rate for all crops taken together decelerated from 2.65
percent per annum during the eighties to 1.38 percent per annum during the
nineties. And that for rice deceleration from 3.21 to 1.27 and for wheat from
3.15 to 2.32 per cent per annum.
Similar is the case for cotton. The main reason for deceleration is crop yields is the neglect in public in investment in Research and Development and extension in agriculture.

However, the overall index of production shows a rising trend in production of all the crops in the country. (Ref. Table. 4.2). (G.S. Bhalla "Globalization and Indian Agriculture - Millennium study Vol. 19).
## TABLE 4.5

**ALL INDIA COMPOUND GROWTH RATES OF AREA, PRODUCTION & YIELD OF MAJOR CROPS.**

<table>
<thead>
<tr>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Area</td>
<td>Production</td>
<td>Yield</td>
<td>Area</td>
<td>Production</td>
<td>Yield</td>
</tr>
<tr>
<td>All Crops</td>
<td>0.10</td>
<td>3.19</td>
<td>2.56</td>
<td>0.25</td>
<td>2.28</td>
<td>1.31</td>
</tr>
<tr>
<td>Non Foodgrains</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food grains</td>
<td>0.23</td>
<td>2.85</td>
<td>2.74</td>
<td>-0.17</td>
<td>1.94</td>
<td>1.52</td>
</tr>
<tr>
<td>Cereals</td>
<td>-0.26</td>
<td>3.03</td>
<td>2.90</td>
<td>-0.08</td>
<td>2.10</td>
<td>1.58</td>
</tr>
<tr>
<td>Rice</td>
<td>0.41</td>
<td>3.62</td>
<td>3.19</td>
<td>0.62</td>
<td>1.90</td>
<td>1.27</td>
</tr>
<tr>
<td>Wheat</td>
<td>0.46</td>
<td>3.57</td>
<td>3.10</td>
<td>1.67</td>
<td>3.81</td>
<td>2.11</td>
</tr>
<tr>
<td>Coarse Cereals</td>
<td>-1.34</td>
<td>0.40</td>
<td>1.62</td>
<td>-0.54</td>
<td>1.48</td>
<td>-0.08</td>
</tr>
<tr>
<td>Pulses</td>
<td>-0.09</td>
<td>1.52</td>
<td>1.61</td>
<td>-0.61</td>
<td>0.61</td>
<td>0.96</td>
</tr>
<tr>
<td>Oilseeds</td>
<td>1.51</td>
<td>5.20</td>
<td>2.43</td>
<td>1.14</td>
<td>2.13</td>
<td>1.25</td>
</tr>
<tr>
<td>Cotton</td>
<td>-1.25</td>
<td>2.80</td>
<td>4.10</td>
<td>2.36</td>
<td>1.73</td>
<td>-0.61</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>1.44</td>
<td>2.70</td>
<td>1.24</td>
<td>1.81</td>
<td>2.78</td>
<td>0.95</td>
</tr>
<tr>
<td>Tobacco</td>
<td>-2.79</td>
<td>-1.05</td>
<td>1.79</td>
<td>1.28</td>
<td>1.05</td>
<td>-0.23</td>
</tr>
</tbody>
</table>

**Source:** "State of the Indian farmer" (A millennium study)  
Pub.: Academic Foundation – Crops & Cultivation. Vo. 9 Page 239  
by Ministry of Agriculture (G.O.I. 2004), New Delhi.

(4.4) **DEVELOPMENTS IN AGRICULTURAL INPUTS**

An attempt has been made to discuss the growth trends in important inputs according to New Agricultural Technology in this paragraphs under various heads. The important inputs which have taken into account are irrigation, fertilizers, plant protection, H.Y.V. seeds, labour and mechanization.
There are other inputs also viz. soil conservation, credit and capital, extension services etc. which affect development but being out of scope of this study, no consideration has been given except for reference.

(1) IRRIGATION -

Monsoon in India is most unpredictable, therefore to ensure stability in the drought prone agricultural fields, irrigation became an age-old practice. The country has been bestowed a remarkable water cycle, with monsoon as its core. But because of uncertainty of rains and uneven distribution, the farmer stress more and more on enhanced irrigation. Before independence potential irrigated land in the country was 30 million hectares nearly.

After independence, in the planning periods, the Union Government has been giving high priority to the creation of irrigation potential in the country. A number of areas were earmarked to be covered under the fold of irrigation. In 1950-51, irrigation potential was enhanced from 20 million hectares to 22.6 million hectares of land. Combined irrigated area in the first five years plan increased to 26.26 million hectares. In second Five Year Plan targets could not be achieved due to shortage of funds. Area under irrigation in 1960-61 was only 29 million hectare. At the end of Third Five Year Plan area under irrigation increased to 33.6 million hectares. Thereafter a rapid extension of irrigation in new areas took place. In 1978-79 total area under irrigation increased to 55 million hectare over 1960-61.
Estimated water resources of the country are around 2332.35 km$^3$ per annum. But out of this massive resources potential only a very small share of this amount is generally harnessed each year. According to their nature, water resources are broadly divided into two groups.

(1) Surface water.

(2) Ground water.

Surface water share is about 80 percent. Total surface water resources estimated are 1880 km$^3$ per annum, but only 36.7 percent is actually recovered.$^9$

Ground water is another alternative resource for agricultural irrigation. Total estimated ground water reserve in the country is 452 km$^3$. But this resource is not exploited scientifically and random and uneven exploitation create ecological imbalances in many of the regions. Falling ground water level may cause serious damage to ecological balance, in near future.

**TYPES OF IRRIGATION -**

There are four types of irrigation used in the country.

(1) Well irrigation.

(2) Tank Irrigation

(3) Canal Irrigation

(4) Other methods.

