1.1. INTRODUCTION

Agriculture has been the backbone of the Indian economy and it will continue to remain so for a long time. It has to support almost 17 per cent of world population from 2.30 per cent of world geographical area and 4.20 per cent of world’s water resources. The economic reforms, initiated in the country during the early 1990s, have put the economy on a higher growth trajectory. The annual growth rate in Gross Domestic Product (GDP) has accelerated from below six per cent during the initial years of reforms to more than eight per cent in recent past years. The workforce engaged in agriculture between 1980-81 and 2010-11 witnessed a very small decline; from 60.50 per cent to 52.50 per cent.\(^1\)

The storage, transportation, processing, value addition and marketing of farm produce need to be improved to enhance household food, nutrition and livelihood security. Indian agriculture is characterized by agro-ecological diversities in soil, rainfall, temperature, and cropping system. Besides favorable solar energy, the country receives about three trillion m\(^3\) of rainwater, 14 major, 44 medium and 55 minor rivers share about 83 per cent of the drainage basin. About 210 billion m\(^3\) water is available as ground water but, irrigation water is becoming a scarce commodity.

Thus proper harvesting and efficient utilization of water is of great importance. Intensive cultivation as a result of introduction of high yielding varieties in the mid 1960’s required higher energy inputs and better management practices. Land preparation, harvesting, threshing and irrigation are the operations, which utilize most of the energy used in agriculture. The share of animate power in agriculture decreased from 92 per cent in 1950-51 to 16 per cent in 2010-11. For desired cropping intensity with timeliness in field operations, animate energy sources alone were no
longer adequate. Farmers opted for mechanical power sources to supplement animate power.\textsuperscript{2}

1.2. AGRICULTURE SCENARIO IN INDIA

In the past agriculture has played and will continue to play a dominant role in the growth of Indian economy in the foreseeable future. It represents the important sector producing around 12.40 per cent of the Gross Domestic Product (GDP) in 2010-2011, is the largest employer providing more than 60 per cent of the jobs and is the prime arbiter of living standards for seventy percent of India’s population living in the rural areas. These factors together with a strong determination to achieve self-sufficiency in food grains production have ensured a high priority for agriculture sector in the successive development plans of the country.\textsuperscript{3}

An important facet of progress in agriculture is its success in eradication of its critical dependence on imported food grains. In the 1950’s nearly five per cent of the total food grains available in the country were imported. This dependence worsened during the 1960’s when two severe drought years led to a sharp increase in import of food grains. During 1966 India had to import more than 10 million tonnes of food grains as against a domestic production of 72 million tonnes. In the following year again, nearly twelve million tonnes had to be imported. On the average well over seven percent of the total availability of food grains during the 1960s had to be imported.\textsuperscript{4}

The present cropping intensity of 134 per cent has registered an increase of only 26 per cent since 1950-51. The net sown area is 125.73 million hectare in 2010-11. Presently, the total net irrigated area covers 46.50 per cent of the net sown area; the remaining 53.50 per cent is rain fed. Nearly two-thirds of the area under food grain crops is under rice and wheat cultivation. The degradation of land and surface as
well as ground water resources results in fast deterioration of soil health. Losses due to biotic (insect-pests, diseases, weeds) and a biotic (drought, salinity, heat, cold, etc.) stresses account for about one-fourth of the value of agricultural produce. The storage, transportation, processing, value addition and marketing of farm produce need to be improved to enhance household food, nutrition and livelihood security.  

The nation is striving to find ways and means to keep its burgeoning population adequately fed. On the one hand it is facing the problem of declining productivity and on the other, challenges posed by liberalization. In such a scenario, leveraging the available natural resources and existing infrastructure is the only way to make the ends meet. Management of the already built infrastructure in harmony with natural systems is the clarion call of the day.

Knowledge to the extent of existing infrastructure and natural resources is one of the most basic pre-requisites to utilize them effectively and in a sustainable manner. The discipline of agricultural engineering endeavors to develop technologies for enhancing productivity and reducing the cost of cultivation. Traditionally animate power was used for field operations and processing activities. As a result of introduction of mechanical power, agricultural engineering activities have expanded considerably. To sustain the project population of 1.363 billion by 2025 the productivity has to be increased by 100 per cent from the present level by intensification of agriculture. It is estimated that the energy input to agriculture would have to be increased from the present level of 1.3 to 2.4kW/ha.  

The productivity of wheat, rice and oilseeds increased to a greater extent than other crops. The increase in production of food grain was possible as a result of adoption of quality seeds, higher dose of fertilizer and plant protection chemicals, coupled with assured irrigation. The growth in production of fruits (46 million
tonnes), vegetables (91 million tonnes), milk (81 million tonnes), fish (57 million tonnes) has also increased. As a result, not only the country has achieved self sufficiency in foods but have adequate agro-produce for export.  

Our agriculture is now at the crossroads. The use of certified/quality seeds by the farmers has increased to 700,000 tonnes. The fertilizer consumption has increased to 26.85 million tonnes (more than 112.69 kg/ha) in 2010-11 from 0.29 million tonnes in 1960-61. It increased at an annual growth of 12.64 per cent. The use of technical grade plant protection chemicals has increased to 58.46 thousand tonnes (0.52 kg/ha) from a meagre of 8.62 thousand tonnes in 1960-61. Crop and site specific agricultural mechanization and agro-based small and medium enterprises in rural sector using a proper blend of conventional and renewable energy sources will facilitate in enhancing agricultural productivity and profitability resulting in higher income for farmers and better quality of life.

Water is an essential natural resource for the survival of life, a key input for plant growth and is instrumental in the upkeep of the environment. Although water is a renewable source, it is quite dynamic and scarce. The distribution of water is highly skewed and to make it better the technical feasibility of inter basin transfer of water by linking Himalayan and Peninsular rivers has been investigated and the proposal is under consideration of the Government of India. It is estimated that after the development of full irrigation potential of 140 million ha as against the cropped area of 200 million ha by the year 2011, about 60 million ha will be left as rain fed. It, therefore, demands that every drop of rainfall should be conserved and it can be done by in-situ and ex-situ harvesting of rainfall.
Out of this 1122 bcm (690 bcm from surface water and 432 bcm from ground water) can be utilized for meeting diverse demand. The spatial and temporal distribution of water resources in the country is highly uneven. The present extent of utilization has been estimated to be 605 bcm out of which about 83 per cent is for irrigation purposes.9

