Chapter II

Production of Agro based Industries

1. Brief History –

Agriculture is the backbone of economic structure in India and such as Agriculture planning is destined to play a pivotal role in regional resource development with growing unemployment, a balanced agro-based industrial development seems to be only way out, but the progress of heavy industrialisation in terms of both production and of creating employment potential is not adequate. This due to stagnation that characterised the industrialisation which would assure an adequate rate of growth of national income and also create potential employment opportunity viewed in this context in India which is basically Agricultural in its character, agro based industrialization as an approach could be used as a tool for economic development. The most important long-term economic problem facing the country is unemployment, particularly disguised unemployment and this problem is becoming increasingly a cute day by day in spite of the planned efforts to tackle it. The backlog of unemployment which was .5 million at the beginning of the first five year Plan increased to 7.3 million by the beginning of the second five year plan and it increased to 100 million (near abut) the present time. This fact highlights the vital importance not only of checking population growth
but also of expending employment opportunities by means of rapid industrialisation.

These Industries substantially increased the wage rates for different Agricultural operation. The wage differential were reduced among casual labourers men, woman and children to a large extent, but the wage differentials cropped up between Agricultural workers and agro based industrial workers.

The impact of these industries was significant on the income levels of all categories of rural employment. The increase in income was more spectacular in the households of Agricultural workers and workers employed in these industries. The studies reviewed above have direct bearing in one way or other on the present study. Some of the earlier studies are based on macro approach and others on micro approach. However, the present study is a micro level evaluation of the impact of agro based industries on the various sectors of the rural economy.

In brief the agro based industries imply the following –

1. These must faster the sprit of interdependence between Agriculture and industry.

2. Such industries must use the raw materials provided by Agriculture and their output must have a market among the rural population.

3. Surplus rural manpower must be absorbed by these industries.
4. Improved technology can be adopted in order to increase productivity.

5. Such industries should, as far as possible, use the indigenous technical know-how and conserve the foreign by exchange avoiding the import of sophisticated machinery.

Agro-processing could be defined as set of techno economic activities carried out for conservation and handling of Agricultural produce and to make it usable as food, feed fibre, fuel or industrial raw material. Hence, the scope of the agro-processing industry encompasses all operations from the stage of harvest till the material reaches the end users in the desired form, packaging, quantity, quality and price. Ancient Indian scriptures contain vivid account of the post harvest and processing practices for preservation and processing of Agricultural produce for food and medicinal uses. Inadequate attention to the agro-processing sector in the past put both the producer and the consumer at a disadvantage and it also hurt the economy of the Country.

Agro-processing is now regarded as the sunrise sector of the Indian economy in view of its large potential for growth and likely socio economic impact specifically on employment and income generation. Some estimates suggest that in developed countries, up to 14 per cent of the total works force is engaged in agro-processing sector directly or
indirectly. However, in India, only about 3 per cent of the work force finds employment in this sector revealing its underdeveloped state and vast untapped potential for employment. Properly developed, agro-processing sector can make Indian a major player at the global level for marketing and supply of processed food, feed and a wide range of other plant and animal products.

2. Significant Agro based Units:

The significance of such industrialisations originates from the fact that the industries as such exhibit Agriculture industry interdependence and mutuality and they, though partially give a view that the agricultural sector may have a status of industry which is a matter of debate. Not by this alone they are labour intensive and capital saving industries and can provide better employment avenues to the developing Indian economy, as has been pointed out, the industries as such are able to create 48 per cent of total industrial employment generated per annum.

There are other significant aspects of these industries even. In this regard they have proved to be powerful instrument for both balanced and decentralized growth of Indian economy. These Industries use agricultural produce as their raw martial or inputs, process them and final output is resulted. It is not worthy that they are not confined to processing of agricultural produce alone (processing of food
crops, sugar cane, oil seeds, fruit and vegetables, cotton, jute and other similar produce) but also to those industries which manufactures or service agricultural implements. Such as Power threshers, cane-crushers, cultivators and levellers, separators, sowing fans and tractors trollies etc. Conclusively, the agro-based industrialisation is a value-added industrialisation.

**Table No – 2.1**

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Items</th>
<th>1973-74</th>
<th>1983-84</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>No. of factories</td>
<td>31.89</td>
<td>33.17</td>
</tr>
<tr>
<td>2</td>
<td>fixed capital</td>
<td>7.07</td>
<td>7.42</td>
</tr>
<tr>
<td>3.</td>
<td>Working capital</td>
<td>13.31</td>
<td>13.28</td>
</tr>
<tr>
<td>4.</td>
<td>Invested Capital</td>
<td>10.36</td>
<td>10.90</td>
</tr>
<tr>
<td>5.</td>
<td>No. of Workers</td>
<td>20.34</td>
<td>23.44</td>
</tr>
<tr>
<td>6.</td>
<td>No. of Employees</td>
<td>12.46</td>
<td>21.92</td>
</tr>
<tr>
<td>7.</td>
<td>Wages to workers</td>
<td>10.46</td>
<td>11.85</td>
</tr>
<tr>
<td>8.</td>
<td>Total emolument</td>
<td>10.85</td>
<td>12.16</td>
</tr>
<tr>
<td>9.</td>
<td>Material consumed</td>
<td>29.03</td>
<td>21.43</td>
</tr>
<tr>
<td>10.</td>
<td>Value of Output</td>
<td>23.37</td>
<td>18.32</td>
</tr>
</tbody>
</table>

3. **Types of Agro-based industries**:

Agro-based industries may be classified into four categories -

(i). **Agro-produce Processing Units**:

Those industrial units which merely process Agriculture produce fall under this category. They do not manufacture any new product; they merely process the raw material so that it can be preserved or transported at lower costs, e.g., rice-mills, dalmills, groundnut decorticating mills, etc.

(ii). **Agro-produce Manufacturing Units**:

These units manufacture entirely new products based on Agriculture produce as the main raw material. The finished goods are entirely different from the Agricultural, e.g., Sugar-factories, bakeries, solvent extraction unit, textile-mills, straw-board etc.

(iii). **Agro-Inputs Manufacturing Units**:

Those industrial units which produce goods either for the mechanisation of agriculture or for increasing the productivity of Agriculture came under this category. These units are directly linked with agriculture, for they support agriculture at various stages, e.g., industries manufacturing fertilizers, pesticides and insecticides, all types of Agricultural implements, pump sets, etc. These must be located in villages.
(iv). **Agro-service Centers:**

Agro-service centers are workshop and service center which are engaged in repairing and servicing pump sets, diesel engines, tractors and all types of farm equipment.

This analysis of the economic characteristics of agro-based industries reveals that they are characterised by high labour intensity and high labour Productivity. Developing economics are generally characterised by an abundance of labour and a scarcity of capital, it is the factor-endowment in developing economics which stimulate the development of agro-based industries that make use of more labour and less capital.

**4. Benefits of Agro based industries:**

The present study is an attempt to examine the impact of agro-based industries on crop production and crop-productivity, rural employment and wage structure of rural economy of India with reference of three industries namely, Sugar, Jute and Oil.

In view of the important role played by agro-based industries in providing employment and in bringing about an improvement in rural economic in general, the Government of India has laid emphasis on these industries in recent years. At present, the Government has been promoting agro-based industries as one of the important measures for rural
development. It is in this context that the present study on "The Impact of agro-based industries on Rural Economy- A Case Study". Assumes importance.

This study is, therefore, Unique because of its coverage of the manifold aspects of the rural economy. It highlights the transformation of the rural economy in the light of crop-production and productivity changes in cropping pattern, wage rate and employment generation etc. Consequent upon the setting up of agro-based industries.

About from the above aspects, the agro based industries help the Agriculturists in the following ways –

(i) The establishment of agro-based industries will solve the problem of exploitation of the farming community by traders and middlemen.

(ii) Some of the Agricultural commodities, such as sugarcane, vegetables, fruits, etc., are perishables. It is better to process them at the raw material source in order to avoid wastage.

(iii) Most of the Agricultural commodities are bulky in weight and occupy a large space consequently the transportation costs are higher. It they are processed at the raw material Source, the transportation costs can be minimized and the farmers can get a fair price.
(iv) Agro based industries will give a big push to Agriculture. The units, though of different types, will act as sources of demand as well as supply to Agriculture in the sense that they absorb the Agriculture produce and supply inputs to Agriculture.

5. **Salient features:**

The following salient features have been drawn in connection with the above objectives, respectively -

(i). The relative importance of raw material as compared to other factors of production like wages, fuels powers etc. increases with the increase in agro-industrial production. Hence, the demand for raw material increases and there takes place a shift of land resources from the low-value-yielding crops to high-value-yielding crops. Also, the land productivity and the quality of Agricultural produce are improved.

(ii). The setting up of an agro based industry increases the volume of employment both in farm and non farm sector.