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$^9$ "Economic Geography" by Prithwish Roy Edn. 2001 Page 498
Publishers: Central Educational Enterprises, Calcutta -9
Well irrigation is age-old in India: This type is popular because of its relative low cost. Approximately there are 14.5 million wells in India. Most of them are dug wells and others are tube wells.

In some of the states like Tamil Nadu tank irrigation is more popular. In Andhra Pradesh and Maharashtra, numerous tanks were constructed and are popular there. Some of the tanks in the country are well maintained and are main source of irrigation. But some good tanks were abandoned and some of them have gone dry. Canals are also a good source. Some of the canals are as old as Gupta period (100-300 AD). Canals which are directly constructed on rivers are called as inundation canals, water is not controlled. When water is used and stored for whole year such canals are called Perennial Canals.

Irrigation projects are classified as major, medium and minor according to their capacity.

Table No. 4.6 shows a clear picture of development of irrigation potential in India and its utilization during plan periods i.e. from 7th Five year Plan to 9th Five year Plan (1985 – 2000).
According to data in this table, in Seventh Five Year Plan, potential created and utilized was 29.9 and 25.5 million hectares respectively. It continued to increase and in 1999-2000 the corresponding coverage become 35.35 and 30.47 million hectares, by major and medium projects.

In case of minor irrigations significant growth is seen. Total irrigation thus increased to 94.73 and 84.70 in 1999-2000. It is worthwhile to view at the data of net irrigated area under different types of irrigation. Table No. 4.7 shows the area irrigated by various types of irrigation.
Table No. 4.7

NET IRRIGATED AREA UNDER DIFFERENT WATER RESOURCES

(Million hectares)

<table>
<thead>
<tr>
<th>Year</th>
<th>Canals Govt.</th>
<th>Canals Private</th>
<th>Tanks</th>
<th>Tubewell &amp; Wells</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990-91</td>
<td>16.97</td>
<td>0.48</td>
<td>2.94</td>
<td>12.88</td>
<td>2.75</td>
<td>46.70</td>
</tr>
<tr>
<td>1991-92</td>
<td>17.00</td>
<td>0.48</td>
<td>2.94</td>
<td>24.69</td>
<td>2.93</td>
<td>48.02</td>
</tr>
<tr>
<td>1992-93</td>
<td>17.00</td>
<td>0.45</td>
<td>2.85</td>
<td>26.38</td>
<td>3.59</td>
<td>50.29</td>
</tr>
<tr>
<td>1993-94</td>
<td>17.18</td>
<td>0.45</td>
<td>2.82</td>
<td>27.66</td>
<td>3.81</td>
<td>51.34</td>
</tr>
<tr>
<td>1994-95</td>
<td>16.79</td>
<td>0.48</td>
<td>3.27</td>
<td>28.91</td>
<td>3.53</td>
<td>53.00</td>
</tr>
<tr>
<td>1995-96</td>
<td>16.56</td>
<td>0.55</td>
<td>3.11</td>
<td>29.69</td>
<td>3.46</td>
<td>53.40</td>
</tr>
<tr>
<td>1996-97</td>
<td>16.78</td>
<td>0.48</td>
<td>3.34</td>
<td>30.81</td>
<td>3.62</td>
<td>55.04</td>
</tr>
<tr>
<td>1997-98</td>
<td>16.61</td>
<td>0.47</td>
<td>3.10</td>
<td>30.88</td>
<td>3.49</td>
<td>54.36</td>
</tr>
</tbody>
</table>

Source: Indian Agriculture 2003 Page No. 51
Pub: Indian Economic Data Research Centre, New Delhi.

Area irrigated under canal irrigation was near about constant. Tank irrigation shows increased use from 2.94 to 3.10 million hectare means a slight increase. Tube wells and wells are most popular and number increased to irrigate 30.88 million hectare in 1997-98.

At present there are 15 major projects which are built after independence. These multipurpose huge projects are hydel power projects, and contribute to economic progress. They are situated in various states form Punjab to Tamil Nadu etc. Famous names are Damodar Valley Project, Bhakranangal Punjab, Hirakud, Tunga Bhadra etc.
These are 171 major irrigation projects which were launched since First plan, which have not been completed till 2004. New Medium and minor irrigation projects are still considered.

**ACHIEVEMENTS -**

Despite the poor progress of completion of irrigation projects, the overall achievements in the creation of irrigation facilities has been better in India if it is compared with the world average at the world level. Total irrigated area was 198 million hectares in 1977 which rose to 228 million hectares in 1987 and 267 million hectares in 1997. This represents a growth 35 percent in the period of 20 years.

In 1977, the total area under irrigation was 48 million hectares in China and 35 million hectares in India, in 1997. While the total irrigated area rose by only 4 million hectare to 52 million hectares in China and it rose in India by 63 percent or 22 million hectares to 57 million hectares. (In 1997 the total area under irrigation in U.S. was 21.4 million hectares and in Pakistan 17.5 million hectares).

**GLOBAL WATER OUTLOOK -**

A report has been prepared by the International Food Policy Research Institute and the International Water Management Institute, under the title “Global Water Outlook 2025”. It is pointed out that there is a need for making fundamental changes in water policies and environment priorities in many countries in order to achieve sustainable use of water and reap the concomitant
benefits. A serious water crisis of global proportion is looming large, threatening to affect, not only environment but also food supply and health of several millions, unless remedial measures are initiated soon.

The requirement of water for household use, industrial purpose and agriculture is expected to increase by at least 50 percent in the next 20 years, due to increase in population and urbanization in developing countries. It will not be possible to curtail the household and industrial use much, it will be the agriculture sector that will be affected the most.