In India, major water resources are from rivers, lakes, canal, reservoirs, tanks and ground water. Globally, fresh water at a tune of 3,240 m km$^3$ is being utilized. Of this, 69 per cent is being used in agriculture sector, eight per cent in domestic, 23 per cent in industrial and other sectors. In India, around 88 per cent water is being used in agriculture sector, covering around 80 M ha area under irrigation.10

Water is drawn either from a dug well or a shallow tube well fitted with a pump set. In both cases a horizontal centrifugal pump set is commonly used. It was estimated that there are about 16.00 million electric motors and 9.00 million diesel engine pump sets for lifting water from various sources. These consume about 100 billion kWh of electricity and 4.0 billion litres of diesel annually.10

The standing committee (Government of India) on the study of operational efficiency of irrigation pumps clearly observed that overall efficiency in diesel operated pump sets was 12.70 per cent and 31.10 per cent in electrically operated pump sets. Because of improper management of the systems, lack of clear cut guidelines and lack of emphasis on water management at farm level, the overall efficiency of these systems continued to remain low. It is reported that, a farmer can save up to Rs. 3300 per year over his present expenses for pump set operation if his pumping system is properly selected. Principal factors influencing watershed operations are physiographic (size, shape, land slope) soils and geography, vegetative
cover, design peak runoff rate, precipitation, socio-economic factors, organization and analysis after treatment to land with soil conservation measures.\textsuperscript{11}

More than 600 million tones of biomass are available from various crops residues and agro-wastes for fuel wood and animal feed. It is estimated that 35-40 per cent of biomass is utilized for animal feed and the remaining as energy source through direct combustion either for cooking food (improved chulha 284.89 lakhs) or for processing of agro-produce (bagasse co-generation 84 MW). This is also available for generation of bio-gas (27.13 lakhs plants) and gasification (28.53 MW). Bio-gas and producer gas can partially substitute HSD in compression ignition engines. Alcohol and plant oils are compatible with fuel injection system of compression engines and can be used after transesterification. Solar dryers and solar cookers (456674 nos) are available to supplement rural energy.\textsuperscript{12}

The size of India’s food industry is estimated at Rs. 2, 50,000 crore. Of this, value added processed food are forecast to rise three times from the present Rs. 80,000 crore to 2, 25,000 crore. The Indian food agro-products industry is predominantly related to conservation and simple processed food. However, there is a trend towards value added, easy to use convenient products. Presently only up to six per cent of the total produce is converted to processed and packed foods. It is targeted to reach 20 per cent in about 10 years.

The future of the Indian food industry can be considered to be bright only if safe and quality food products are made available covering the complete chain starting from raw material production to delivery of safe food to the end user. The demand for processed and convenience foods will be increasing in future and it is
expected to rise from the present level of 3 per cent to 25 per cent by 2020 AD. This will call for development of appropriate technologies not only for value addition but also for handling, packaging, storage, transportation and marketing of products in domestic and international market to deliver safe food.13

The Indian agriculture is facing a lot of challenges in order to meet domestic and international demands especially in the ear of globalization. The major challenges are:

- Improving input use efficiency of seeds, chemicals and fertilizers and water through engineering interventions
- Reducing cost of cultivation
- Improvement in production and productivity
- Diversification necessary to substitute crops requiring high inputs (need for multi faceted ventures)
- Reducing post harvest losses and facilitating non-land primary and secondary processing for value addition and by product utilization
- Providing nutritional security for rural population checking and reducing environmental degradation (soil and water)
- Checking over exploitation of natural resources (Ground water and soil nutrients)Improving power availability and energy use efficiency Easing the pressure on conventional energy sources by substitution with renewable energy options in crop production and processing
- Bringing more area under efficient water application methods and harnessing available resources through watershed management, rainwater harvest and ground water recharge
- Making the fruits of R&D in engineering, available to farmers through effective transfer of technology and commercialization
• Making agriculture information-driven and the farmers information-guided

• Empowerment of women by forming cooperatives and evolving woman friendly technologies;

• The Indian farmers have limited access to the latest equipment and technology.

• This results in high production cost and difficulty in competing in international market for sale of surplus produce. Further, there is little feedback from the farmers for product improvement and assessment of product acceptance. There is a need to generate more interaction among the farmers, R&D workers, departments of agriculture and industry.

• There are wide technological gaps in meeting the needs of various cropping systems and regions. Urgent steps need to be taken to make farm machinery

• R&D Base stronger

• Reduction of drudgery and improvement of safety and comfort in agricultural sector;

• Empowerment of farmers for equitable distribution and efficient utilization of water, energy, agro processing and marketing of farm produce. The widely fragmented and scattered land holdings in many parts of the country need to be consolidated to give access to the benefits of agricultural mechanization.

• Appropriate equipment is required to improve moisture conservation and timeliness of operations in rain fed agriculture.\textsuperscript{14}
Figure 1.1
Agriculture Map of India

Source: Department of Economics and Statistics, Government of India.
1.3. AGRICULTURAL SCENARIO IN TAMILNADU:

The total Geographical area of the State is 1.30 crore ha. Geographical area of Tamilnadu has been classified according to different types of land use during 09-10 and presented in the table below:

Table 1.1
AGRICULTURAL SCENARIO IN TAMILNADU
(In ha)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Category</th>
<th>2009-10</th>
<th>2008-09</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Area</td>
<td>Area</td>
</tr>
<tr>
<td>1</td>
<td>Forest</td>
<td>2126672</td>
<td>2105906</td>
</tr>
<tr>
<td>2</td>
<td>Barren and uncultivable land</td>
<td>490335</td>
<td>491908</td>
</tr>
<tr>
<td>3</td>
<td>Land put to non-agricultural uses</td>
<td>2175608</td>
<td>2172597</td>
</tr>
<tr>
<td>4</td>
<td>Culturable waste</td>
<td>32445</td>
<td>333441</td>
</tr>
<tr>
<td>5</td>
<td>Permanent pastures and other grazing lands</td>
<td>109924</td>
<td>1100009</td>
</tr>
<tr>
<td>6</td>
<td>Misc. tree crops and groves not included in the net area sown</td>
<td>252828</td>
<td>258965</td>
</tr>
<tr>
<td>7</td>
<td>Current fallow</td>
<td>1116981</td>
<td>1013374</td>
</tr>
<tr>
<td>8</td>
<td>Other fallow lands</td>
<td>1542137</td>
<td>1497549</td>
</tr>
<tr>
<td>9</td>
<td>Net area sown</td>
<td>4892142</td>
<td>5042896</td>
</tr>
<tr>
<td></td>
<td>Geographical area</td>
<td>13033072</td>
<td>13026645</td>
</tr>
<tr>
<td></td>
<td>Area sown more than once</td>
<td>679568</td>
<td>781352</td>
</tr>
<tr>
<td></td>
<td>Gross area sown</td>
<td>5571710</td>
<td>5824248</td>
</tr>
</tbody>
</table>


While cultivated land (cultivated at least once in its entire span) consisting of net area sown, current fallow and other fallow lands is 6546260 ha (which is 58.2% of the total geographical area), land not cultivated but available for cultivation (cultivable waste) is 326445 ha forming 2.5% of the total geographical area during 09-10.
The Gross area sown represents the total area cultivated under all food and nonfood crops including the area sown more than once during the fasli year. The gross area sown during 09-10 is 5571710 ha as against 5824248 ha during 08-09, registering a decrease of 52538 ha (4.5%).