(iii). The setting up of an agro based industry increases the demand for labour in both Agricultural and industrial sector, there by increasing the wages for different Agricultural operations irrespectively of the category of workers and the value nature
of operations: but the wage differential among male, female
and child workers are reduced.

Some other salient features have been drawn –

(a). To measure the relative share of various cost items in the agro
industrial production and also the feedback effects of agro
industrial production on the Agricultural economy.

(b). To study the impact of agro based industries on rural
employment (i.e., direct employment in agro based industries
and indirect employment in the farm sector).

(c). To evaluate the impact of agro based industries on the wage
structure of the rural economy and also to show the wage
differential between agricultural and industrial sector.

**HISTORICAL PERSPECTIVE:**

By the middle of the nineteenth century, common agro processing
industries included hand pounding units for rice, water power driven flour
mills, bullock driven flour mills, bullock driven oil ghanies, bullock
operated sugarcane crushers, paper making units, spinning wheels and
handloom units for weaving. In British India, during the year 1863, a note
was written by the Governor of Madras state, Sir William Denison to the
government of Madras state for laying greater stress on agriculture and
agro processing (Royal Commission 1828) Based on this, a set of improved machinery was brought from England for demonstration and adoption. It included threshing machines, winnowers, chaff cutters, besides steam ploughs, steam harrows, cultivators, seed drills and horse hoes. The demonstration continued at saidapet near Madras till 1871 with little outcome.

Importance of agro-processing sector was first realized and documented after the disastrous famine of Bengal during 1870’s. Report of the Famine Commission, set up by the British Government, in its report submitted in 1880, clearly stated the need for agricultural improvement and improved post harvest infrastructural development specifically, rail network. Need was also felt for incorporating chemical interventions in the agricultural sector and precision farming through agricultural mechanisation manned by engineers. The Royal Commission on Agriculture setup by the British Government, Conducted a detailed study. In its report published during the year 1928, it called for scientific approach to the sector and stressed for developing rural industries and cooperatives.

Realizing the importance of the agro-processing sector for rural development as a tool for POORN SWARAJ (complete self rule), Mahatma Gandhi during 1930’s promoted CHARKHA (spinning wheel)
and balanced nutrition by setting example and writing articles in his famous magazine “Harijan”. It was continued by his followers namely, Narhari Bhave, Binoba Bhave and Jay Prakash Narayan. They promoted self-dependence through KHADI and village industries.

The R&D institutions developed by the British for taking care of agricultural and rural industries included: The Imperial Agricultural Research Institute, Pusa; Indian Veterinary Research Institute, Mukteshwar; Dairy Research Institute at Bangalore; Poona Agriculture College; Public Agriculture College, Saidapet (Madras); Sibpur Engineering College (Bengal) etc. Horticultural Research Station was created at Chaubatia (U.P.) in Kumaon Hills for horticultural research including packaging and transportation improvements.

Post independence era in India witnessed rapid growth in agro processing sector specifically during 1980s. It followed the first phase of the Green Revolution that had resulted in increased agricultural production and the need for its post harvest management. The importance of the sector was realized by the business community leading to diversification from grain trading to processing. Lead was given by the rice processing industry, followed closely by wheat milling, paper and pulp industry, milk processing sector, jute industry, sugarcane processing and oils extraction through solvent plants. In some areas like the solvent
extraction industry, the growth in installed processing capacity has been far higher than the supply of the raw materials. However, in other areas like fruits and vegetable processing, the growth has not been encouraging on account of poor demand for processed products by the consumers. In such cases, the industry has also not been able to develop the demand adequately.

**TRENDS IN AGRICULTURAL PRODUCTION**

At the start of the twentieth century, Indian agriculture was in a stage of subsistence. By the year 1925-26, the total area under some major crops in undivided British India was: rice – 32 mha, wheat – 9.6 mha, sorghum – 8.2 mha (Royal Commission on Agriculture (1928)). The yields were very low. In the year 1950-51, India produced only 50 million tonnes of food grain and a variety of other crops.

By the year 2000-2001, India started producing about 700 million tonnes (Mt) of biological materials per year including food grains, oilseeds, fruits, vegetables, sugarcane, milk, eggs, meat, fish, tea, coffee, fiber crops, floricultural produce, forest produce and so on. The country has diverse agro-climatic conditions and consumer preferences and hence it produces a vast variety of agricultural and livestock materials. Table 1 gives the change in agriculture production over the last fifty years. As could be seen, India holds a major share for some of these products in the
global context. However, their market potential is not being fully realized due to poor post harvest management and inadequate infrastructure and programme for processing of agro-produce.

<table>
<thead>
<tr>
<th>Table No - 2.2</th>
<th>Production status change over last fifty years</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Commodity</strong></td>
<td><strong>1950-51, Mt</strong></td>
</tr>
<tr>
<td><strong>Food grains</strong></td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Oil seeds</strong></td>
<td>5</td>
</tr>
<tr>
<td><strong>Fruits</strong></td>
<td>12</td>
</tr>
<tr>
<td><strong>Vegetables</strong></td>
<td>10</td>
</tr>
<tr>
<td>Potatoes</td>
<td>1.7</td>
</tr>
<tr>
<td>Onion</td>
<td>1.0</td>
</tr>
<tr>
<td>Mushroom</td>
<td></td>
</tr>
<tr>
<td><strong>Livestock &amp; Poultry</strong></td>
<td></td>
</tr>
<tr>
<td>Milk</td>
<td>17</td>
</tr>
<tr>
<td>Meat</td>
<td>0.7 (1971-72)</td>
</tr>
<tr>
<td>Eggs</td>
<td>10 bn(#) (1980-81)</td>
</tr>
<tr>
<td>Fish</td>
<td>0.75</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
</tr>
<tr>
<td>Fresh water</td>
<td></td>
</tr>
<tr>
<td><strong>Honey</strong></td>
<td>0.7 kt (1963-64)</td>
</tr>
<tr>
<td><strong>Coconut</strong></td>
<td>4.5 bn(#)</td>
</tr>
<tr>
<td><strong>Spices</strong></td>
<td></td>
</tr>
</tbody>
</table>
Sugarcane 57 309.4
Certified seeds 0.75
Lac 40 kt 20 kt
Fibre crops
  Cotton 0.7 2.5
  Jute 0.67 1.67
  Coir 0.13 (1954-55) 0.34
  Wool 32 kt (1980-81) 45 kt

**EXTENT OF POST HARVEST LOSSES**

On account of poor post harvest management, the losses in farm produce in India have been assessed to be of a very high order. Various studies have estimated post production losses in food commodities to the tune of Rs. 75,000-1,00,000 crore per annum. Table 2 provides a view of the extent of losses and the monetary value of the lost produce in terms of quantity and quality. It may be mentioned that the estimated loss includes losses during storage, handling and milling/processing. It does not include losses at consumer’s end.

It is also estimated that the extent of losses could be brought down to less than 50 per cent of the existing level on proper transfer and adoption of agro processing technology. For reducing the rest of the losses, new initiatives need to be called for. Hence, it would be in the long term interest of the economy to invest in developing suitable
infrastructure such as proper grain storage structures, cold stores and processing systems to avoid the losses.

**Table No - 2.3**

**Present level of production of different types of food commodities and their estimates of post-harvest losses**

<table>
<thead>
<tr>
<th>Type of food commodity</th>
<th>Present level of Production</th>
<th>Past-harvest losses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quantity (Mt)</td>
<td>Average Price</td>
</tr>
<tr>
<td>1. Durables (cereals, pulses, oilseeds, etc.)</td>
<td>230</td>
<td>10,000</td>
</tr>
<tr>
<td>2. Semi-perishables (potato, onion, sweet potato, tapioca etc)</td>
<td>40</td>
<td>3,000</td>
</tr>
<tr>
<td>3. Perishables (fruits, vegetables, milk, meat, fish, eggs etc.)</td>
<td>210</td>
<td>15,000</td>
</tr>
<tr>
<td><strong>Total/Average</strong></td>
<td>480</td>
<td>11,604</td>
</tr>
</tbody>
</table>

**R&D IN AGRO PROCESSING SECTOR**

Significant increase has taken place after early fifties in the number of institutions engaged in agro processing research. In the area of teaching, presently there are 18 universities/colleges offering first degree, 11 offer post graduate and 7 offer Ph.D. degree.

