1.1 INTRODUCTION

Agriculture is the main occupation of Indian economy with approximately 58% of the population depending on agriculture directly or indirectly. One third of our national income comes from agriculture. Indian economy is a mixed economy. Since pre independence India had suffered shortage of food and foodgrains, after independence the ruling governments has taken five year plan and many other measures to increase the agricultural production. First five year plan was initiated to concentrate on agriculture sector and their production. Huge amount was allocated to develop the primary sector and to achieve food security in the country. At the same time green revolution was initiated, by providing high yield seeds and chemical fertilizers.

During 1950 India’s food production about 50 metric tonnes; in 2015 it has increased to 258 metric tonnes. India’s population is growing day by day and it is placed second after china in agricultural production. Due to rapid growth of population, there is need of more food grain production for achieving self sufficiency. It is well understood that food grain production depends on quality of seeds, fertilizers and availability of irrigation facilities. At present, India ranks first in the world in the production of tea and groundnuts, second in the production of rice, sugarcane, jute and oil seeds. Government of India has taken many initiatives for increasing agriculture production by providing subsidized inputs. It is one of the largest sectors for livelihood and encompasses secondary and tertiary sectors. Therefore agriculture plays a vital role in Indian economy. However as a developing country we still have large number of rural population living with low income, hence our agriculture sector which is the backbone of the village should grow subsequently.

As per the statistics of the year 2015, agriculture and associated sectors like forestry and fisheries accounted for 13.9% of the GDP (Gross Domestic Product). Even Today, Indian farmers are gambling with monsoon. Most of the farmers in India heavily depend on rainwater because there are no affordable irrigation facilities. Inspite of the Government taking several initiatives towards improving
irrigation facility through construction of reservoir, check dams, canal networks and watershed development programmes.

In the past, because of the lack of irrigation facilities, most of the states suffered from famine and agricultural production failed. The consequence being India importing food grains from other Nations. However the first five year plan of 1951-1956, focused on Agriculture and Irrigation based on Harrod-Domar model. During this period large dams, reservoir, lakes, check dams like Bhakra-nangal project, Damodar valley project, Hirakud dam, Nagarjuna Sagar dam, Krishnarajasagara dam and Mettur dam were initiated. At the same time government felt the need of improvement in quality of seeds and fertilizers hence emphasis given to green revolution in the country, M. S. Swamynathan was the father of green revolution in India. Under his leadership high yield seeds, fertilizers and irrigation were introduced. It was successful and today India is one of the leading food production countries in the world.

Irrigation is an age old practice as old as man’s first attempt towards crop growing. The beginning of agriculture revolutionized the way of living of primitive man who was till then dependent only on hunting and food gathering. Early agriculture involving mainly food production changed slowly to modern agriculture through continuous evolution of agricultural technologies. This transformation gave a strong structural and economic base to the human society for its existence and progress. However it is seen that Irrigation has dictated largely the pace and the progress of agricultural development all over the world.

Irrigated lands contribute significantly in the world agriculture output and food supply because water being the most precious for agriculture. It is seen that the supply of water is directly proportional for the increase in productivity. Indian economy is directly and indirectly dependent on agriculture. As per the estimates released by Central Statistics Office the total Share of Agriculture & Allied Sectors (Including agriculture, livestock, forestry and fishery sub sectors) in terms of percentage of GDP(Gross Domestic Product) is 13.9% during 2013-14 at 2004-05 prices. Agriculture and Irrigation are two faces of one coin; agriculture is still a
key activity in developing countries like India. Basic needs of human beings are food, energy and income which are met from agriculture.

“Agricultural development is now generally recognized as an integral part of overall economic development. Not only the physical capital develop our economy but also some of the social and institutional change that enhance human welfare” (Shekadar, 2015).

Irrigation has contributed significantly to poverty reduction, food security, and improving the Quality of life for rural populations. Development of Irrigation is one of the major factors in agricultural development; the significance of water has been predictable from ancient days.

1.2 ORIGIN OF IRRIGATION

Irrigation is defined as “to supply (something, such as land) with water by using artificial means (such as pipes)”. However in common terms Irrigation facility is used to assist in the growing of agricultural crops, maintenance of landscapes, and revegetation of disturbed soils in dry areas and during periods of inadequate rainfall. The word has its origin from, from Latin irrigation (nominative irrigation) a watering (Merriam Webster dictionary).