The area has sown more than once represents the difference between the gross area sown under all crops and the net area sown during the fasli year. The area has sown more than once during 09-10 was 679568 ha as against 781352 ha in 08-09, the decrease being 13.0 %. The area sown more than once is 12.2% of the gross area sown in the state during 09-10.
The cropping intensity for the State during 09-10 is 1.139. It is highest in Nagapattinam district with 1.713 followed by Thiruvarur district with 1.654. The following table shows the district wise Cropping intensity during 09-10 in Tamilnadu.

**Table 1.2**

**CROPPING INTENSITY**

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>District</th>
<th>Cropping intensity</th>
<th>Sl.No</th>
<th>District</th>
<th>Cropping intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kancheepuram</td>
<td>1.050</td>
<td>17</td>
<td>Ariyalur</td>
<td>1.043</td>
</tr>
<tr>
<td>2</td>
<td>Thiruvallur</td>
<td>1.201</td>
<td>18</td>
<td>Pudukottai</td>
<td>1.007</td>
</tr>
<tr>
<td>3</td>
<td>cuddalore</td>
<td>1.339</td>
<td>19</td>
<td>Thanjavur</td>
<td>1.308</td>
</tr>
<tr>
<td>4</td>
<td>Villupuram</td>
<td>1.086</td>
<td>20</td>
<td>Thiruvarur</td>
<td>1.654</td>
</tr>
<tr>
<td>5</td>
<td>Vellore</td>
<td>1.102</td>
<td>21</td>
<td>Nagapattinam</td>
<td>1.713</td>
</tr>
<tr>
<td>6</td>
<td>Thruvannamalal</td>
<td>1.180</td>
<td>22</td>
<td>Madural</td>
<td>1.018</td>
</tr>
<tr>
<td>7</td>
<td>Salem</td>
<td>1.198</td>
<td>23</td>
<td>Theni</td>
<td>1.086</td>
</tr>
<tr>
<td>8</td>
<td>Namakkal</td>
<td>1.121</td>
<td>24</td>
<td>Dindigul</td>
<td>1.013</td>
</tr>
<tr>
<td>9</td>
<td>Dharmapuri</td>
<td>1.203</td>
<td>25</td>
<td>Ramanathapuram</td>
<td>1.000</td>
</tr>
<tr>
<td>10</td>
<td>Krishnagiri</td>
<td>1.058</td>
<td>26</td>
<td>Virudhunagar</td>
<td>1.027</td>
</tr>
<tr>
<td>11</td>
<td>coimbatore</td>
<td>1.042</td>
<td>27</td>
<td>Sivagangai</td>
<td>1.000</td>
</tr>
<tr>
<td>12</td>
<td>Thiruppur</td>
<td>1.026</td>
<td>28</td>
<td>Tirunelveli</td>
<td>1.175</td>
</tr>
<tr>
<td>13</td>
<td>Erode</td>
<td>1.127</td>
<td>29</td>
<td>Thoothukudi</td>
<td>1.028</td>
</tr>
<tr>
<td>14</td>
<td>Tiruchirapalli</td>
<td>1.095</td>
<td>30</td>
<td>The Nilgiris</td>
<td>1.000</td>
</tr>
<tr>
<td>15</td>
<td>Karur</td>
<td>1.019</td>
<td>31</td>
<td>Kanyakumar</td>
<td>1.119</td>
</tr>
<tr>
<td>16</td>
<td>Perambalur</td>
<td>1.029</td>
<td></td>
<td>State</td>
<td><strong>1.139</strong></td>
</tr>
</tbody>
</table>


Water is an important determinant factor of production of crops in agriculture sector. Intensive and extensive cultivation of land depend mainly on the availability of water. Medium and minor irrigation schemes are implemented in the state for augmenting the irrigation for agriculture. The various sources of irrigation are canals,
tanks, tube wells, Open wells and springs. The number of sources of irrigation is furnished in the following table.

Table 1.3

<table>
<thead>
<tr>
<th>SOURCES OF IRRIGATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sources</strong></td>
</tr>
<tr>
<td>1. Canals</td>
</tr>
<tr>
<td>a) Govt.</td>
</tr>
<tr>
<td>b) Private</td>
</tr>
<tr>
<td>2. Reservoirs</td>
</tr>
<tr>
<td>3. Tanks</td>
</tr>
<tr>
<td>a) Ayacut above 40 ha.</td>
</tr>
<tr>
<td>b) Ayacut below 40 ha.</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>4. Wells</td>
</tr>
<tr>
<td>A) Tube Wells &amp; Others</td>
</tr>
<tr>
<td>a) Govt.</td>
</tr>
<tr>
<td>b) Private</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>B) Open wells</td>
</tr>
<tr>
<td>a) Govt.</td>
</tr>
<tr>
<td>b) Private</td>
</tr>
</tbody>
</table>

The net area irrigated by different sources during 09-10 was 2863866 ha as against 2931113 ha in 08-09 showing a decrease of 67247 ha or 2.3% over the previous year. The net area irrigated during 09-10 constituted 56.8% of the net area sown in the state. Villupuram district is at the top with 236484 ha net area irrigated. However the highest percentage of the net area irrigated to the net area sown was recorded in Thiruvarur District with 97.4% followed by Thanjavur District with
85.6% and Kancheepuram with 85.0% whereas the lowest percentage was recorded in The Nilgiris district with 0.5%. The following table shows the net area irrigated by various sources compared with 08-09.