Among R&D organizations in the area of agro-processing, ICAR has 17 Institutes with some component of Post Harvest Technology
(PHT), CSIR has 3 laboratories, State Agricultural Universities have 18 programmes, IITs have 2 programmes and 11 other organizations have similar programme. Some of the leading government funded R&D Institutes (based on their infrastructure and sanctioned scientific manpower) in 2000-2001 were: CFTRI, Mysore; CIPHET, Ludhiana; IARI, New Delhi; NDRI, Karnal; DFRL, Mysore; CIAE, Bhopal; IIT, Kharagpur; GPBUA&T, Pantnagar; IGMRI, Hapur; TNAU, Coimbatore; PAU, Ludhiana; GAU, Anand; RAU, Udaipur; BCKV, Kalyani; OTRI, Anantpur; PPRC, Thanjavur; MERADO, Ludhiana; MPKV, Rahuri; ILRI, Ranchi; IVRI, Izatnagar; NIRJAFT, Kolkata; CIRCOT, Mumbai; IISR, Lucknow; IGFRI, Jhansi; KVIC Mumbai; HBTI, Kanpur and PHT Institute, Pune. The ICAR has a system of All India Coordinated Research Projects (AICRP) in various important areas. In the field of PHT, there are 4 AICRPs: (1) All India Coordinated Research Project on Post Harvest Technology (21 centers in the country, coordinated from CIPHET, Ludhiana), (2) Processing, Handling, and Storage of Jaggery and Khandasari (5 centers, coordinated from IISR, Lucknow), (3) Application of Plastics in Agriculture. Plant Environment Control & Agricultural Processing (5 centers, coordinated from CIPHET, Ludhiana) and (4) Post Harvest Technology of Horticultural Crops (8) Centers, coordinated from IARI, New Delhi). Also, there are other AICRPs that
have a component of PHT. These are (1) Renewable Sources of Energy for Agriculture and Agro-based Industries (16 centers, coordinated from CIAE, Bhopal), (2) Farm Implements and Machinery (21 centers, coordinated from CIAE, Bhopal), (3) Utilization of Animal Energy with Enhanced System Efficiency (6 centers, coordinated from CIAE, Bhopal), (4) Human Engineering and Safety in Agriculture (4 centers, coordinated from CIAE, Bhopal). Besides these, there are about 60 ad-hoc research projects operating in different SAUs, universities, IITs, CSIR Institutes and other laboratories that have been working on problems related to PHT. A number of Universities have programmes in the area of agro processing. Some of the state governments also have been supporting R&D activities on agro processing in a number of their laboratories/departments.

Although nearly 2000 scientists were associated with agro-processing R&D in the year 2000-2001, only about 200 out of them could be considered as full time R&D workers in agro-processing.

R&D Work in agro-processing carried out in India during the last 50 years categorized as follows:
- Studies on physical, biochemical, nutritional, and engineering properties/characteristics of different food, feed, fibre, and industrial raw materials.

- Response studies of different biological materials w.r.t. their storage, handling, and moisture conditioning.

- Refinement of traditional equipment and processes for production of different foods, feeds, fibres and fuel materials for better quality, higher capacity, energy efficiency, and reduced drudgery to workers.

- Development of new produces and processes for better nutrition, convenience and taste.

- Enhancement of shelf life of the produces, safe storage/packaging and development of better performing materials.

- Better economic utilization of agricultural residues, by-products and recycling of wastes.

- Design and Development of instruments and equipment for post harvest operations and their evaluation, feasibility analysis, field trials/multi-location evaluation etc.

- Design, layout planning and development of pilot plants, agricultural produce bulk handling systems and area specific agro-processing models.

- Studies and modeling/simulation of post harvest systems and industry for the purpose of optimization, forecasting and policy analysis.
• Energy auditing and use of non-renewable sources of energy for post harvest operations.

• Product quality analysis, sensory evaluation and consumer acceptance studies.

• Work conditions, safety and pollution control.

Among large number of technologies developed, the most popular ones include:

1. Agriculture produce refinement equipment such as, cleaners, graders and driers for on-farm operations as well as industrial operations.

2. Processes and equipment for parboiling of rice, preparation of puffed rice and flaked rice.

3. Development of processes and equipment for processing of pulses to produce dhal for higher recovery and better quality.


5. Adoption and development of processes, and equipment for production of protein rich produces such as full fat soy flour, soy drink/ soy milk, soy paneer (TOFU) and soy fortified baked products.

6. Development of equipment such as, leaf cup and dona making machine, multipurpose mills, mini flour mill, grain pearlers, maize dehuskers, shellers, groundnut decorticaters, fruit graders, juice
extractors, high recovery mechanical oil expellers and improved storage structures for cereals, pulses, oilseeds, onion and potato.

7. Processes and equipment for production of high quality ground spices and spice mix, development of raw materials and processes for production of instant sweets, curries, snack foods, instant soft drinks, idli, dosa, sambhar mixes/powders, egg powder, production and packaging of milk products such as shrikhand, butter milk, paneer, ghee and sweets.

8. Equipment for high recovery of sugarcane juice, processes for production of high quality jaggery and liquid jaggery.

9. Processes, equipment and pilot plants for production of various industrial raw material from lac including dyes and pharmaceutical products.

10. Improved technology for processing of jute sticks to yield jute fibre and impregnation, preparation of jute based textile materials and bags.

11. Control of stored grain insects by using chemical and physical methods, storage structures for on-farm, trade, and process plant level operations.

12. Processing and canning of meat, meat products and fish. Some work has also been done in the area of processing forest produce such as oil extraction from oil bearing materials, collection and processing of resins and production of dyes, chemicals and pharmaceutical products. The
latest developments have been in the area of floriculture. Due to high export potential, R&D work has been initiated at some centres on pre-cooling, packaging, and transport of cut flowers and low cost designs of green houses. Agro-processing models have also been developed for some of the agro-climatic regions in the Country. In the area of agro-processing of fruits and vegetables, development of tools and techniques for harvesting, pre-cooling of freshly harvested produce, minimal processing, controlled ripening, juice extraction, concentration and storage has been done. Similarly, in the area of spices & condiments, floriculture, production of mushrooms, honey, eggs and fish, technologies have been developed for post harvest loss reduction and value addition.

**GROWTH OF AGRO PROCESSING SECTOR**

Starting with a small number of processing facilities in 1950-51, a fairly well spread network of processing facilities has developed in the Country. Various estimates suggest the number of processing units in 2000-2001 as: atta chakkis and small hammer mills - 2,70,000, rice hullers - 90,000, rice shellers - 11,900, huller-cum-shellers - 12,000, modern rice mills - 30,000, bullock/ electricity operated oil ghannis - 2,00,000, oil expellers - 55,000, dhal mills - 12,000, roller flour mills -
700, rice flaking and puffing units - 2,000, bakery units - 54,000, solvent extraction plants - 700, vanaspati plants - 100, fruits and vegetables processing plants - 5,000, dairy plants - 450, cold storage units - 3,000, licensed units in organized sector for meat processing - 165, pork processing units - 144, fish processing units - 18 and so on. Major problems faced by these units have been:

(a) low capacity utilization, (b) poor recovery of the finished product from the raw materials, (c) problems of arranging adequate working capital and its management, (d) low product quality and (e) unreliable assured power supply. Strong R&D support will have to be continued to overcome these and many other problems to ensure that our agro-processing technology becomes competitive at the global level. As stated earlier, inspite of the problems, agro-processing technology in India has continued to make steady progress towards modernization. Table 3 gives information of the latest development trends in respect of major crops/crop groups.
### Table No- 2.4
Recent trends in agro processing technologies

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Crop/ Item</th>
<th>Recent products, processes, trends and technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Rice</td>
<td>Fully automatic modern rice mills Partially cooked/quick cooking rice, Breakfast cereals and value-added products, Attractive packaging and branding</td>
</tr>
<tr>
<td>2.</td>
<td>Wheat</td>
<td>Fully automatic roller flour mills Whole bran wheat flour, Fortified wheat flour, Attractive packaging and branding, Large number of baked products Automatic chapatti making machines</td>
</tr>
<tr>
<td>3.</td>
<td>Maize</td>
<td>Corn flour-packaged and branded, Corn flakes and value-added products including ready-to-eat snacks (salted &amp; sweetened) Starch material, corn oil with specific consumer desired attributes, Cattle feed Baby corn Large, automatic corn processing plants</td>
</tr>
<tr>
<td>4.</td>
<td>Coarse Cereals</td>
<td>Value-added products including breakfast foods &amp; extruded fortified tasty products Industrial raw materials</td>
</tr>
<tr>
<td>5.</td>
<td>Pulses</td>
<td>Automatic processing units for pulses with driers, colour sorters and packaging unit Attractive consumer packaging with branding Cold storing of processed pulses Snack foods and other value added products</td>
</tr>
<tr>
<td>6.</td>
<td>Soybean</td>
<td>Production of full fat soy flour/enzyme active soy flour for bakery and fortified foods Ready-to-eat snackfoods</td>
</tr>
</tbody>
</table>
CROP AND COMMODITYWISE STATUS OF AGRO-
PROCESSING INDUSTRIES

The commodity-wise growth of agro-processing industries in the
country during the years 1950 to 2000 has been as given below.

Rice Processing Industry

Starting with 20.6 Mt of rice production during 1950-51, the
country has come a long way to produce about 89.48 Mt of rice in the
year 1999-2000. Similarly, in processing sector, the technology has
undergone significant changes. Earlier, hand pounding, pedal operated
system and Engleberg huller units were common for milling of paddy. By
the year 1998-99, there were nearly 30,000 modern rice mills using
rubber rolls for paddy dehusking. Of these, more than 5,000 are large rice
mills with parboiling facility and nearly 100 have colour sorters for
removal of discoloured rice for export market.