(2) **HIGH YIELDING AND HYBRID SEEDS**

High yielding varieties of seeds and hybrid seeds have been proved to be a boon for agriculture in India since green revolution. National Seeds Corporation was the first to produce and distribute HYV Seeds and hybrid seeds, in India since 1963. Seed producing industry belonged to public sector till 1988 when new seed policy was announced and enforced. New Seed Policy liberalized impart of seeds as well as permitted foreign collaboration in private sector. Since the new seed policy came into force, production, consumption and demand for good quality seeds has been continuously increasing.

At the end of 2000, National Seed Corporation was the major producer and distributor, besides this, State Farm Corporation of India and 13 state seed corporation and about 100 major private sector seed companies are in the field of this business. Government is well aware of quality of seeds and have set up
organizations for this purpose. There are 21 state seed corporation agencies and 101 State Seed Testing Laboratories in the country.

At present most of the seeds of coarse grains like bajra, sorgham, maize, ragi etc., and oilseeds, vegetable cotton etc. are produced and marketed by private sector while most of the cereals and other food crops seeds are produced and distributed by State Seed Sector. Andhra Pradesh is a seed capital of India.\textsuperscript{10} The seed processing of most of the seed companies including the multinational companies are located in Andhra Pradesh. 59 percent of the total production of hybrid seeds of cotton in India is produced in Andhra Pradesh.


\textsuperscript{10} Indian Agriculture 2003. Page 61
Pub: Indian Economic Data Research Centre, New Delhi.
Table No. 4.8 gives a detail idea about production of HYV and hybrid seeds in India during 1990-91 to 1999-2000.

**TABLE 4.8**

**PRODUCTION OF SEEDS IN INDIA (1990-91 TO 1999-2000)**

(Figures 000 Quintals)

<table>
<thead>
<tr>
<th>YEAR</th>
<th>BREEDER</th>
<th>FOUNDATION</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990-91</td>
<td>33.98</td>
<td>335</td>
<td>5929</td>
</tr>
<tr>
<td>1991-92</td>
<td>33.96</td>
<td>375</td>
<td>5788</td>
</tr>
<tr>
<td>1992-93</td>
<td>36.00</td>
<td>393</td>
<td>6025</td>
</tr>
<tr>
<td>1993-94</td>
<td>37.00</td>
<td>406</td>
<td>6220</td>
</tr>
<tr>
<td>1994-95</td>
<td>40.11</td>
<td>473</td>
<td>6586</td>
</tr>
<tr>
<td>1995-96</td>
<td>43.36</td>
<td>476</td>
<td>6992</td>
</tr>
<tr>
<td>1996-97</td>
<td>46.02</td>
<td>576</td>
<td>7327</td>
</tr>
<tr>
<td>1997-98</td>
<td>46.13</td>
<td>684</td>
<td>7879</td>
</tr>
<tr>
<td>1998-99</td>
<td>38.99</td>
<td>675</td>
<td>8497</td>
</tr>
<tr>
<td>1999-2000</td>
<td>51.23</td>
<td>466</td>
<td>8798</td>
</tr>
</tbody>
</table>


Observation of table shows a steady upward demand and production of seeds in India. Breeder seeds increased to 51.23 thousand quintals in 1999-2000 which was only 33.98 thousand quintals in 1990-91. In percent the increase was 50.76. Foundation seeds also shows rising trend, in 1990-91 it was 335 thousand quintal and grew to 466 thousand quintals (39.10 percent) in 2000. Total production increase to 8798 thousand quintals in 2000, which was 5929 quintals in 1991 (48.38 percent).
**AREA COVERED UNDER H.Y.V. SEED**

A steady increase in the area under HYV seeds shows that, importance and use of HYV seeds is understood by more and more farmers every year and therefore during last couple of decades area covered has been increasing. Table 4.9 shows the changes in covered area under H.Y.V. seeds, for important crops like cereals.

**TABLE 4.9**

**AREA COVERED UNDER H.Y.V. SEEDS FOR MAIN CEREALS**

(MILLION HA.)

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Paddy</td>
<td>27.39</td>
<td>27.95</td>
<td>27.48</td>
<td>28.91</td>
<td>31.04</td>
<td>31.38</td>
<td>33.40</td>
<td>32.20</td>
</tr>
<tr>
<td>Wheat</td>
<td>20.97</td>
<td>20.54</td>
<td>21.70</td>
<td>22.02</td>
<td>23.18</td>
<td>23.04</td>
<td>23.70</td>
<td>23.00</td>
</tr>
<tr>
<td>Jawar</td>
<td>7.06</td>
<td>6.78</td>
<td>6.92</td>
<td>6.76</td>
<td>7.08</td>
<td>7.49</td>
<td>8.30</td>
<td>9.00</td>
</tr>
<tr>
<td>Bajra</td>
<td>5.70</td>
<td>5.44</td>
<td>5.62</td>
<td>5.10</td>
<td>5.38</td>
<td>5.48</td>
<td>6.10</td>
<td>7.00</td>
</tr>
<tr>
<td>Maize</td>
<td>2.61</td>
<td>2.78</td>
<td>2.58</td>
<td>2.72</td>
<td>3.39</td>
<td>3.60</td>
<td>3.80</td>
<td>3.60</td>
</tr>
<tr>
<td>Ragi</td>
<td>1.25</td>
<td>1.22</td>
<td>1.10</td>
<td>1.18</td>
<td>1.20</td>
<td>1.18</td>
<td>1.10</td>
<td>1.20</td>
</tr>
<tr>
<td>Total</td>
<td>64.98</td>
<td>64.98</td>
<td>65.40</td>
<td>66.69</td>
<td>71.33</td>
<td>72.31</td>
<td>76.40</td>
<td>76.00</td>
</tr>
</tbody>
</table>

Source: "Agriculture statistics at a glance 2000"
Pub: Directorate of Agriculture & cooperation, Ministry of Agriculture, New Delhi.