Table 1.4

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Sources</th>
<th>Net area irrigated 09-10</th>
<th>08-09</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Area</td>
<td>%</td>
</tr>
<tr>
<td>1</td>
<td>CANALS (including tanks)</td>
<td>757090</td>
<td>26.4</td>
</tr>
<tr>
<td>2</td>
<td>TANKS</td>
<td>503491</td>
<td>17.6</td>
</tr>
<tr>
<td>3</td>
<td>WELLS</td>
<td>1593968</td>
<td>55.7</td>
</tr>
<tr>
<td>a.</td>
<td>Tube wells/ Bore wells</td>
<td>391107</td>
<td>13.7</td>
</tr>
<tr>
<td>b.</td>
<td>Open wells</td>
<td>1202861</td>
<td>42.0</td>
</tr>
<tr>
<td>4</td>
<td>OTHERS</td>
<td>9317</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td><strong>2863866</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>


Cropping pattern refers to the proportionate area under different crops during a fasli year. The gross cropped area under all crops has decreased to 5571710 ha in 09-10 from 5824248 ha in 08-09. While the area under Food crops accounted for 73.6% and that of non-food crops formed 26.4% only, of the gross cropped area during the year under report. The following table shows the cropping pattern in the state during 09-10 besides indicating relative share of area under principal crops to total cropped area.

Factors such as fertility of land, monsoon behaviour, rainfall, irrigation, application of fertilizers, climatic conditions, marketing facilities, prices, availability of agricultural labourers etc. determine the area and productivity of any crop. The crop-wise analysis of production between current year and previous year is presented in the table below.
The production of food grains during the year under report is 7504548 tonnes as against 7101735 tonnes in 08-09 recording a remarkable increase of 402813 tonnes or 5.7%. Rice is major constituent accounting for 75.5% of the total food grain production in the state. Crop wise production of food grain is given in the following table.

Table 1.5
CROPWISE PRODUCTION OF FOODGRAIN

<table>
<thead>
<tr>
<th>SL.NO</th>
<th>CROP</th>
<th>09-10 Production</th>
<th>%</th>
<th>Area</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rice</td>
<td>5665258</td>
<td>75.49</td>
<td>5183385</td>
<td>72.99</td>
</tr>
<tr>
<td>2</td>
<td>Jowar</td>
<td>221960</td>
<td>2.96</td>
<td>213436</td>
<td>3.01</td>
</tr>
<tr>
<td>3</td>
<td>(Cholam)</td>
<td>82652</td>
<td>1.10</td>
<td>84021</td>
<td>1.18</td>
</tr>
<tr>
<td>4</td>
<td>Bajra</td>
<td>160939</td>
<td>2.14</td>
<td>169944</td>
<td>2.39</td>
</tr>
<tr>
<td>5</td>
<td>(Cumbu)</td>
<td>1138126</td>
<td>15.17</td>
<td>1257882</td>
<td>17.71</td>
</tr>
<tr>
<td>6</td>
<td>Ragi</td>
<td>517</td>
<td>0.01</td>
<td>411</td>
<td>0.01</td>
</tr>
<tr>
<td>7</td>
<td>Maize</td>
<td>8805</td>
<td>0.12</td>
<td>5679</td>
<td>0.08</td>
</tr>
<tr>
<td>8</td>
<td>Korra</td>
<td>19682</td>
<td>0.26</td>
<td>16503</td>
<td>0.23</td>
</tr>
<tr>
<td>9</td>
<td>Varagu</td>
<td>2240</td>
<td>0.03</td>
<td>3104</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td>Sub Total (A)</td>
<td>7300179</td>
<td>97.28</td>
<td>6934365</td>
<td>97.64</td>
</tr>
<tr>
<td>10</td>
<td>Bengalgram</td>
<td>4542</td>
<td>0.06</td>
<td>4363</td>
<td>0.06</td>
</tr>
<tr>
<td>11</td>
<td>Redgram</td>
<td>20274</td>
<td>0.27</td>
<td>16703</td>
<td>0.24</td>
</tr>
<tr>
<td>12</td>
<td>Greengram</td>
<td>47673</td>
<td>0.64</td>
<td>31336</td>
<td>0.44</td>
</tr>
<tr>
<td>13</td>
<td>Blackgram</td>
<td>98712</td>
<td>1.31</td>
<td>82983</td>
<td>1.17</td>
</tr>
<tr>
<td>14</td>
<td>Horsegram</td>
<td>21816</td>
<td>0.29</td>
<td>21052</td>
<td>0.30</td>
</tr>
<tr>
<td>15</td>
<td>Other pulses</td>
<td>11352</td>
<td>0.15</td>
<td>10933</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>Sub Total (B)</td>
<td>204369</td>
<td>2.72</td>
<td>167370</td>
<td>2.36</td>
</tr>
<tr>
<td></td>
<td>TOTAL FOODGRAIN (A+B)</td>
<td>7504548</td>
<td>100.00</td>
<td>7101735</td>
<td>100.00</td>
</tr>
</tbody>
</table>

In India, rice is the major constituent of food grains in general (apart from wheat) and so the rice producing states are considered to be the major food grains producing states. Out of the total production of 234.47 million tonnes of food grains at the national level as per the final estimates for the year 2008-09 which is the latest available data for all India comparison, the contribution of Tamilnadu stands at 7.10 million tonnes, placing it at 12\textsuperscript{th} in the ranking of states. The comparison of area and production of food grains in major food grains producing states is presented in the following graphical representation.
Figure 1.3
Agriculture Map of Tamilnadu

Source: www.mapofindia.com
1.4. AGRICULTURAL MECHANISATION IN INDIA

Mechanization refers to interjection of machinery between men and materials handled by them. In agriculture materials are soil, water, environment, seed, fertilizer, pesticides, growth regulators, irrigation, agricultural produce and by-products such as food grains, oilseeds, fruits and vegetables, cotton, sugarcane, jute and kenaf and other cash crops, milk, meat, eggs and fish. There is scope of mechanization in every unit operation of production agriculture, post-harvest and agro-processing, and rural living. Mechanization has varied connotations.

While in the developed world it tends to be synonymous to automation but in developing countries, like India, mechanization means any improved tool, implement, machinery or structure that assists in enhancement of workers’ output, multiplies the human effort, supplements or substitutes human labour that is enabling and removing, avoids drudgery or stresses that adversely affect human mental faculties leading to errors, imprecision and hazards and eventually loss of efficiency. It also means automation and controls that assure quality, hygiene. Agricultural mechanization in a limited sense relates to production agriculture.