Innovations in rice processing include improved process of
parboiling developed at IIT, Kharagpur; CFTRI, Mysore; PPRC,
Thanjavur and other R&D centres. Starting from sun drying, the
technology for drying of paddy now includes use of a variety of driers,
specifically for parboiled paddy. Continuous flow LSU type driers have
been most commonly used units followed by tray driers (batch type).
Thermic fluids are used as medium of heat transfer for heating the air
used for drying in a large number of rice mills. Though efforts have been made to improve the rice hullers, limited success was achieved in improving their performance with respect to reduction in broken percentage. Rubber roll technology for dehusking has now been well established. Efforts are ongoing to find use of tafflon to replace rubber rolls for economy.

Several types of rice bran stabilizer have been designed and tested. Chemical method developed at CFTRI, Mysore; steam heating at IIT, Kharagpur, electrical heating method developed at Pantnagar could find limited applications in Industry. Stabilization through extrusion technology has also been tried with limited application of expanders. Among most common value-added products of rice include puffed and flaked rice used as snack foods.

Rice and wheat form the major part of government operated procurement system and storage. In the month of March 2001, the total stocks of rice and wheat in FCI/ CWC and other government owned godowns were about 35 million tonnes for the public distribution system, for processing industry and for future use.

Significant achievements have been recorded in packaging technology for milled rice for ready-to-cook applications in domestic market and export. Quick cooking rice has been developed at DFRL,
Mysore and CFTRI, Mysore. The technology is being used for making available food supplies to defence personnel in boarder areas under war or war like situations. Rice is partially cooked and packed under highly sanitary conditions. It is autoclaved and supplied for safe use upto 6 months of period. Rice bran oil is a common form of edible oil besides its application in industry specifically as soap stock. For utilization of rice husk, a number of efforts were made at GBPUA&T, Pant Nagar; PAU, Ludhiana; CFTRI, Mysore; IIT, Kharagpur; TNAU, Coimbatore; PPRC, Thanjavur and other R&D laboratories. Its application as sources of furfural, high grade silicon, insulation material, particle board and as source of fuel have been well demonstrated. However, rice husk is being used only as source of fuel in rice mills, in making particle boards, in poultry houses as bedding material and in land fills. Similarly, paddy straw has found limited applications as cushioning material in packaging of fruits and for preparation of soft boards. It is extensively used as cattle feed in many parts of the country. The upcoming areas in rice processing R&D include high capacity dehuskers and more efficient polishers improved technology for storage of paddy and rice, on-farm/ community level drying of paddy, mechanical handling systems for grain markets and millers, cold storage of rice and down stream products, products
diversification in the form of flakes, puffed rice, snacks, bakery items, quick cooking and ready-to-eat rice etc.

The recovery of brown rice as obtained from the hullers, shellers, and modern mills could be in the range of 62-64, 65-67 and 68-70 per cent, respectively. The potential yield of rice is 70-72%. The need is therefore, to promote modern rice mills and develop milling technology for fine rice. If all paddy is milled in modern rice mills, 3 million tones of additional rice worth Rs. 15,000 million could be obtained.

**Wheat Processing Industry**

Wheat is a major crop of India. In the year 1950-51, the country produced 6.5 Mt of wheat, that has increased to 76 Mt by the year 2000-2001. India has emerged as the second largest producer of this cereal in the world. Wheat contains 12% bran, 3% embryo and 85% flour. It is mainly processed for flour (atta), maida, suji and dalia.

In last 50 years, harvest and post harvest technology of wheat has advanced substantially. The most significant development has been the use of self propelled harvester combines used for harvesting and threshing of wheat. From a small figure of about 20-30 combines during 1950-51 imported from USSR by the State Farm Corporation of India, the number has now grown to nearly 6,000 combines. In the year 1998-99, there were about 27 lakh atta chakkis (7.5-10 kW rating) and 700 roller
flour mills in the country. This number has risen from 53,000 *atta chakkis* and 200 roller flour mills in 1971-72. The figures were much lower 50 years back.

The industry could grow on account of R&D inputs starting from the design and development of a variety of threshing machines. Mud bins, wooden plank and mud plastered bins, gunny bags and metal bins have been in use by the farmers for storage of wheat for food and for seed purposes. The traders and government agencies use gunny bags and godown type structures for storage of wheat. For transit level storage, CAP structures have been in use. Metal bins have gained popularity among farmers in the capacity range of 0.2-1.0 tonne of grain storage. As wheat is usually harvested at low moisture content, drying has not been a major problem except for untimely rains.

A number of commercial organizations have been offering processing units for handling, cleaning, grading, drying, storage, treatment and bagging of wheat for seed and food applications. Wheat is now increasingly being used in the form of bread, biscuits, suji and atta. Wheat flakes and puffed wheat as breakfast cereals has been gradually picking up. In the area of wheat milling, Central Food Technology Research Institute, Mysore; Central Institute of Agricultural Engineering, Bhopal and a number of other R&D institutions have developed mini
flour mills for higher efficiency in small scale. Traditionally used smaller size atta chakkis may face problems of declining clientele. Better mechanized chakkis (with lower pollution level and better energy efficiency) are likely to increase in number. The number of roller flour mills is also likely to increase steadily, however, majority of the mills may continue facing the problems of low capacity utilization and working capital constraints. These units would need to function through vertical integration of operations for sustaining profitability and achieve cost reduction through appropriate automation and computerization. Increase in demand is also expected in grain handling machinery, silo systems in grain markets and seed processing machinery.

Trends in consumer preferences suggest increasing demand for baked products. Demand for bread is likely to grow faster than the demand for biscuits. Presently bread is consumed mostly in large cities. Its consumption is expected to grow in smaller towns also. States with higher per capita income would continue to lead in the consumption of baked products. Among diversified products, full bran wheat bread has also been gaining popularity.
**Processing of Coarse Cereals**

Production of coarse cereals has risen from 15.4 to 32.0 Mt between 1950-51 and 2000-2001. The growth has not been as rapid as in case of wheat and rice. It is because of low profitability of these crops for farmers. Till 1950s, we were dependent on manual methods of harvesting of these crops, bullock treading, storage in mud bins and gunny bags and milling by manual chakkis or water mills. By the year 1998-99, power operated equipment were available for all operations including threshing, pearling and milling. For storage of coarse cereals, metal bins have been designed at IGSI, Hapur; CIAE, Bhopal; CFTRI, Mysore; PAU, Ludhiana and several of the other R&D Centres. For drying of freshly harvested HYV sorghum or maize, hot air driers using agriculture residue as a source of fuel are now in use.

Technology has also been developed for production of value-added products from coarse cereals such as extruded snacks developed from ragi at CFTRI, Mysore; ragi based snacks at UAS, Bangalore and IIT, Kharagpur; corn products at GNDU, Amritsar; ready-to-eat traditional foods with storage life of 6-9 months at DFRL, Mysore and sorghum-soybean fortified foods at IIT Kharagpur. The trends indicate that coarse cereals are now increasingly used as cattle feed, speciality/occasional foods, and industrial products such as starches. Efforts are required to
develop high yielding varieties of coarse with desired characteristics for
different uses and to explore new food uses. Safe storage of the flour
produced from most of the coarse ce.cals has been a problem due to its
high degree of perishability. This problem needs to be solved.

Processing of Pulses

India produced 8.4 Mt of pulses in the year 1950-51. The
production grew to a level of about 14 Mt by the year 2000-2001. Starting
with nearly 500 dhal mills in the country in 1950-51, there were about
15,000 dhal mills of 100-500 TPD capacity in the year 2000-2001.

Pulses were generally stored in gunny bags or in small tin
containers under straw cover during 1950s. By the year 2000-2001, metal
bins and gunny bags (with profilectic treatment by insecticides) were in
use. Research at CIAE, Bhopal; CFTRI, Mysore; JNKVV, Jabalpur and
GBPUA&T, Pantnagar has revealed that pulse grains need to be stored at
20-22 degree Celsius in partially airtight containers at 8-10 per cent
moisture content for long duration storage. A number of plant based mild
insecticides and insect repellents (such as, neem seed powder) have been
developed for safe storage of seeds.

In the area of milling of pulses, CFTRI developed a dhal mill that
has the advantage of not being dependent on natural sun shine. It involves
subjecting the pulse grain to high temperature (120 degree Celsius) for
short time and the dehusking by carborundum rollers resulting in higher dhal recovery. For small entrepreneurs in rural areas, dhal mills have been designed at CIAE, Bhopal; PDKV, Akola; IIPR, Kanpur, TNAU, Coimbatore; GBPUA&T, Pantnagar and CFTRI, Mysore. These units in specific regions have gained popularity as these are low investment machines which can be owned and operated with low risk.