All these years (since 1990-91) the area under cereal corps has been increasing. Some of the corps like paddy, wheat, jowar has shown a significant area coverage increase, but some coarse cereals like ragi remained near about constant.
Infact there had been a massive growth during the preceding decade (1970-80), as in 1970-71 area under paddy was only 5.59 million hectare, and in 1990-91 it become 27.39 Million hectares. However there was a slow growth upto the year 2000.

CROP WISE CONSUMPTION (USAGE) OF SEEDS IN THE COUNTRY

It is also important to study cropwise distribution (use) of various HYV seeds, which are certified quality seeds. Table No. 4.10 gives a overall idea about each group of corps and amount of seeds in lakh quintal which was used in the country during the last decades.

Cereal Group – includes wheat, paddy, maize, jowar, bajra, ragi, barley, etc.
Pulses group – includes gram, lentil, peas, udad, moong, arhar, cowpea, and others.
Oilseeds Group – includes groundnut, rapeseed/mustard, sesamum sufflower, sunflower, soyabean, linseed, castor seed and others.
Fibre group – includes cotton jute, mesta and others.
Other crop includes potato etc.
### TABLE 4.10

**CROPWISE DISTRIBUTION OF CERTIFIED / QUALITY SEEDS**

(Figures in Lakh Quintals)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals</td>
<td>34.70</td>
<td>35.35</td>
<td>36.72</td>
<td>38.74</td>
<td>41.35</td>
<td>44.03</td>
<td>46.43</td>
<td>51.78</td>
<td>57.27</td>
<td>61.14</td>
</tr>
<tr>
<td>Pulses</td>
<td>3.41</td>
<td>3.29</td>
<td>3.40</td>
<td>3.62</td>
<td>3.60</td>
<td>3.58</td>
<td>4.19</td>
<td>3.89</td>
<td>4.06</td>
<td>3.87</td>
</tr>
<tr>
<td>Oilseeds</td>
<td>8.59</td>
<td>9.66</td>
<td>10.75</td>
<td>11.38</td>
<td>12.01</td>
<td>12.64</td>
<td>12.53</td>
<td>12.87</td>
<td>13.83</td>
<td>12.98</td>
</tr>
<tr>
<td>Fibres</td>
<td>2.16</td>
<td>2.93</td>
<td>2.09</td>
<td>2.01</td>
<td>2.20</td>
<td>2.58</td>
<td>3.18</td>
<td>3.21</td>
<td>2.92</td>
<td>2.93</td>
</tr>
<tr>
<td>Other</td>
<td>8.24</td>
<td>7.17</td>
<td>7.37</td>
<td>6.45</td>
<td>6.70</td>
<td>7.09</td>
<td>6.94</td>
<td>7.04</td>
<td>6.89</td>
<td>7.06</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td>57.10</td>
<td>57.50</td>
<td>60.33</td>
<td>62.20</td>
<td>65.86</td>
<td>69.92</td>
<td>73.27</td>
<td>78.79</td>
<td>84.97</td>
<td>87.98</td>
</tr>
</tbody>
</table>

Source: "Agriculture statistics at a glance 2002"
Pub: Directorate of Agriculture & cooperation, Ministry of Agriculture, New Delhi.

From the table it is seen that cereals group shows a significant increase in use of HYV certified seeds. It was 34.70 lakh quintals in 1990-91 and increased upto 61.14 lakh quintals in 1999-2000. This means an increase of 76.19 percent, which is quite significant. Pulses group has a moderate growth of 13.48 percent, i.e. 1991 to 2000. Oilseed group of corps has also quite significant growth from 8.59 to 12.98 lakh quintals (means 51.10 percent growth). Fibre corps has a slight increase.

From the above analysis, it becomes clear that no doubt there is an increase in the input and area covered under HYV Seeds, but the rate of increase is not very high. It is low or moderate except for few crops. The
possible reason is that due to ignorance, many of the farmers use seeds, saved from the yield of previous years crop production, in planting the new crop and most of these seeds are high yielding varieties which lose their efficacy due to repeated planting. This is particularly true in the case of crops like soyabean, rice and wheat. Hybrid seeds, however, can be used only once and most progressive farmers in India have realised this.

The use of hybrid seeds has become more common during last decade, due to the high yield obtained. The cultivation period is also smaller with hybrid seeds than conventional seeds. The percent share of area under vegetables during 1995 upto 2000 was as follows:-

Cabbage 22.92% cauliflower 1.72% chilly 0.91% brinjal 13.91% Goard 2.01% Melon 2.61% tomato 28.26% etc.

In the past few years, most of the increase in the output of agricultural crops in India has taken place due to increase in the yield brought about by the development production and distribution of hybrids and high yielding variety seeds in the country. The increase in area has been only nominal. Though shift in cultivation from one crop to the other has been significant, the number of farmers in the country has not gone up much. Output of foodgrain has risen from 80 million tonnes in the 1960 to nearly 200 million tonnes now, in 2000. Fruits and vegetables production is going up at a considerable rate than in the past.
(3) **CHEMICAL FERTILIZERS**

This is the third important input responsible for fast growth in foodgrain and production of all other crops in India. Fertilizers provide nutrition to the plants like balanced diet to human body. Fertilizers provide additional nitrogen, phosphorous and potash to the crops. Their use in optimal quantity is essential for maintaining the fertility of land to obtain the benefit of high yielding variety seeds. In India about 50-55 percent of the fertilizer is used in the cultivation of paddy, wheat, sugarcane, 10-15 percent in cotton and groundnut, 15 percent in fruits and vegetables, 10 percent in coarse cereals, and 10 percent in oil seeds and pulses. India is the third largest producers of fertilizers in the world. But consumption of fertilizers per hectare is only 77 kg average, the corresponding average in China is 345 kg per hectare.