At the time of independence in 1947, Indian agriculture uses mostly bullock drawn ploughs, wooden pegtooth harrows, wooden planks for pulverization compaction and smoothening, bullockcarts, and handtools such as Khurpi, crobar, spade, hoe, sickle, axe, chopper/Dau etc. Some philanthropist, facilitated by colonial masters, is trying to introduce western soil inversion plough like Meston plough, a 15 cm size long beam bullock drawn plough. The only mass manufactured items are spades, pickaxe, crobars, and watering buckets manufactured by Tata’s. Traditional equipments in use are made by local craftsmen, using locally available materials with little standardization, where quality depends on the craftsmanship.
The amendments in agriculture are accompanied with due inputs of mechanization in natural resource development, agricultural field operations and on-farm primary processing. After intensive testing and evaluation in late 1950s, manufacturing of irrigation pumping sets commenced. Initially two-thirds are engine operated and one-third electric operated. As rural electrification advanced, proportions have changed in favour of electrical power. Animal drawn improved equipment such as seed drills, seed-cum-fertilizer drills, 5 hp power threshers’ primovers like diesel engines, electric motors got into manufacturer and use.\textsuperscript{15}

The Central Tractor Organisation (CTO) established soon after independence to reclaim marshy lands in Tarai of UP and scrub forests elsewhere to settle displaced people who come from across the border set the pace of tractorisation in India. CTO uses crawler tractors, their operation, and upkeep and later on indigenous fabrication of certain fast wearing components, after OE stocks exhausted, are locally developed. For tractorisation of agricultural field operations around mid-1960s small 4-wheel general purpose tractors were brought in CKD (completely knocked down) condition and assembled, marketed, operated, and serviced by training Indian technicians.

The adoption of agricultural mechanization in India is increasing continuously. Mechanization facilitates farmers to undertake agricultural activities with less drudgery and higher efficiency. The first tractor to India was brought in 1914. In 1930’s pump-sets were introduced in the country. In the 1940’s, high horsepower crawler tractors were imported under the aegis of Central Tractor Organization (CTO) mainly for land development and to eradicate obnoxious weed kans grass. At the time of independence, Indian farmers used mostly bullock-drawn ploughs and wooden planks for pulverization, compaction and smoothening. Hand tools like spades, pick
axe, crowbars, hoe, sickle and chopper were in use. For irrigation, watering buckets and for transportation bullock carts were in use. In late 1950’s, manufacturing of irrigation pump-sets started. There were only about 8,000 tractors in 1950 and these increased to 39,000 units in 1960.

Confidence thus gain resulted in progressive indigenous manufacturer. Swaraj 35 hp from M/s Punjab Tractor was the first totally indigenous tractor. A little later two-wheeled tractors popularly known as power tillers are introduced and at one stage more than a dozen firms had manufacturing licenses. However farming system in vogue, wet cultivation during kharif and upland farming during Rabi, and lack of proper after-sales-services support adversely affect their growth.

With the introduction and growth of tractors in India in production of matching equipment for scraping and land levelling, seedbed preparation, seeding and planting, seed-cum-fertilizer drilling, spraying and dusting, harvesting and power threshing, 2-wheel and 4-wheel tractor trolleys get in to indigenous manufacturer and these get reserved for Small Scale Industries (SSI) sector.

By early 1980s vertical conveyor reapers (VCR) are introduced to mechanize sickle harvesting, initially walking type, then a larger tractor version and subsequently riding type self propelled units. During 1982-84 production of tractor mounted VCRs increase tenfold each subsequent year reaching to 3000 in third year but get reduced to 2000 annual production in the fourth year, the year insurgency in Punjab touched its peak. At this point of time Punjab farmers find combining of rice and wheat cheaper and less risky.
Several manufacturers (29) in small scale sector took up to produce general purpose standard grain harvesting combines by manufacturing tractor mounted, self propelled and tractor driven versions. Combining, however, created problem of rice and wheat straw gathering, transforming and handling as Bhusa. Straw disposal through incineration is found creating serious environment pollution whereas straw incorporation in to the soil is leading to nitrogen stealing. Invention and introduction of straw combines provide a solution to reclaiming wheat Bhusa but still about 50-60 per cent of the rice and wheat straw is being disposed by burning. It may not be entirely due to combines; demand for wheat bhusa has also declined. Its transport to feed deficit areas in loose farm is expensive and uneconomical. Complete feed block buffer stocking to fight feed famines is a possibility. \(^{16}\)

In fact, the mechanization in India was driven by assured price to farmers for their produce (wheat and rice initially). The intensification of agriculture was assisted by higher inputs of farm power, but also because the greater profitability of farming-generated surpluses that could be spent on capital equipment. With adoption of HYV seeds the number of tractors doubled by 1971 and 96 per cent of the tractors were privately owned on farms of over 10 ha in size. By 1980, the number of tractors was more than 500,000 (1 tractor/260 ha) which in 2010 reached about 4.0 million units (1 tractor/35 ha). At present, India is the largest producer of tractors in the world at annual production of 500,000 units with export of over 50,000 tractors.

Through all these years, the economics of ownership of most tractors had been justified by custom hiring for on-farm works as well as for off-farm transport and construction activities. The use of tractors in transport activities accounted for about 60% of average annual use of 600 hours. Many small farmers also started owning
tractors due to opportunity of custom hiring. Custom hiring of combine harvesters has been another remarkable success in mechanization, some custom operators hiring covering almost five states (600 km) in one crop season and earning on an average Rupees 300,000 (US$ 6,000) per annum on each combine. In Northern India, most farmers replaced bullocks by she-buffaloes and sold their milk and used the cash for daily necessities and custom hiring of farm machines.  

The rising wage of labour and bullock costs also contributed to the higher viability of tractors and created the conditions for diversification into high value crops and the provision of mechanization services at competitive rates, to their more numerous small-scale farmers. The benefits to smallholders could also be increased through tractor hiring services. As a result, in Northern India most of the wheat crop now is threshed by custom-hired threshers mounted on trailers and powered by tractors of 45 and higher hp.

Power availability per hectare is a common indicator of mechanization. The agricultural mechanization in India had large variations in terms of power availability varying from 0.60 kW/ha in Orissa to 3.5 kW/ha in Punjab during 2001. The average farm power available was about 1.46 kW/ha comprising of about 84 per cent from mechanical and electrical sources and 16 per cent from animal power and human labour.