In a number of dhal mills, improved machinery including cleaners, graders, magnetic separators, washers, driers, polishers, colour sorters and packaging systems are being used. With complete phasing out of hand operated dhal chakkis, commonly used during 1950s, the technology has turned fully mechanized and more-and-more urban based. There is a need to evolve more efficient machines and processes for pre-treatment of the grain, dehusking, sorting, polishing and packaging in order to improve dhal recovery and consume less energy. Also, there is a need for product diversification and development of technology for quick cooking and ready-to-eat dal.

**Oilseeds Processing**

Besides, animal based fat specifically obtained from milk and milk products, edible plant oils have been the major source of oils and fats for most of the population in the country. In the year 1950-51, the country produced 5.2 Mt of oilseeds. Production by the year 2000-2001 had
increased to 24.5 Mt. In the year 1950-51, most of the oilseeds were crushed in either bullock operated oil ghanies or a few mechanical oil expellers. Both of these resulted in high volume of edible oil left in the cake. By the year 2000-2001, there were nearly 2.5 lakh oil ghanies, 60,000 oil expellers and 700 solvent extraction plants. Besides, there were 200 oil refining units in the country and 100 units for production of hydrogenated oil (Vanapati). Per capita availability of edible oils is still very low at 8.0 kg per capita per year in the country. Out of this, 2 kg/capita is imported oil.

R&D Institutions in the country have been working on pre-treatment of oilseeds for higher recovery of oil. Steaming has been found as one of the most useful methods for pre-treatment. On mechanical oil expellers, a number of Institutions including CFTRI, Mysore; CIAE, Bhopal; RAU, Udaipur; OTRI, Anantpur; HBTI, Kanpur and KVIC, Mumbai have done significant work on mechanical oil expellers. KVIC tried to improve the design of bullock operated oil ghanies to make them suitable for operating on 1.5 kW electric motor. Hence, the capacity of these units has improved significantly. These units produce pungent oil that is being traditionally liked by the consumers. The oil produced from ghanies is also being mixed with oil obtained from mechanical oil expellers to produce pungent oil. In the area of solvent extraction of oil
from traditional and non-traditional oilseeds, a large number of researches have been done. A number of chemical solvents have been tried. However, for reasons of economy, food grade hexane has been accepted commercially for solvent extraction of edible oil. Work done at different R&D Institutions also reveals that for long duration storage, oilseeds need to be put in metal containers with limited aeration. Hence, metal bins designed at IGSI, Hapur; CIAE, Bhopal; GBPUA&T, Pantnagar and other centers have become popular. Due to shortage of edible oil in the country, efforts have also been directed to obtain edible oil from non-traditional sources including rice bran and oil palm. On refining, the quality of these oils has been reported satisfactory for edible purposes.

In the area of packaging of edible oils, significantly rapid growth has been recorded specifically in commercial sector. Polypacks and plastic containers have gained popularity over traditionally used metal containers about 30-35 years ago. The future areas of research include application of bio-technology for enhancing yield of edible oil from different oilseeds, application of de-oiled cake for food purposes through protein isolation and health applications of edible oil for treating various physiological disorders.

Production of oilseeds is 24.5 million tonnes. Out of the total production, 7% is used for seed, 8% for food, and 85% for oil extraction.
Export of meal/oilseeds cake has been worth Rs. 15,000 million. Refinement of meal/cake for food products development could be of high importance. Oil expeller with lighter weight, high energy efficiency and capable of extraction up to 90% oil and above needs to be developed for decentralized oil milling. Hydraulic press, batch solvent extraction, extrusion-expelling and physical refining, also need to be considered and tried.

Besides other oilseeds, soybean has gradually become an important crop of India. Its production is around 5.3 million tonnes. Soybean is a special legume. It has 40% protein and 20% oil. India has 154 solvent extraction plants and 60 soyfood units. Average recovery is 17.7% for oil and 82.4% for meal. Soymeal contains about 48% protein. Its export has been worth Rs.15,000 million/year. Soy foods are nutritious and economical and must be promoted. A strategic plan for expanded and diversified use of soybean for food and feed in India for the next 25 years should be made and implemented. This crop has a great potential to enhance nutrition and health of the people and alleviate poverty.
Processing of Fruits and Vegetables

Joint effort of R&D institutions, farmers, government agencies and the trade has resulted in India emerging as a major producer of fruits and vegetables in the world. In the year 2000-2001, the country produced about 45 millions tonnes of fruits and 80 millions tonnes of vegetables. It was next to China in production of vegetables and topped in production of fruits. However, the growth in post harvest sector has not kept pace with the production. Even during the year 2000-2001, there were only 6,000 fruits and vegetable units in the country that had grown from a figure of about 1,000 during 1950-51. Less than one per cent of the total produce was processed, though the installed capacity of the processing industry has grown steadily from 0.27 Mt in 1980 to about 3 Mt in 2000-2001.

Significant developments in technology include better understanding of the process of ripening of fruits, optimum harvesting time, pre-cooling of freshly harvested produce, cold storing of the raw fruits and vegetables, sorting, cleaning, waxing, packaging technology for fruits. At CFTRI, DFRL, IIHR, Bangalore; IARI, New Delhi; GBPUA&T, Pantnagar; IIVR, Varanasi and HPKV, Palampur; a number of technologies have been developed. Most significant work has been recorded in the technology for ripening of the fruits under controlled
conditions. Production of juices and value-added products including jams, jellies, pickles, canned products etc. has become a commercial success. The industry using indigenous technology includes units engaged in juice extraction, concentration of juices, canning and production of several of the products like jams, jellies, canned fruits, dried vegetables etc. Technology is still being imported for establishment of large scale exported oriented units for production of items like banana paste, concentrates of various fruit juices, sorting, cleaning, washing, waxing and packaging of raw fruits and vegetables.

By the year 1998-99, share of different products in the total processed fruits and vegetables was; pulp and juice 27%, jams and jellies 10%, pickles 12%, ready-to- serve beverages 13%, syrups 8%, squashes 4%, tomato products 4%, by canned vegetables 4% and other products 18%. The industry has been facing problems of low capacity utilization, technological obsolescence and marketing. It has to work under the constraints of high fluctuations in raw material quality and fluctuating market price, poor technology for handling and storage, inadequate R&D support for product development, high cost of energy and uncertainty in availability of adequate quantity for processing purposes, inadequate and expensive cold chain facilities and varying requirement of processing conditions from one material to another. Future R&D has to focus on the
issues of economically producing value-added products and product diversification, besides the issues mentioned above.

**Sugarcane Processing Industry**

Sugarcane production was 310 Mt in the year 2000-2001. About 80% of the cane produced is milled, about half for the production of refined white sugar in the organized sector with the sugar mills located in the production catchments in public, private and co-operative sectors and about 42% for the production of Jaggery and Khandasari. Based on sugar recovery, minimum price scheme has been introduced. Mills have loose tie-up with the growers, some of them provide critical input support to the growers. Apparently, it is working well. But there have been cases where farmers burnt their crops in the absence of remunerative prices. For Jaggery, canes are crushed, clarified and concentrated. Gur as sweetener has better nutritional profile than white sugar. It is possible to refine the process and the product for greater competitiveness and realize export potential specially where people of Indian origin are located. Energy efficient furnaces, concentration pans, clarificants, moulds and storage are needed for Gur. Khandasari units used open pan in place of vacuum pans for concentration and the sugar obtained is of lower quality compared to white sugar from mills. Sugar recovery in Khandasari is much lower. These units depend on grid supply or diesel generators for
mechanical/electrical power or both when grid power or both when grid power supply is erratic and diesel gensets are kept as standby power sources. This increases the cost of production of Khandsari. Bagasse, tops, dry leaves and molasses are by-products. Modern sugar mills with co-generation meet their entire energy needs, both thermal and electro mechanical from these bagasse fired boilers – steam turbine units. They feed extra power to grid or save 15-20% bagasse for the use as feedstock or paper making. Jaggery promotional and regulatory measures have been taken by the Government to improve quality and production. Large number of sugar mills are using outdated processes and equipment, some of them not only use entire bagasse but also use wood.

**Cotton Processing Technology**

Cotton is a natural textile fibre. Traditional cotton textile industry could not face onslaught of modern high speed spinning, weaving and surface finish technologies. Small scale textile industry supported by Swadeshi and Khadhi and Village Industries Commission face serious labour problems also. Cotton seeds are valued as feed and oilseed and the stalks are used as fuel. However, stalks yield excellent paper and pulp, particle boards and microcrystalline cellulose (MCC). Cotton hulls also yield good particle board and furfural. Cotton willow dust can be used for production of bio-gas. Cotton wastes can be used for mushroom
production. There is scope for income and employment generation if cotton stalks are utilized for pulp and paper making.