During past 15 years, major changes in cropping pattern took place in Madhya Pradesh, Maharashtra, Rajasthan Gujarat etc. has changed consumption of fertilizers in these states. This is why, the production of soyabean, sunflower, castor, mustard, and fruits has gone up in these states considerably.

All this together has created a large demand for fertilizers in the country. IFFCO is the largest producers of fertilizers with an output of 52.5 lakh tonnes (2000). India does not produce potash fertilizers at all, therefore the requirement has to be met through imports. During 1995-2000 production of all fertilizers increased and the imports have fallen recently.
TRENDS IN CONSUMPTION

India ranked fourth in consumption of fertilizers; after the U.S. Russia, and China. In India, the consumption of fertilizers has gone up more than three times from 5.5 million tonnes in 1980-81 to 18.07 million tons in 1999-2000. Fluctuations in consumption each year occurs due to conditions of rains. Punjab state use maximum quantity of fertilizers. Average consumption there is 184 kg per hectare. Average of Tamil Nadu is 163 kg and Andhra Pradesh has 158 kg average per hectare. Table 4.11 gives details of consumption of fertilizers during the 10 year 1990-91 to 1999-2000. Season wise classification has been shown.

**TABLE 4.11**

**SEASON WISE ANNUAL CONSUMPTION OF FERTILIZERS IN INDIA**


<table>
<thead>
<tr>
<th>Year</th>
<th>Kharif</th>
<th>Rabi</th>
<th>Total</th>
<th>Percentage Share</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Kharif</td>
</tr>
<tr>
<td>1980-81</td>
<td>21.38</td>
<td>33.78</td>
<td>55.16</td>
<td>38.8</td>
</tr>
<tr>
<td>1990-91</td>
<td>57.41</td>
<td>68.05</td>
<td>125.46</td>
<td>45.8</td>
</tr>
<tr>
<td>1996-97</td>
<td>69.20</td>
<td>73.88</td>
<td>143.08</td>
<td>48.4</td>
</tr>
<tr>
<td>1997-98</td>
<td>80.92</td>
<td>80.96</td>
<td>161.88</td>
<td>50.0</td>
</tr>
<tr>
<td>1998-99</td>
<td>78.34</td>
<td>89.64</td>
<td>167.98</td>
<td>46.6</td>
</tr>
<tr>
<td>1999-2000</td>
<td>88.61</td>
<td>92.08</td>
<td>180.69</td>
<td>49.0</td>
</tr>
</tbody>
</table>

Source: Indian Agriculture 2003 Pg.76
Table 4.11 explains the continuous growth in consumption of fertilizers in the country. It is remarkable to note that compared to 1980-81 the amount in 1990-91 jumped to almost little less than three times. The main reason was that prices of fertilizers were under the control of government; and subsidized. After 1992 (25 Aug 1992), phosphatic and potassic fertilizers were decontrolled. The prices of these increased sharply; therefore there was a fall in consumption. This is seen in the table that consumption increased at a very moderate rate during the stipulated decade. However, the total consumption shows rising trend. In 1980-81 it was 55.16 lakh metric tonnes, and increased to 125.46 lakh M.Tons in 1990-91 and 180.69 lakh metric tones in 1999-2000. In percentage the growth was 127.42 and 227.57 percent in respective years (over 1980-81).

This growth in consumption is mainly due to changes in cropping pattern during the last decade. Farmers cultivate in all three seasons hence demand for fertilizers shows sharp upward trend.

**FERTILIZER SUBSIDY**

To encourage balanced use of fertilizers government continued to provide subsidy and concession on decontrolled phosphatic and potassic fertilizers, since 1977. In the year 1999-2000 the price of urea was fixed at Rs. 4600 per ton. On an average Rs. 4000 per ton subsidy is borne by the Government on urea sold to farmers.
Table No. 4.12 shows state-wise per hectare consumption of fertilizers in India. It is clear from the table that since 1990-91 till 1999-2000 every state shows increased consumption of fertilizers. States like Punjab, Andhra Pradesh, Tamil Nadu, Maharashtra, West Bengal show a steady increase in consumption during the year.

The fact which comes out is that, due to spread, and more use of new agricultural technology, farmers, especially in irrigated area have been reaping more gains and consequently consumption also increased as the cropping pattern changed.
### TABLE 4.12

**STATEWISE CONSUMPTION OF ALL FERTILIZERS PER HECTARE**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Andhra Pradesh</td>
<td>122.17</td>
<td>114.20</td>
<td>138.00</td>
<td>129.90</td>
<td>158.10</td>
</tr>
<tr>
<td>Bihar</td>
<td>57.44</td>
<td>57.18</td>
<td>73.90</td>
<td>85.90</td>
<td>97.70</td>
</tr>
<tr>
<td>Gujarat</td>
<td>72.20</td>
<td>73.24</td>
<td>70.60</td>
<td>102.00</td>
<td>87.80</td>
</tr>
<tr>
<td>Haryana</td>
<td>103.77</td>
<td>107.79</td>
<td>124.50</td>
<td>139.90</td>
<td>148.50</td>
</tr>
<tr>
<td>Haryana</td>
<td>68.76</td>
<td>64.40</td>
<td>75.30</td>
<td>92.80</td>
<td>103.40</td>
</tr>
<tr>
<td>M.P.</td>
<td>36.19</td>
<td>35.33</td>
<td>33.30</td>
<td>48.20</td>
<td>47.20</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>60.67</td>
<td>52.14</td>
<td>64.30</td>
<td>75.20</td>
<td>88.90</td>
</tr>
<tr>
<td>Orissa</td>
<td>20.75</td>
<td>21.96</td>
<td>24.40</td>
<td>30.10</td>
<td>44.40</td>
</tr>
<tr>
<td>Punjab</td>
<td>162.02</td>
<td>162.23</td>
<td>165.70</td>
<td>169.60</td>
<td>184.60</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>121.80</td>
<td>117.19</td>
<td>105.50</td>
<td>150.40</td>
<td>164.90</td>
</tr>
<tr>
<td>U.P.</td>
<td>88.41</td>
<td>86.00</td>
<td>102.00</td>
<td>117.50</td>
<td>125.40</td>
</tr>
<tr>
<td>West Bengal</td>
<td>90.18</td>
<td>87.58</td>
<td>97.70</td>
<td>108.80</td>
<td>136.00</td>
</tr>
<tr>
<td>All India</td>
<td>69.26</td>
<td>67.09</td>
<td>74.40</td>
<td>86.80</td>
<td>95.60</td>
</tr>
</tbody>
</table>