Due to concerted efforts, the total food grain production in India increased from 51 million tons during 1950, to 241 million tons in 2010-11. The use of chemical fertilizers increased from 65,600 tons (about 0.5 kg/ha) in 1950 to 23 million tons (160 kg/ha) in 2007-08. The increased cropping intensity and higher quantities of inputs and outputs could no longer be effectively managed by animate
power alone. Therefore, farmers adopted mechanical power extensively and the growth of farm power and agricultural machinery over last 50 years in India has been phenomenal. 18

The growth of the mechanization in India has followed the same general pattern found worldwide. Farm operations requiring high power inputs and low control are mechanized first (tillage, transport, water pumping, milling, threshing, etc.). Farm operations requiring medium levels of power and control are mechanized next (seeding, spraying, intercultural operations, etc.). Farm operations requiring high degree of control and low power inputs are mechanized last (transplanting, planting of vegetables, harvesting of fruits and vegetables, etc.). This is because any power intensive work can be done faster mechanically and at a lower cost. Whereas converting human knowledge into machine knowledge is difficult and costly.

Banks, when sanctioning a loan to a farmer for purchase of a tractor, take income from custom work into consideration. Due to implementation of Mahatma Gandhi National Rural Employment Guarantee Scheme, wages for labour throughout India have gone up leading to scarcity of farm labourers. This has provided tremendous boost to mechanization, especially through opportunities for custom hire work. Many small farmers also started purchasing tractors due to opportunity of custom hiring. Similarly, the ownership of many other farm machinery and equipment like, pumps for tube-wells, seed-drills and planters is economic due to renting out to other farmers. However, ownership of large threshers, laser land levelers and combine harvesters is mainly due to custom work.
The total investment in the farm machines in 2005 was estimated to be around Rs 273 billion (US$ 6 billion). This compares to an annual investment in 1997 of some Rs 180 billion (US$ 5 billion). Annual investment in 2005 in agro-processing and post- harvest equipment was estimated to be around Rs 200 billion, bringing the total annual investment to Rs 453 billion or US$ 10 billion. In 2011, the investment in farm machinery has risen to about Rs 440 billion with a further Rs 340 billion invested in agro-processing and post harvest equipments.

The overall demand for agricultural machinery has increased in the last decade. India’s import of agricultural tractors is seen comparatively lower than the import of other agricultural machinery. The import value of agricultural tractors is below US$2.0 million, except in 2005, 2006 and 2007. In 2011, the import value of US$8.258 million is the highest in the last two decades. Also in the last two decades, the import quantity of agricultural tractors is less than 500, except in 1995, 2005 and 2006. The tractor manufacturing industry in India generally fulfills the country’s demand for agricultural tractors.19

Harvesters and threshers are the major agricultural machinery being imported by India. From 2001 onwards, the demand for harvesters has increased significantly. The total import value of harvesters and threshers reaches US$ 62.44 million in 2011. Moreover, the import demand for milking and dairy machinery, soil machinery and other agricultural mechanized equipment realize steady growth. In 2011, the import value of milking and dairy machinery reaches US$ 22.68 million, while in the same year, imported soil machinery and other agricultural machinery are worth US$18.84 million, US$16.62 million, respectively.
India exports a large number of agricultural tractors to other countries. Since 2000, the export of agricultural tractors experiences enormous growth. In 2000, only 3,841 tractors are exported which generated an export value of US$16.77 million while in 2011, the country exports about 42,864 agricultural tractors, which contributes US$384.00 million to agricultural machinery export of the country. The regular 4-wheel tractor is regarded as the major contributor of India’s total tractor export, followed by track-laying tractors. The export of pedestrian controlled tractors (walking tractors or power tillers) is observed very low as compared with other 4-wheel tractors and track-laying tractors.\(^{20}\)

India’s export of other agricultural machinery such as harvesters and threshers, milk and dairy machinery, soil and other machinery is much lower than the export of agricultural tractors. The export of soil machinery has steadily increased during the last two decades. Since 2003 onwards, the export of harvesters, threshers and other agricultural machinery show consistent growth with an export value of about US$18.0 million and US$21 million, respectively in 2011. Milk and dairy machinery record the least export value over the last two decades. The production and sale of agricultural tractors and power tillers has increased considerably within the last 25 years. The production and sale of agricultural tractors found much higher than that of power tillers in the country. In the last 25 years the sale of power tillers increased by only about 11,000 units, while the sale of tractors increased by about 200,000 units.

Until late 1960s the use of irrigation equipment is limited but from the early 1970s the use of irrigation pumps and equipment increase considerably and still growing continuously. The highest amount of diesel found to be used in Potato production (81.69 litres / ha) while the highest amount of electricity being consumed
in sugarcane production (425.74 kWh / ha). When compared with production, the highest amount of diesel consumption is observed in mustard production (0.034 litres / kg) while the highest amount of electricity is used in wheat production (0.078 kWh / kg). Except for a few exceptions, the use of power-driven pumps for irrigation purposes is higher than the use of stationary diesel engines for pumping and irrigation.\textsuperscript{21}

1.5. STATEMENT OF THE PROBLEM

The technological improvements in Indian agriculture since mid sixties have brought about revolutionary increase in agricultural production. Interestingly, the growth rate of food grain production particularly in case of wheat and rice was much higher than the growth rate of population. The country was facing acute food shortages till eighties has now become not only self sufficient but also a net exporter of food grains.

This has been made possible due to evolution of high yielding crop varieties, increased use of chemical fertilizers, development of irrigation facilities and plant protection measures accompanied by effective price support programmes of farm products. The increased use of purchased inputs in agriculture necessitated to raise their use efficiencies though mechanization. The increase in the use of human and bullock labour and rising wage rates and cost of up-keep of bullock further made the case of farm mechanization still stronger.

Farm mechanization has been helpful to bring about a significant improvement in agricultural productivity. Thus, there is strong need for mechanization of agricultural operations. The factors that justify the strengthening of farm mechanization in the country can be numerous. The timeliness of operations has
assumed greater significant in obtaining optimal yields from different crops, which has been possible by way of mechanization.

The quality and precision of the operations are equally significant for realizing higher yields. The various operations such as land leveling, irrigation, sowing and planting, use of fertilizers, plant protection, harvesting and threshing need a high degree of precision to increase the efficiency of the inputs and reduce the losses. However, when such operations are performed through indigenous methods, their efficiency is reduced.

The time taken to perform sequence of operations is a factor determining the cropping intensity. So as to ensure timeliness of various operations, it is quite inevitable to use such mechanical equipments which have higher output capacity and cut down the number of operations to be performed. This has helped in increasing area under cultivation and increase in cropping intensity.