It is worth mentioning here that in ancient times provisions were made for the storage of water in big tanks, reservoirs and dams to meet the requirements of the agriculturists in different seasons. The purpose of the famous tank at Mohenjo-Daro is not very clear, although serving as a reservoir with channels, its utility for agricultural purposes may be conceivable. From the Rig-Vedic period onwards, we find two terms in the Rig-Veda kïipa an artificial hollow in the earth, signifying a well, and avata - also indicating an artificial well. These are described as unfailing (aksita) and full of water. The raising of water from these wells was done by a wheel (cakra) of stone to which a strap (varatra) with a pail (koka) attached to it was fastened. The water thus drawn was led into broad channels. The term khanitrima is construed to refer to artificial channels for diverting the water lifted from the wells when needed for the fields. The same process continued for a long time. In the time of Panini, roughly in the 5th century B. C., some improvement
was made by tapping the rivers for irrigation. Panini refers to many important rivers sources of irrigation. Patanjali’s Mahabhāṣya, associating its banks as especially suitable for growing paddy crops, Patañjali also refers to periodical supply of water for fields through canals since drought in the village was not an unusual feature (Puri, 1968).

“The Grand Anicut (Canal) across the Cauvery River in Tamil Nadu was begun 1800 years ago and its basic design is still used today. In 1800, some 800 000 ha were irrigated in India. Major irrigation canals were built following the major famines at the end of the nineteenth century and, in 1900, the Indian peninsula (including Bangladesh and Pakistan) had some 13 Mha under irrigation. In 1947, India had about 22 Mha under irrigation. High priority has been given to irrigation with nearly 10 percent of all planned outlays since 1950 being invested in irrigated agriculture. This has resulted in the development of, on average, 0.6-0.7 Mha new irrigated schemes every year” (FAO, 2015).

During the British colonial era commercial crops like poppy and opium were given more importance. Both these crops required dedicated irrigation system mainly in eastern and northern regions of India. This diversion of food crop land to cash crop led to massive famines during the year 1850 and 1905. Millions of People died during this period with major famines and hence British as started construction Major irrigation canals. It can be noted that “Sir Arthur Cotton led some irrigation canal projects in the Deccan peninsula, and landmarks are named after him in Andhra Pradesh and Tamil Nadu. However, much of the added irrigation capacity during the colonial era was provided by groundwater wells and tanks operated manually (Balfour, 1885)”.

**1.3 DIFFERENT TYPES/ METHODS OF IRRIGATION**

However, the process of irrigation can be done in two ways. First one is by direct modifications of the land surface that occur when canal networks are constructed and land is cleared, shaped and leveled for irrigation, on the other hand, by indirect in-depth transformations that take place when the water and salt balances in the area are changed following the import of additional quantities of water and salt into the area (Shanan, L. 1987).
Irrigation water may be applied to the crops in three basic methods that include

- Surface irrigation
- Sprinkler irrigation
- Sub-surface irrigation

These methods can be appropriately chosen by the farmers based on the local condition like Surface slope of the field, roughness of the field, depth of the requirement of water, duration of the water requirement etc.

1.3.1 Surface Irrigation

Surface irrigation is the oldest and the most used method of irrigation followed in Egypt, China, India and countries of the Middle East and is the most likely used methods. It conveys water from the source to fields in lined or unlined open channels or low head pipelines. Basins, borders and furrows are the primary method of applying water. This is best suited for soil with low or moderate infiltration capacities and lands with relatively uniform terrain and slopes less than 2 to 3 % (Booher, 1974).

1.3.2 Sprinkler Irrigation

In the sprinkler method of irrigation, water is sprayed into the air and allowed to fall on the ground surface somewhat resembling rainfall. The spray is developed by the flow of water under pressure through small orifices or nozzles. The pressure is usually obtained by pumping. With careful selection of nozzle sizes, operating pressure and sprinkler spacing the amount of irrigation water required to refill the crop root zone can be applied nearly uniform at the rate to suit the infiltration rate of soil.

1.3.3 Sub Surface Irrigation

Subsurface irrigation is a highly-efficient watering technique that reduces outdoor water use by 30 to 40 %. The system consists of drip irrigation tubing planted about five inches below the surface. The water goes straight to your lawn's roots, and it doesn't blow away or run down the sidewalk.
Today, Irrigation has assumed an increasing significance under Indian agriculture in the context of the new technology where high yielding varieties and multiple cropping patterns are being practiced. Indian economy is agricultural oriented in the sense water shortage for agriculture is also the main cause of rural poverty. Rural uplift is a focal point of our plan strategy. Water wastage in heavy rainfall areas and water shortages elsewhere draw our attention to the urgent need of creating proper and adequate irrigation facilities for overall and agricultural development. Nithi Ayoga has therefore, attached a marked significance to the problem of irrigation right from the first five year plan.