Source: Indian Agriculture 2003 Pg. 74
Pub: Indian Economic Data Research Centre - New Delhi.

**PRODUCTION OF FERTILIZERS:** Table No. 4.13 gives a summary of ten years production of fertilizers in India.
### TABLE 4.13

**PRODUCTION OF FERTILIZERS IN INDIA**

(Lakh Metric Tonnes)

<table>
<thead>
<tr>
<th>Year</th>
<th>Nitrogenous</th>
<th>Phosphatic</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990-91</td>
<td>69.93</td>
<td>20.52</td>
<td>90.55</td>
</tr>
<tr>
<td>1991-92</td>
<td>73.01</td>
<td>25.62</td>
<td>98.63</td>
</tr>
<tr>
<td>1992-93</td>
<td>74.30</td>
<td>23.06</td>
<td>97.36</td>
</tr>
<tr>
<td>1993-94</td>
<td>72.31</td>
<td>18.16</td>
<td>90.47</td>
</tr>
<tr>
<td>1994-95</td>
<td>79.45</td>
<td>24.93</td>
<td>104.38</td>
</tr>
<tr>
<td>1995-96</td>
<td>87.77</td>
<td>25.58</td>
<td>113.35</td>
</tr>
<tr>
<td>1996-97</td>
<td>85.99</td>
<td>25.56</td>
<td>111.55</td>
</tr>
<tr>
<td>1997-98</td>
<td>100.86</td>
<td>29.76</td>
<td>130.62</td>
</tr>
<tr>
<td>1998-99</td>
<td>104.80</td>
<td>31.41</td>
<td>136.31</td>
</tr>
<tr>
<td>1999-2000</td>
<td>108.90</td>
<td>33.99</td>
<td>142.89</td>
</tr>
</tbody>
</table>

Source: Indian Agriculture 2003. Pg. 75
Pub: Indian Economic Data Research Centre, New Delhi.

In production field also growth is seen clearly. Comparing to 1990-91 the growth is little less than double, in the year 2000.
(4) PLANT PROTECTION (PESTICIDES) -

According to new agricultural technology, it is very essential to protect crop plants from various pests, insects and infections to maximize the production. Some of the HYV seeds plants are delicate and are attacked by various pests or infection which destroy corps to a very large extent.

PRODUCTION & CONSUMPTION -

According to Pesticides Manufacturers and Formulators Association at present these are 55 main producers of pesticides in the large and medium sector (including 6 multinationals) and about 300 pesticide formulators in the country. Pesticide industry in India is the forth largest in the world and second in Asia. But it has a very small share of world’s production i.e. 1.5 to 2 percent. Main manufactures are Rallies India, United Phosphorous, Excell Industries etc. Bayers India, BASF, Monsanto and Syngenta (India) are multinational producers of pesticides. The Domestic producers have 60 percent share while others have 40 percent share in production. Production of insecticides was 65 percent, herbicides was 15 percent, fungicides was 12 percent and other was 8 percent in India, in 2000.

Production of pesticide is regulated under Insecticides Act 1968 and the Insecticides Rules 1971 made thereunder. At present a total of 145 technical pesticides have been registered in the country. Production is in the form of dusts, wettable powders, emulsifiable concentrates, granules and capsules.
The following table No. 4.14 gives a complete summary of 50 years (each decade) of consumption of technical grade pesticides in the country.

**TABLE 4.14**

**CONSUMPTION OF TECH. PESTICIDES IN INDIA**

(METRIC TONNES)

<table>
<thead>
<tr>
<th>Year</th>
<th>Consumption</th>
<th>Year</th>
<th>Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950-51</td>
<td>2,350</td>
<td>1993-94</td>
<td>63,650</td>
</tr>
<tr>
<td>1960-61</td>
<td>8,650</td>
<td>1994-95</td>
<td>61,360</td>
</tr>
<tr>
<td>1970-71</td>
<td>24,320</td>
<td>1995-96</td>
<td>61,260</td>
</tr>
<tr>
<td>1980-81</td>
<td>45,000</td>
<td>1996-97</td>
<td>56,110</td>
</tr>
<tr>
<td>1990-91</td>
<td>75,000</td>
<td>1997-98</td>
<td>52,240</td>
</tr>
</tbody>
</table>

Source: (i) Ministry of Agriculture.
(ii) Indian Agriculture 2003 Pg. 85.