**Processing of Jute**

Jute has the distinction of having ushered India into industrialization era. Both jute production and manufacture of jute-based products are highly labour intensive, concentrated mostly in Eastern India. Mini jute carding and spinning mills have now been developed which allow decentralized production of utility items from jute but these are not popular yet. For each tonne of jute, 2-3 tonnes of jute sticks are produced. Chemically these resemble hardwood. Sticks are traditionally used as fuel wood and low cost structural material. Jute sticks yield excellent particle boards and the technologies are now fully commercial. Jute sticks are a good feedstock for paper pulp. The sticks can also be used as fuel for steam and power generation.

**Processing of Commercial Crops**

The commercial crops include spices, condiments and crops such as gorgon nut (makhana), water chestnut, bettle leaves, tobacco etc. Post harvest operations of these crops are highly energy intensive and there is a scope for reducing energy consumption and improvement of quality through proper cleaning, grading, drying/dehydration, milling, grinding
and other operations. India has been a leading producer, consumer and exporter of spices like black pepper, cardamom, chilies, spice oils and oleoresins. It produces about 3.0 Mt of spices valued at over Rs. 60,000 million. About 7% of the total production is exported. Contribution of R&D to PHT of spices includes equipment and processes for cleaning, grading and packaging of whole spices and production of value-added products such as oleoresins and spice oils. Institutions like CFTRI, DFRL, Indian Institute of Spices Research and some of the SAUs including TNAU, Coimbatore have contributed significantly to this development. Projected world trade in spices in 2001 AD was estimated to about 6.25 lakh tonnes, valued at US$ 3 billion and projected export from India at that time was about 10% of the world trade. To achieve and maintain India’s share in the trade, the quality of spices and their products will have to be improved. New products like dehydrated pepper, freeze dried green pepper, ginger candy, ginger beer/in-brine/ squash, ginger flakes have to be developed. Development of internationally accepted quality products, packed under hygienic conditions need attention in this context. Similarly, in the area of PHT of other crops, contribution of R&D basically has been on raw materials refinement, product quality enhancement and diversification.
**Processing of Plantation Crops**

Plantation crops contribute substantially to the national economy with export earning of Rs. 12.4 billion. Coconut alone contributed Rs. 1.72 billion by way of exports during 1996-97. However, the coconut based industry in India has been in the infancy stage. There is considerable scope of product diversification, viz. production of coconut milk and milk powder, coconut cream, shell powder, shell charcoal etc. Coconut wood utilization needs more attention. In case of other crops, financially viable technologies for product diversification need to be developed. Such products are arecanut fat, tannin, areuline, other chemicals from arecanut, honey/chocolate coated or salted kernels from cashewnuts and value added products from by-products. The post harvest operations in these crops need to be mechanized. Though the technology has been developed for desiccated coconut, coconut cream and other products, it needs refinement. At CPCRI, Kasargod, a coconut dehusker has been developed for manually opening the nuts. Another motorized unit is under development. Copra drier using LDPE cover and batch type hot air copra drier using agricultural waste as source of fuel have also been developed at CPCRI, Kasargod; KAU, Thrissur and TNAU, Coimbatore. In case of the plantation crops like oil palm, necessary efforts are required for processing and value addition, especially with
regard to quality of products, energy inputs, packaging etc. to meet the international quality standards and to reduce the cost of production. Processing of cocoa beans at small scale also needs attention.

**Processing of Medicinal and Aromatic Products**

The plant based pharmaceuticals, herbal medicines, perfumery, cosmetics, fragrances and food flavour industries have recorded a phenomenal expansion in last 50 years and as a result, this sector figures in high annual growth rate industries in agri-business. The market for plant based pharmaceuticals in the year 1994 was estimated to range between US$ 32-43 billion. The world essential oil production at raw materials level was estimated to be about Rs. 32 billion of which 55-60% goes to food flavours, 15-20% as fragrances and the remaining is broadly used as starting raw material for isolation of aromatic chemicals. In terms of market share in production value, India is sliding downwards and presently stands at sixth rank with only 6% share in world trade. The R&D work on PHT of medicinal and aromatic plants had been confined to the IBRI, Lucknow and a few of the CSIR and ICAR laboratories. The thrust has been harvesting of the plants, curing/drying, and extraction of the medicinal and aromatic substances. The export earnings could be increased by innovations in the field of post harvest technology for increasing productivity and improving quality. In case of medicinal plants,
studies need to be conducted to develop testing procedures/analytical facilities to meet stringent international standards and to carry out product/process development for low cost chemicals from both raw materials and other by-products.

**Apiculture Produce Processing**

Bee-keeping i.e., rearing the bees in artificial hives to produce honey and other products offers an immense potential for providing employment to rural folk in India where many evergreen and moist deciduous forests, orchards etc. constitute good bee keeping areas. The unique feature of bee keeping is that the capital investment required is small and unlike many other industries, it does not need raw material in usual sense as nature offers the same in the form of nectar and pollen. The equipment required, viz; bee boxes of standard sizes, honey extractor smoker, hive tools etc. have been researched and improved in design and these can be manufactured even in small rural carpentry and black smithy shops. Improved bee hives have been developed which make honey production much easier than the traditional long hanging hives. In general, equipment like smoker, comb foundation sheet machine, honey extractor, queen excluder, honey tank and uncapping equipment have been developed by R&D organizations namely, KVIC, Mumbai; PAU, Ludhiana and IARI, New Delhi. There is need for R&D to develop
suitable equipment in this reference and for product diversification. Good work has also been reported by GNDU, Amritsar in improving quality of honey through proper processing and measuring its bio-chemical and engineering properties that could be used by processing industry.

**Processing of Traditional Foods**

India has a very strong base of traditional food products, which have been developed under varied agro-climatic, geographical and socio-cultural situations over the centuries. Besides, conventional chapatis, these may include expended, puffed, flaked, extruded, fermented products, sweets, instant mixes, breakfast foods, bakery products, beverages, health and special foods. The production of traditional foods during 1996-97 has been estimated nearly 30 times more than that of all western style high cost processed foods in the Indian market. There is an urgent need to upgrade the conventional foods technology so that the industrial manufacturing of products can be promoted and the scope of marketing expanded. There can be substantial domestic and export demand for traditional foods. Production of Bikaneri Bhujia for export and frozen Idli for domestic markets are some of the successful examples. A chapatti making machine developed at CFTRI, Mysore for defence canteens and hotels is a fine example of modernisation of traditional food sector. Similarly, long life chapatti and parotha technology developed at
DFRL, Mysore has been a success story for providing food of liking for many defence personnel working in remote and frontier areas. Technologies during last 50 years have also been developed for gulabjamun mix, idli and dosa mixes and a variety of other food items to suit to Indian palate. R&D has contributed significantly in rapid growth of processing units and trade in traditional food sector however much more needs to be done.

Floriculture

Flowers and plants have always been an integral part of human living. Besides their aesthetic importance, they are also useful in improving the quality of life. Ornamental plants play a very important role in environmental planning of urban and rural areas for abatement of pollution, social and rural forestry, wasteland development, aorestation and landscaping of outdoor and indoor spaces. Floriculture is also an important agri-business with potential for export trade.

The area under floriculture in India has increased to nearly 40,000 ha, which constitutes around 17% of total global acreage. Inspite of such a large area, production value is very low. The quality of Indian produce is poor and not acceptable in international market. The produce quality deteriorates further due to improper packaging, storage and transportation. Major contribution of R&D in this area has been in the
form of raising varieties that are more attractive and flower life is longer. Also, technology has been developed at IIHR, Bangalore; IARI, New Delhi; UAS, Bangalore; HPKV, Palampur; GBPUA&T, Pantnagar and PAU, Ludhiana for longer shelf life of cut flowers.

Floriculture is largely an export oriented agro-industry. There are 14 flowers in the world cut flower trade. The trade is growing at the rate of 15% per annum. Yet Indian exports are limited only to a few flowers namely, Gladiolus, Chrysanthemums, Jasmine and Orchids. India's share in the world floriculture trade is a minuscule with 0.59% exports during 1992-93 valued at Rs. 149.1 million. Cultivation of high quality varieties under protected conditions, proper tools and equipment, appropriate packaging and storage can create a niche for Indian flowers in the world market.

**Agro based & Food Processing industries**

**Investment potential of Agro based & Food processing Industries**

Uttar Pradesh produces 38% of India's Wheat-production, 20% of Paddy, 21% of Sugarcane, 34% of Groundnut, 17.5% of Rape-seed, 8% of Fruits and 14% of Vegetables. It has the unique distinction of producing 4% of world's wheat and is the leading producer in India for Sugarcane, Vegetables and Potatoes. It also has the largest livestock population and highest milk production in India, offering excellent
opportunities for setting-up food processing units. Floriculture, Mushroom and other Horticulture based industries provide exciting prospects. U.P is among the largest producers of agricultural commodities within the country.