Higher productivity of land and labour is another factor, which clearly justifies farm mechanization. Not only the output per hour is more, the total labour requirement is also reduced. The displaced labour may of course be absorbed in the other alternatives created by the increased mechanization such as manufacturing, repair and service shops and the sale services. Thus, it only results in the shifting of the labour from one vocation to the other. As production increases with mechanization of the farm operations, it creates a good scope for commercialization of agriculture.
Normally, there are good chances to reduce the cost of production if farm operations are mechanized as it saves labour, both human and bullock. In the absence of mechanization, the ever-increasing wage rate of human labour and cost of upkeep of draught animals could have increased the cost of production much higher.

Further, large scale production means less per unit cost on the farms. Moreover, it reduces the weather risk and risk of non-availability of labour and thus wastage is minimized. Timely marketing is also made possible by quick mechanical transportation, cleaning and handling. Further, the area under fodder and feed for draught animals could be reduced due to decline in their use. The land thus released can be brought under commercial crops.

The use of farm mechanization enlarges the employment opportunities both on farms and in nonfarm sectors through increase in area under plough, multiple cropping, development of agro-industries and related services. On the other hand, displacement of human labour does take place and demand for semiskilled labour in place of unskilled labour is increased. Also, the drudgery for human labour is reduced and unhygienic operations such as handling of farm yard manure can be done with machinery.

The agricultural mechanization in India has come a long way in the last 50 years. India produces wide range of agricultural equipment needed to practice modern intensive farming. However, there are unit operations in certain commercial crops and commodities where mechanization is needed, and for which presently there is no viable solution. With quantitative restrictions removed from 1st April, 2001 it is faced with new challenges, some have reservations whether it will be able withstand
pressures of multinational companies and countries that are aggressively marketing their goods in export markets. Indian farm equipment industry has demonstrated its resilience and responsiveness to changing market situations in the past and should come out victorious at the end adopting modernization measures. Nevertheless, the challenge is formidable.

The large and medium scale manufacturers have well organized distributors and dealers throughout the country to undertake advertising and product promotion in their respective territories, conduct product awareness training programmes for the prospective customers, provide after-sales-service to the customers including free services, repair and maintenance and supply of parts. Therefore, this organized sector has the whole of the country as their market due to which their production volumes are large, and their information feedback about their product performance, improvements required in design, production processing or quality, and the new requirements of the farmers to undertake product developments.

Very few small-scale industries have established their marketing network and therefore provide service support in their premises. In the absence of standardization of parts and components farmers are compelled to carry their machines to the manufacturers for repair and replacement of parts and components. Due to this, their market size is limited to their proximity and they are not able to develop their businesses.

1.6. NEED AND SIGNIFICANCE OF THE STUDY

The purpose of this study is to provide manufacturers with information from which effective promotional measures especially for agricultural equipments may be
devised. The identification of unique characteristics and factors affecting promotional practices should assist the manufacturers of agricultural equipments with specific market-environments designed around very specific and unique demands of their customers.

Additionally, role of dealers in promotional practices of agricultural equipments should also assist both manufacturers and dealers for effective formulation and implementation of marketing and promotional strategies and practices. This can be accomplished by complete elimination of the constraints altogether when possible, or by using innovative sale promotional measures to understand the consumer’s expectation and satisfaction in purchasing of agricultural equipments.

Hence, the main inquiry of the present study concerns on influence of promotions on customer’s purchase behaviour of agricultural equipments. Besides, the outcome of the study would used to understand the effectiveness of promotions and also provide the guidelines to improve the standard and quality of promotional practices in order to enhance the customer’s buying behaviour of agricultural equipments.

1.7. SCOPE OF THE STUDY

The study focuses on better understanding the socio-economic profiles of the dealers of agricultural equipments and type, quantity, brand name and prices of various agricultural equipments sold by the dealers in the market. The present study would help to identify key promotional practices adopted by the manufacturers and their effectiveness on sale of agricultural equipments.
It would also useful to understand manufacturer’s and dealer’s preference of promotional practices and its impact on of purchasing of agricultural equipments. Besides, the problems faced by the dealers would give the factual situations which lead to the sales pattern of agricultural equipments.

The present study would be highly useful for formulating marketing, advertising and promotional strategies for improving the sales of agricultural equipments and it would be useful to improve the corporate image of manufacturer’s of agricultural equipments. The study covers only the equipments used in the following agricultural operations like land development, land preparation, seeding, transplanting, plant protection and harvesting.

1.8. OBJECTIVES OF THE STUDY

1. To examine the socio economic profile of agricultural equipment Dealers.
2. To assess the current promotional practices adopted by agricultural equipment manufacturers.
3. To identify the factors influencing the choice of promotional practices of agricultural equipment manufacturers.
4. To examine the role of dealers in carrying out the promotional practices of agricultural equipment manufacturer’s and to analyze the problems faced by the dealers in promoting agricultural equipments and
5. To offer concrete suggestions and recommendations for the betterment of promotional practices of agricultural equipments.
1.9. HYPOTHESES

1. There is no significant difference among the dealers selling the agricultural equipments of different manufacturers.

2. There is no significant difference between unit prices of the agricultural equipments of different manufacturers.

3. There is no significant difference in preference of promotional practices for agricultural equipments by the manufacturers is rejected.

4. There is no significant difference in reasons for the choice of promotional practices of agricultural equipments by the manufacturers.

5. There is no significant relationship between factors determining the choice of promotional practices for agricultural equipments and annual sales.

6. There is no significant influence of factors determining the choice of promotional practices for agricultural equipments on annual sales.

7. There is no significant difference in role of dealers in carrying out the promotional practices for agricultural equipments.

8. There is no significant influence of factors determining the role of dealers in carrying out the promotional practices of agricultural equipments on annual sales.

1.10. RESEARCH METHODOLOGY

The research methodology constitutes the blue print for the data collection, measurement and analysis of data. It is the overall operational pattern or framework, of the research that stipulates what information is to be collected from which sources by what procedures.
1.10.1. RESEARCH DESIGN

The descriptive research design has employed for the present study. It is chosen for the present study in order to derive the meaningful relationship promotional practices and annual sales of agricultural equipments.

1.10.2. SAMPLING PROCEDURE

Among the different states in India, Tamil Nadu has been purposively selected for the present study. The dealers of agricultural equipments have been selected by adopting random sampling technique. Each dealer is chosen randomly and entirely by chance, such that each dealer has the same probability of being chosen at any stage during the sampling process and each subset of k dealers has the same probability of being chosen for the sample as any other subset of k dealers.