Consumption of pesticides in the country was only 2350 tonnes in the year 1950-51 it increased to 8620 tonnes in 1960-61 and 24320 tons in the year 1970-71. Again there was an increase in 1980-81 when consumption went upto 45000 metric tonnes. In 1990-91 it registered an increase upto 72133 tonnes. Since then according to Ministry of agriculture the consumption has been falling and it fell to 46200 metric tonnes in the year 1999-2000. However data from the market shows a rise in consumption, the above fall occurs, may be because the statistics compiled only belongs to main corps like food cereals, oilseeds, sugarcane only in which production is constant, while pesticides are also used in cultivation of horticulture and plantation crops.
Per capita consumption of chemical pesticides in India is quite low at 1.8 kg per hectare compared with China 5.4 kg and in Korea 6.4 kg and 3.9 kg in Indonesia.

Cropwise pattern of consumption in the country is as follows:

<table>
<thead>
<tr>
<th>Crop</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton</td>
<td>45%</td>
</tr>
<tr>
<td>Plantation</td>
<td>7%</td>
</tr>
<tr>
<td>Rice</td>
<td>22%</td>
</tr>
<tr>
<td>Pulses</td>
<td>4%</td>
</tr>
<tr>
<td>Vegetables</td>
<td>9%</td>
</tr>
<tr>
<td>Wheat</td>
<td>4%</td>
</tr>
</tbody>
</table>

The other crops account for only 9%.

**PRODUCTION**

A summary of production of pesticides in the country is as follows:

**TABLE 4.15**

**PRODUCTION OF TECH. PESTICIDES IN INDIA** (Tonnes)

<table>
<thead>
<tr>
<th>Year</th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994-95</td>
<td>90758</td>
</tr>
<tr>
<td>1995-96</td>
<td>96880</td>
</tr>
<tr>
<td>1996-97</td>
<td>94350</td>
</tr>
<tr>
<td>1997-98</td>
<td>87689</td>
</tr>
<tr>
<td>1998-99</td>
<td>102440</td>
</tr>
<tr>
<td>1999-2000</td>
<td>95333</td>
</tr>
</tbody>
</table>

Source: Indian Agriculture 2003 pg. 85

Pub: Indian Economic Data Research Centre New Delhi.
Observation of the table shows that production in 1995-96 increased to 96880 tonnes, than 90758 tonnes in 1994-95. But declined during two succeeding years to 94350 and 87689 respectively. Thereafter it rose to 102240 tonnes in 1998-99 and fell to 95333 tonnes in 1999-2000. This fall in between these years was due to the announced ban on use of BHC powder in agriculture, on March 31st 1997.

(5) FARM MECHANIZATION -

A simple meaning of farm mechanization is using mechanical power in farm operations. In the fast developing but thickly populated country like India mechanization may be of complimentary nature. Various machines used on farms can perform many operations like ploughing, sowing, harvesting, threshing and crushing, etc. Apart from these, power driven machines are used in lifting irrigation, transportation etc. Mechanisation increases efficiency of labour in agriculture and raises the productivity. It is economical also as it saves costs on labourers. In India mechanization is preferred mainly because it increases yield through more timely and effective farm operations. Optimum yield of the new high yielding varieties depend on correct seed-bed preparation, proper seeding dates, precise fertilizer placement, and the uniform and timely distribution of water and chemicals. All of these can be better provided through mechanization. It is on this ground it is useful and meaningful to examine the extent to which farmers use mechanization. The data useful for this is the sale of various machines by manufacturers during the given period. The sale reflects demand and demand reflects utility of those machines.
In 1991-92, there were 395815 thousand wooden and iron ploughs, 12218 thousand tractors, 45774 thousand diesel pumps, 64035 thousand electric pump sets, 5861 thousand sugarcane crushers and 133860 thousand animal wooden carts in the country.

Use of tractors has become very popular in the country since last 3-4 decades. During the decade 1999-2000 about 2.05 million tractors and 1,17,000 power tillers were sold in the country.

Effective demand could be studied well from the following table No. 4.15 (a). This table gives a statewise and yearly summary, of tractors sold since 1990 to 2000.
### Table 4.15 (a)

**STATEWISE ANNUAL SALE OF TRACTORS IN INDIA**

(Figures & Numbers)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Punjab</td>
<td>19593</td>
<td>26413</td>
<td>25527</td>
<td>24128</td>
<td>27679</td>
</tr>
<tr>
<td>Haryana</td>
<td>14754</td>
<td>20491</td>
<td>18871</td>
<td>20032</td>
<td>21100</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>9500</td>
<td>12741</td>
<td>16715</td>
<td>19992</td>
<td>26664</td>
</tr>
<tr>
<td>U.P.</td>
<td>30687</td>
<td>29586</td>
<td>32870</td>
<td>42438</td>
<td>69665</td>
</tr>
<tr>
<td>M.P.</td>
<td>9868</td>
<td>10366</td>
<td>22878</td>
<td>23505</td>
<td>28815</td>
</tr>
<tr>
<td>Bihar</td>
<td>4958</td>
<td>3582</td>
<td>5326</td>
<td>8066</td>
<td>13230</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>5325</td>
<td>4660</td>
<td>11796</td>
<td>16789</td>
<td>18742</td>
</tr>
<tr>
<td>Gujarat</td>
<td>6263</td>
<td>8861</td>
<td>17357</td>
<td>18631</td>
<td>17747</td>
</tr>
<tr>
<td>T.N.&amp; Kerala</td>
<td>3962</td>
<td>6737</td>
<td>12695</td>
<td>11295</td>
<td>9554</td>
</tr>
<tr>
<td>Karnataka</td>
<td>3258</td>
<td>5994</td>
<td>8385</td>
<td>10800</td>
<td>8245</td>
</tr>
<tr>
<td>Andhra Pradesh</td>
<td>5153</td>
<td>7301</td>
<td>10823</td>
<td>14337</td>
<td>16911</td>
</tr>
<tr>
<td>Others + Exports</td>
<td>7863</td>
<td>6868</td>
<td>7957</td>
<td>10994</td>
<td>24383</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>121184</td>
<td>143600</td>
<td>191200</td>
<td>220937</td>
<td>273181</td>
</tr>
</tbody>
</table>

Source: (1) Ministry of Agriculture  
(2) Indian Agriculture - 2003 Page 13  
Pub: Indian Economic Data Research Centre New Delhi.