**Table No – 2.5**

<table>
<thead>
<tr>
<th>Item</th>
<th>India</th>
<th>UP</th>
<th>Production (%)</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>58.50</td>
<td>22.56</td>
<td>38.50</td>
<td>First</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>249.25</td>
<td>108.43</td>
<td>43.50</td>
<td>First</td>
</tr>
<tr>
<td>Rice</td>
<td>79.00</td>
<td>10.10</td>
<td>12.80</td>
<td>Third</td>
</tr>
<tr>
<td>Maize</td>
<td>9.57</td>
<td>1.39</td>
<td>14.40</td>
<td>First</td>
</tr>
<tr>
<td>Fruits</td>
<td>33.89</td>
<td>3.35</td>
<td>10.15</td>
<td>Third</td>
</tr>
<tr>
<td>Vegetables</td>
<td>71.57</td>
<td>9.60</td>
<td>13.40</td>
<td>Third</td>
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<tr>
<td>Mango</td>
<td>9.20</td>
<td>1.99</td>
<td>13.40</td>
<td>Second</td>
</tr>
<tr>
<td>Potato</td>
<td>136.61</td>
<td>64.86</td>
<td>47.45</td>
<td>First</td>
</tr>
<tr>
<td>Livestock</td>
<td>406.10</td>
<td>317.30</td>
<td>78.10</td>
<td>First</td>
</tr>
<tr>
<td>Milk Production</td>
<td>63.50</td>
<td>11.20</td>
<td>17.65</td>
<td>First</td>
</tr>
</tbody>
</table>

**Promotional policy**

Considering the importance of this sector, the State Govt. of U.P has formulated a comprehensive policy to promote investment in this
sector. The twin objectives of this policy are to generate maximum employment and ensure sustained integrated development through proper utilisation of agricultural and animal husbandry resources available in the State.

- Separate Sectoral identification of agricultural produce and animal husbandry resources.
- Establishment of high level infrastructural facilities.
- Financial support and provision of linkages like raw material, storage, transportation and marketing for establishment of industries based on agricultural and animal husbandry resources.
- Special facilities with the object of encouraging industries, based on agricultural produce and animal husbandry resources.
- Special efforts for export of produce of industries based on agricultural and animal husbandry resources.
- Simplification of prevalent rules and procedures.
- Creation of 'DATA BASE' for raw material and marketing and technical upgradation.

**Potential opportunities**

**Foodgrains & Cereals**
There is vast potential for setting up units based on agriculture produce viz. wheat-based Gluten,.... Export oriented rice mills in the State of Uttar Pradesh are as under:

**Table No – 2.6**

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Capacity</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paddy Processing Complex</td>
<td>Paddy-5 lakh tonnes per year Rice, Rice Bran Oil, Cattle Feed, 8 MW captive power</td>
<td>Gorakhpur</td>
</tr>
<tr>
<td>Export Oriented Raw Basmati Processing Project</td>
<td>Raw &amp; Par boiled Rice 72000 TPA</td>
<td>Dehradun, Saharanpur, Muzaffarnagar, Nainital</td>
</tr>
<tr>
<td>Wheat Based Gluten Project</td>
<td>Gluten - 6000 TPA, Wheat Starches - 40000 TPA, Wheat Bran-18500 TPA</td>
<td>Meerut, Ghaziabad</td>
</tr>
</tbody>
</table>

**Fruits & Vegetables**

The total area under Fruits & Vegetables cultivation, including potatoes was 920 Million hectares which yielded 13 million tonnes of produce during the year 1994-95. Fruits like Mangoes, Guava, lemon, Papaya and Grapes are successfully grown in the plains area of the State, whereas Apple, Peach, Pears, Apricot, Lemon, Leechee etc. are grown in the hilly regions of the State. Choicest varieties of mangoes like
Dushehri, Chausa, Langra, Fazli, Safeda etc. are grown in the State.

There is a vast potential for setting-up of medium scale fruits & vegetables processing projects in U.P. Projects are as follows:

**Table No – 2.7**

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Capacity</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frozen Fruits &amp; Vegetables Project</td>
<td>IQF Products-4800 TPA</td>
<td>Ghaziabad, Bulandshahr</td>
</tr>
<tr>
<td>Vacuum Freeze dries fruits &amp; Vegetables Project</td>
<td>Freeze dried products-300 TPA</td>
<td>Ghaziabad</td>
</tr>
<tr>
<td>Fruit Juice concentrate Project</td>
<td>Apple Juice Concentrate-7190 TPA, Citrus Juice Concentrate-490 TPA</td>
<td>Haldwani, Nainital</td>
</tr>
<tr>
<td>Potato based Alcohol Project</td>
<td>Potato Alcohol-11000 KL/annum</td>
<td>Farrukhabad</td>
</tr>
<tr>
<td>Potato Processing Complex</td>
<td>Potato Flakes-2700 TPA, Frozen Potato French Fries-12000 TPA, Potato Chips-600 TPA, Mashed Potato Products-4800 TPA</td>
<td>Farrukhabad</td>
</tr>
<tr>
<td>Potato Flakes/Granules Project</td>
<td>Potato Flakes Granules-4200 TPA</td>
<td>Ghaziabad</td>
</tr>
<tr>
<td>Onion/Garlic Power Project</td>
<td>Onion Flakes-600 TPA. Onion Powder</td>
<td>Mainpuri, Etawah</td>
</tr>
<tr>
<td>Integrated Fruits &amp; Vegetables Grading Packaging &amp; Cooling Centres</td>
<td>600 TPA, Garlic Powder-800 TPA</td>
<td>Handling of Fruits &amp; Vegetables</td>
</tr>
</tbody>
</table>

**Sugar and Derivatives**

The State of Uttar Pradesh is the largest producer of Sugar-cane in the country having sugarcane acreage of 2.38 million hectares and 117 sugar mills, with total installed capacity to crush 0.283 million MT of sugarcane per day.

The sugar cane available in UP constitutes 12% sugar, 32% bagasse and 4% of molasses. The total sugar cane production in India vis a vis the state of Uttar Pradesh during the last few years has been as under:

**Table No – 2.8**

<table>
<thead>
<tr>
<th>Year</th>
<th>India</th>
<th>U.P.</th>
<th>Contribution of UP %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990-91</td>
<td>241.04</td>
<td>102.06</td>
<td>42.34</td>
</tr>
<tr>
<td>1992-93</td>
<td>230.83</td>
<td>100.42</td>
<td>43.50</td>
</tr>
<tr>
<td>Year</td>
<td>Production</td>
<td>Area (hectare)</td>
<td>Yield (metric tonnes)</td>
</tr>
<tr>
<td>----------</td>
<td>------------</td>
<td>----------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>1993-94</td>
<td>229.66</td>
<td>109.99</td>
<td>47.89</td>
</tr>
<tr>
<td>1994-95</td>
<td>271.23</td>
<td>122.84</td>
<td>45.29</td>
</tr>
<tr>
<td>1995-96</td>
<td>269.38</td>
<td>143.71</td>
<td>53.35</td>
</tr>
</tbody>
</table>

(Fig. in million tonnes)

UP is the largest producer of Sugarcane in India among all the states and accounts for over 45% of Sugarcane production of the country. About 30% sugarcane in U.P. is used for manufacturing white sugar.

Setting-up of Integrated Sugar-complexes, envisaging paper production based on Boggase, Alcohol & Alcohol-based on Molasses and Co-generation of electricity apart from the production Sugar itself within these complexes is being encouraged.

Potential-projects based on sugarcane are as under

**Table No – 2.9**

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Capacity</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar Complex with Captive Power Plant</td>
<td>Sugar Plant 2500 MT Capacity Crushing per day, Power Plant 6.5 MW</td>
<td>Eastern of Western Part of the State</td>
</tr>
<tr>
<td>Alcohol Based Chemicals Complex with Captive Distillery</td>
<td>Distillery 18000 KL per year Acetic Acid 6000 MT per day plant Acetic Anhydride 3000 MT per day Plant, Ethyl Acetate 3000 MT per day Plant.</td>
<td>Western Part of the State</td>
</tr>
</tbody>
</table>
Sugarcane

Sugar, molasses and bagasse are main derivatives of sugarcane. Molasses is further used for manufacturing industrial alcohol, potable alcohol and other chemicals.

Bagasse is used for co-generation of power and paper manufacturing.

Sugar

Even after having the number one position in sugarcane production, UP accounts for about 25-30% of India's sugar production. In UP, only 29% sugarcane is used by sugar mills and balance 71% of sugarcane is utilized by manufacturers of other miscellaneous products. If 50% of sugarcane is used for sugar production, UP has the potential to produce about 50% of country's sugar production. At present, there are 115 sugar mills operational in the State of Uttar Pradesh.

Molasses
Production of Molasses in India vis a vis State of Uttar Pradesh has been as under for the past few years.