1.10.3. SAMPLE SIZE

The total number of dealers for agricultural equipments in Tamil Nadu is 840 according to Department of Economics and Statistics, Government of Tamil Nadu. The sample size was determined with the help of following sample size determination formula.

The sample size for the present study is determined by using the following formula:

\[ N = \frac{t^2 \times p (1-p)}{m^2} \]

\( N = \) Required Sample Size
\( t = \) Confidence Level at 95\% (Standard Value of 1.96)
\( p = \) Response from the Dealers through Pilot Study
\( m = \) Margin of Error at 5\% (Standard Value of 0.05)
Introduction

Step 1:

\[ n = 1.96^2 \times 0.4(1-0.4) / 0.05^2 = 369 \]

Step 2: Contingency

The sample is further increased by 10% to account for contingencies such as non-response or recording error.

\[ n + 10\% = 369 + (369 \times 0.10) = 369 + 37 = 406. \text{ Hence, it is round to 400.} \]

The total sample size for the present study is 400 which include both exclusive and non-exclusive dealers of agricultural equipments.

1.10.4. PERIOD OF STUDY

The data and information collected from the dealers of agricultural equipments pertains to the year 2011-12.

1.10.5. METHODS OF DATA COLLECTION

1.10.5.1. PRIMARY DATA

The data and information is collected from the primary source of dealers of agricultural equipments through pre-tested structured questionnaire.

1.10.5.2. SECONDARY DATA

The data and information is collected from the secondary sources of journals, research papers, research reports, government reports, conference proceedings, magazines, newspapers and websites.
1.10.6. TOOLS OF DATA COLLECTION

The structured questionnaire is developed based on prior research studies, experts’ opinion and pilot study. The structured questionnaire consists of six major parts in order to study the objectives. A five point Likert scale (5=Strongly Agree; 4=Agree, 3=Neither Agree nor Disagree, 2= Disagree 1= Strongly Disagree) is used to study the sales promotional practices, reasons for promotional practices and role of dealers in sales promotional practices for agricultural equipments.

1.10.7. PILOT STUDY:

Before beginning to carry out the present study, the researcher initially conducted a pilot study in order to find out the feasibility and the relevance of the present study. The aim of the pilot study is to refine and further develop the questionnaire used for the main survey. The pilot study is conducted with 40 dealers of agricultural equipments and the results from this study helped to modify the questionnaire and understand the response rate of the respondents. Further, the researcher contacted several marketing experts from the academic fields and the agricultural equipment manufacturers and dealers for assessing the significance and validity of carrying out the research work. All the questions used are either extracted from referenced material or identified as important by the pilot study respondents.

1.10.8. DESIGN OF QUESTIONNAIRE

PART-I – It consists of socio-economic profiles of dealers such as exclusive dealership, location, gender, age, educational qualification, experience, marital status, type of family, family size, number of employees, operating capital, annual sales and geographical coverage of dealers.
PART–II - It includes the manufacturer name and unit price of land development, tillage, seed bed preparation equipments, sowing and planting equipments, weeding, inter cultivation and plant protection equipments and harvesting and thrashing equipments.

PART–III - It deals with the various sales promotional practices for agricultural equipments adopted by the manufacturers.

PART–IV - It consists of reasons for the choice of promotional practices of agricultural equipment manufacturers.

PART–V - It includes the role of dealers in carrying out the promotional practices of agricultural equipment manufacturers.

PART–VI - It deals with the important constraints faced by the dealers in promoting agricultural equipments.

1.11. FRAMEWORK OF ANALYSIS

In order to understand the socio economic profile of dealers of agricultural equipments, manufacturer of agricultural equipments, the percentage analysis and frequency distribution are worked out. In order to examine the difference among the dealers selling the agricultural equipments of different manufacturers, the Chi-Square test has been employed.

In order to study the difference in unit of prices of agricultural equipments of different manufacturers, preference of promotional practices for agricultural equipments by manufacturers, reasons for the choice of promotional practices of agricultural equipments by the manufacturers and role of dealers in carrying out the sales promotional practices for agricultural equipments, the ANOVA test has been applied.
In order to discriminate the location of the dealers based on the preference of promotional practices for agricultural equipments by manufacturers, the discriminant analysis is carried out. In order to identify the factors determining the choice of promotional practices of agricultural equipments by the manufacturers and the factors determining the role of dealers in carrying out the promotional practices of agricultural equipments, the exploratory factor analysis has been employed.

The correlation analysis has been carried out to study the relationship between factors determining the choice of promotional practices for agricultural equipments and annual sales of dealers of agricultural equipments.

In order to examine the influence of factors determining the choice of promotional practices for agricultural equipments on annual sales and the influence of factors determining the role of dealers in carrying out the promotional practices of agricultural equipments on annual sales the multiple regression has employed. In order to rank the problems faced by the dealers in promoting agricultural equipments, mean scores has been calculated.

**1.12. LIMITATIONS OF THE STUDY**

The present study is based on the primary data collected from the dealers of agricultural equipments. Hence, the drawbacks and limitations of the field level survey are very much applicable to the present research. The data and information collected from the deals of agricultural equipments are subjected to recall bias.
1.13. CHAPTERISATION

The first chapter deals with the introduction, statement of the problem, objectives of the study, hypotheses, research design, scope of the study, framework of analysis and need and significance of the study and limitations of the study.

The second chapter deals with agricultural equipment industry in India and the various information regarding the various types of agricultural equipments available in India and their usage in the agricultural operations,

The promotional mix is presented in the third chapter. The chapter further deals with the following promotional mix like advertising, sales promotion, personal selling and direct marketing tools.

The fourth chapter deals with review of literature. For clear and easy understanding, the review of literature is presented in the following sub-headings: Promotional Mix, Factors to Consider When Choosing Promotional Elements, Effect of Sales Promotional Measures and Sales Promotional Strategies

The fifth chapter deals with socio-economic profile of dealers and the agricultural equipments. The socio-economic profile of dealers and the agricultural equipments sold by them were analyzed and the results are presented in this chapter.

The sixth chapter deals with sales promotional practices for agricultural equipments. The preference of sales promotional practices, reasons for choice of promotional practices, role of dealers in carrying out the promotional practices for agricultural equipments were analyzed and the results are presented in this chapter.

The seventh chapter comprises of findings, recommendations and conclusion.


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