Infact this table shows a trend in mechanization in the country. Tractor is the first preferred machine. Table shows that some of the states have a high growth rate of mechanization. Uttar Pradesh has a leading number of tractors bought right from the beginning i.e. 1989-90. The sale in this state was 30687 which
increased to 69665 in 1999-2000. Punjab takes the second rank, likewise, Rajasthan, Haryana, M.P. Maharashtra show increased demand during this decade. At present about 35 to 40 percent of the agricultural land in the country is being tilled through mechanical power sources. (Percentage may vary state to state). Rest of the area 60-65 percent is tilled traditionally with help of bull-driven or buffalo driven ploughs, hoes, harrows and sickles are used. The availability of electric power for other machines in the country is 1 Kw. per hectare, available for few hours, because of power shortage.

Power tillers are mostly used in areas where holdings are small and farmers have to cultivate more number of crops tractors are used in large farms. Recently it is a trend in farmers to get tractors on hire to cultivate small holdings also. The number of power tillers sold in 2000 was 16891.

The traditional animal drawn country plough has low output, i.e. 30 to 40 tillage per hectare. In shallow and black soils, Bakhar (straight or curved blade harrow) is used cultivator and disc harrow cover 2-3 times more area and quality of ploughing is also better. The mould broad plough, puddler, peg-tooth harrow, rotavator and ‘patela’ harrow operated by animal or tractor are better machinery. Animal drawn Dufan, Tifans, are also used. But skilled persons are required for seed rate. Mechanical seed drill or seed-cum-fertilizer drill have been developed. Iron plough has capacity for cutting deeper and wider into the soil.
Inter-culture and plant protection could also be done by machines. Traditional Kherpi is the most versatile hand hoe for removal of weeds but it takes a lot of time and labour hours per hectare. For this long handle wheel hoe and peg type weeder has been developed.

For application of plant protection, sprayers are used of small or big size with spray pumps handy for use. Spraying is essential for cotton, paddy sugarcane, fruits and vegetables etc. For harvesting, traditionally, sickle, spade and kherpi were used. But now latest harvester which is multipurpose and automatic machine is developed and popularly used in states like Punjab.

It is difficult to assess direct impact of mechanization on agricultural productivity, but indirect impact can be estimated, such as change in cropping pattern, increase in cropping intensity and timeliness of operations cause increase in output. Recently Central Institute of Agricultural Engineering, Bhopal, in collaboration with agricultural universities developed more than 126 agricultural machinery suitable for different agricultural regions.

In India draught animals continue to be a major source of farm power, with some exceptions of some regions like Punjab. Animal power used for cultivations and sowing is about 90 percent and for rural transport farmers still use 70 percent animal power. Multiproduct retailers situated in the urban market sell agricultural machinery. Except tractor industry, the service has been poor for most of the implements. Farmers knowledge about machinery and
improved implements depends upon how these implements are promoted. For example power tiller has been promoted as a “Mini-Tractor.”

(6) **LABOUR**

Labour input in agriculture is of two types. The first one is labour inputted by the cultivators themselves, as owner of the farm. The Second is labour hired from outside. In India traditionally, landowners and landless labourers lived in villages and there was a sort of coordination between them. Labourers were paid wages in kind i.e. they received some shares of crop production according to the agreement. Balutedari system existed.

But after independence social conditions changed. Wages were required to pay in cash. Population growth was so fast that it created imbalance. After green revolution and mechanization, rural labours became surplus. According to Census 1991, the percentage of cultivators was 38.4 and labourers was 26.4 percent.

Corresponding percentages according to 2001 census were 31.7 percent and 26.5 percent. There is decline of 6.7 percent in cultivators percentage while there is an increase of 0.01 percent in labourers. This may be due to mechanisation. Cultivators may have shifted to other more profitable business hence drop in percentage is observed. The casual or seasonal labours which were unemployed because of mechanization, go to nearby urban areas to find

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jobs. They could accept any unskilled labour job as the wage rate in urban area is more than farm wages. Mechanization has double effect on rural employment, first it creates employment through changes in cropping pattern and intensity of cropping but it displaces the casual workers. A research work undertaken by Dr. Hanumanta Rao is very important and significant in this context. In his report Dr. H.Rao says “The empirical investigations reveal that the structure of labour market in rural India had undergone significant quantitative and qualitative changes during the 25 years period. From 1971 to 1993-94. The contribution of demographic factors and the concomitant effects on labour supply and participation and also the role of technology, in influencing the demand pattern for labour in eight major states (i.e. Bihar, Madhya Pradesh, Maharashtra, Uttar Pradesh, and West Bengal) need monitoring to gauge the emerging employment scenario and challenges possessed by the development process. In fact, these are the states with high levels of poverty as well.

Attention needs to be paid in arresting the increasing trend in casualisation since it has been prevalent more so in the states with high poverty ratios. The public policy of sustainable development cannot ignore the demographic factors and the employment and wages elasticities of economic growth demonstrate that the benefit of development were nullified to a large extent by population explosion. The self and wage employment programmes like Swarnajayanti Gram Swarojgar Yojana and Employment Guarantee
Scheme may have to be devoted with the strategy of development of agriculture and non-agriculture in rural areas. Reduction of workforce from agriculture and non-agriculture sectors which are prerequisites for improving the well being of rural households can be the crux of future development policy.12

Thus changes in agriculture technology has both effects of generation of employment for cultivators and second displacement of seasonal laborers.