**Table No – 2.10**

<table>
<thead>
<tr>
<th>Year</th>
<th>India</th>
<th>U.P.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990-91</td>
<td>5.44</td>
<td>1.65</td>
</tr>
<tr>
<td>1991-92</td>
<td>6.05</td>
<td>2.06</td>
</tr>
<tr>
<td>1992-93</td>
<td>4.38</td>
<td>1.41</td>
</tr>
<tr>
<td>1993-94</td>
<td>4.23</td>
<td>1.44</td>
</tr>
<tr>
<td>1994-95</td>
<td>6.50</td>
<td>1.85</td>
</tr>
<tr>
<td>1995-96</td>
<td>8.29</td>
<td>2.72</td>
</tr>
</tbody>
</table>

(Fig. in million tonnes)

About 95% Molasses is used by distilleries and balance 5% is used for other purposes. As already mentioned above, industrial alcohol, potable alcohol, baker's yeast, oxalic yeast, citric acid, mono sodium glutamate, lysin, ephedrine and cattle feed are the main products which are derived from molasses.

The state has recently decontrolled molasses and reduced Sales tax on molasses used by Distilleries from 20% to 8%. This has benefited all associated industries across the board.

**Bagasse**

Bagasse is the fibrous residue left after extraction of juice from sugarcane. The quantity of bagasse depends upon the fibre contents in the
sugarcane. Composition of bagasse depends on various factors like variety of sugarcane, milling efficiency etc.

Bagasse is the source of fuel mainly for boilers and turbo generator set for co-generation of power. It is also used as raw material for paper manufacturing units, particle boards, furfural and activated carbon. Paper produce from bagasse has good capacity, printing characteristics and high bursting strength which is good for newsprint. Total annual availability of bagasse in the state of Uttar Pradesh is about 18 million tonnes. There is a very good potential for setting up paper manufacturing units using bagasse as main raw material. A very good potential also exists for co-generation of power of about 650 MW in totality in the State of Uttar Pradesh by utilising bagasse.

**Government Policy**

**Policy Regarding Sugar Mills**

- License is required from Government of India for a new unit
- Distribution of sugar is covered under. The Essential Commodities Act
- Govt. exercise control over the various aspect of production, distribution, sales and pricing.
- The ratio of levy to free sales sugar is fixed by Govt.
- However, new units are exempted from levy for initial 8 years period in certain areas.

Policy Regarding Molasses
- Distribution of Molasses is partly controlled by State Govt.
- 50% of production of molasses under control and rest 50% allowed to sold in open market

Other potential areas

There is also scope for pulling up non-conventional units like floriculture, mushroom Cultivation and Neem based Pesticides primarily for exports. The tentative cost of these projects are as under:

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Capacity</th>
<th>Location</th>
<th>Cost (Rs. in Million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floriculture Project</td>
<td>Cut Rose Flowers-112 lakh/annum</td>
<td>Saharanpur</td>
<td>220</td>
</tr>
<tr>
<td>Mushroom Project</td>
<td>Canned Mushroom-2000 TPA</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

Alcohol
There are 41 distilleries in the State of Uttar Pradesh with a capacity of 722.42 million liters.

Alcohol based Industry Chemicals based on alcohol can be classified as:

- Chemical based on Ethylene
- Chemical based on Acetaldehyde
- Chemical based on Acetic Acid
- Misc. Chemicals
Alcohol based chemicals and end uses are given as here under:

**Table No – 2.12**

<table>
<thead>
<tr>
<th>ALCO-CHEMICAL USED FOR MANUFACTURE OF:</th>
<th>Acid, Acetic Anhydride, Butanol, Butadiene, 2-ethyl hexanol, pentaerythritol, glyoxal etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetaldehyde Acetic</td>
<td>Vinyl acetate, PTA, cellulose acetate, acetic esters, chloro acetic acid etc.</td>
</tr>
<tr>
<td>Acetic Acid</td>
<td>Drugs and pharmaceuticals, cellulose acetate, vinyl acetate.</td>
</tr>
<tr>
<td>Acetic anhydride</td>
<td>Dyes and dye intermediates, sulfa drugs, rubber accelerators, peroxide stabliser.</td>
</tr>
<tr>
<td>Acetanilide</td>
<td>Used as solvent and in manufacture of explosives, lacquers and other chemicals.</td>
</tr>
<tr>
<td>Acetone</td>
<td>Butyl acetate, glycol ether/esters, plasticizers, amine, resins, butyl acrylate/methacrylate and used as solvent.</td>
</tr>
<tr>
<td>Butanol</td>
<td>Weedicide</td>
</tr>
<tr>
<td>2,4-D</td>
<td>Solvent for fats, waxes, oils, perfumers, cellulose nitrate, denaturant for alcohol.</td>
</tr>
<tr>
<td>Di-Ethyl Ether</td>
<td>Solvent in paints and varnishes, as a flavouring agent in medicines and pharma.</td>
</tr>
<tr>
<td>Ethyl Acetate</td>
<td>Pesticides</td>
</tr>
<tr>
<td>Acetoacetates</td>
<td>Drugs &amp; pharmaceuticals, pesticides, dyestuffs</td>
</tr>
<tr>
<td>Chemical</td>
<td>Uses</td>
</tr>
<tr>
<td>----------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Acetacetanilide</td>
<td>Dyestuffs</td>
</tr>
<tr>
<td>Acetoacetanilide</td>
<td>Pesticides, dyestuffs.</td>
</tr>
<tr>
<td>Pyridines &amp; picolins</td>
<td>Bulk drugs, vinyl pyridine</td>
</tr>
<tr>
<td>Vinyl acetate</td>
<td>Adhesives, VC-VA copolymers, monomer alcohol, polyvinyl acetate.</td>
</tr>
<tr>
<td>Styrene</td>
<td>Polystyrene, ion exchange resins, ABS, SAN</td>
</tr>
<tr>
<td>Butadiene</td>
<td>SBR, ABS, NBR, Vinyl pyridine latex.</td>
</tr>
<tr>
<td>Chloro acetic acid</td>
<td>EDTA</td>
</tr>
<tr>
<td>Ethylene oxide</td>
<td>Ethylene glycols, EO condensates for dyes, textiles, plastics etc.</td>
</tr>
<tr>
<td>Ethylene Glycol</td>
<td>Polyester fibre/films, brake fluids, dehydrants, explosives, textile chemicals.</td>
</tr>
<tr>
<td>CMC</td>
<td>Textile detergents, pesticides, leather, paper, ceramics, oil drilling, welding electrodes.</td>
</tr>
<tr>
<td>2-Ethyl hexanol</td>
<td>Plasticizers, defoamer in oil industry.</td>
</tr>
<tr>
<td>EDC-VCM-PVC</td>
<td>Plastics</td>
</tr>
<tr>
<td>Ethylene</td>
<td>EDC-VCM-PVC, styrene, polystyrene, SBR, ethylene oxide, ethylene glycol etc.</td>
</tr>
</tbody>
</table>
Textiles

The Indian textile industry is among the oldest and most diverse of industries, where sophisticated technology co-exists with traditional techniques. It is the second largest textile industry in the world.

The textile industry is the largest industry in India accounting for 20 per cent of total industrial output, providing direct employment to about 27 million people and contributing nearly 38 per cent to the total value of exports. The textile industry comprises mainly of two segments (i) organised textile mill sector and (ii) unorganized textile sector which includes powerlooms, handlooms, woolen textiles, silk fabrics and craft fabrics. The industry output is estimated at Rs.600 billion.

The Indian textile industry continues to be predominantly cotton based, consuming about 70 percent of cotton based raw material. There was phenomenal growth during the last four decades and spindlage increased from 11 million in 1951 to 31.75 million by the end of March, 1996.

7. Role of Government in development of Agro based Units

Agro-based industrialisation may be called as a system of economic development in which the Agricultural output/products are
used to develop a technically up-to-date, diversified industry capable of assuring on adequate rate of growth for the economy as a whole and of overcoming economic and social change. So agro-based industrialisation can be regarded as a precursor to economic development and social changes.

The Government has not considered agro-based industries as a separate segment for the allotment of funds in its five year plans. The "Rural agro-based Industries" (argo-produce processing units and agro-produce manufacturing units) are included in village and small industries and the "Urban agro-based industries" (agro-input Manufacturing units and agro-service centers). Are included in medium and large-scale industries. Hence the term village and small industries may be considered to include rural agro-based industries as well, and the measures applicable to village industries are also applicable to rural agro-based industries. In the balanced growth hypothesis of prof. Ranger Nurekse it has been viewed that agriculture and industry are inter-dependent and balanced development process may occur if these two sectors are developed, leading to each other on mutual-complacency basis. The agro-based industrialisation bases to this theoretical possibility. Practically, the concept is based on local-resource- oriented industrial process.
These industries use agricultural produce as their raw material or inputs, process them and final output is resulted. It is noteworthy that they are not confined to processing agricultural produce alone (processing of food crops, sugar cane, oil, seeds, fruits and vegetables, cotton, fruit and other similar produce) but also to those industries which manufacture or service agricultural implements such as power threshes, crane, crushers, cultivators and levelers, separators, sowing fans and tractor trolleys etc. Conclusively, the agro-based industrialisation is a value-added industrialisation.