1.4 IMPORTANCE OF IRRIGATION

Self sufficiency in food, creation of marketable surplus so, as to promote agro based industrial development and also to earn foreign exchange through export of food items demand agricultural development at an accelerated rate. Removal of agricultural backwardness so, as to increase agricultural productivity is the only solution. It could be possible through sufficient irrigation facilities, henceforth irrigation is a key to agriculture development.
One of the major reasons for giving much attention to irrigation is Insufficient, uncertain and irregular rains, the duration of rainfall is available to only four months in a year i.e., June to September when monsoon arrives. Remaining eight months are dry; there is some rainfall during the month of December to January in some parts of nation. Even during monsoon, the rainfall is scare and undependable in many parts of the country. Most of the time monsoons are delayed. Considerably while sometimes they cease permanently. Sufficient or proper development of irrigation facilities can helps the nation in solving the problems created by insufficient, uncertain and irregular rains with the help of irrigation, droughts and famines can be effectively controlled. Second reason is higher productivity on irrigated land, Productivity of irrigated land is considerably more than the productivity of on unirrigated land and value of land will be increased.

1.5 ROLE OF IRRIGATION IN NEW AGRICULTURAL STRATEGY

The successful implementation of high yielding varieties programme depends, to a large extent, on the timely availability of ample water supply. The high yielding varieties of seeds and chemical fertilizers require substantial water at regular intervals of time. Therefore benefits of new strategy can be extended only if more irrigation facilities are made available to larger areas of land and irrigation plays a protective role during drought years.

1.6 CLASSIFICATION OF IRRIGATION CATEGORIES

- Major
- Medium
- Minor

Major irrigation schemes are those schemes which have culturable command areas of more than 10,000 hectares. The medium irrigation schemes have a CCA of 2,000-10,000 hectares and minor schemes those with culturable command areas up to 2000 hectares.

In addition to this lift irrigation, tube well irrigation and sprinkler irrigation have been practicing in India and Karnataka. Especially in Karnataka surface water
and tube well irrigation have been playing important role in development of agriculture.

Surface irrigation method: Surface irrigation refers to irrigation of lands by allowing water to flow over the soil surface from a supply channels at upper reach of the field. Crops in India are irrigated mostly by surface irrigation. Sub irrigation involves irrigation to crops by applying water from beneath the soil surface either by constructing trenches or installing underground perforated pipe lines, overhead or sprinkler irrigation methods. Sprinkler irrigation refers to application of water to crops inform of spray from above the crop like rain. It is also called the overhead irrigation as water is allowed. Drip irrigation also called trickle irrigation refers to the application of water at a slow rate drop by drop through perforations in pipes or through nozzles attached to tubes. Spread over the soil to irrigate a limited area around the plant.
1.2 Chart of Benefits of Irrigation

Source: Chamber, 1988 and http://ir.inflibnet.ac.in:8080/jspui/bitstream
1.7 BENEFITS OF IRRIGATION

There are several benefits in irrigation, some of them are mentioned as follows

- **Increase in Crop Yield**: the production of crop mainly dependent on sufficient water supply at right time and quantity.

- **Protection from Famine**: supply of irrigation facilities ensures protection against failure of crops due to famine. Without irrigation facilities in regions, farmers largely dependent on rainfall, since rainfall may not sufficient therefore irrigation facilities save the crops from timely drought.

- **Cultivation of Superior Crops**: assured irrigation facilities may encourage superior crops which may lead to grow high yield varities otherwise, invested money would be wasted.

- **Elimination of Mixed Cropping**: farmers have tendency to cultivate more than one type of crop in a year with sufficient of water supply. Most of the time crops may die due to required amount of water. Farmers may prefer single crop for whole year, it may increases yield of the crop.

- **Economic Development**: sufficient irrigation facilities may leads to growth of farming community and to increase their socio-economic conditions. Also government earned their income through collecting tax from the farmers. Agricultural contribution to gross domestic product will also increase.

- **Hydro Power Generations**: Irrigation not only part of agriculture also generates hydro power. It is also one of the commercial and also basic amenities for overall development.

- **Domestic and Industrial Water Supply**: Irrigation provides water supply for drinking purpose and for industrial purpose.

- **Tourism**: tourism is also one of the major benefits from irrigation, it gives wide publicity as tourist place, also earns profit from tourism.
Irrigation enlargement in the past had mostly taken place as a measure of famine. It is famine and drought that gave birth to the idea of artificial irrigation. Now with the population multiplying rapidly irrigation has assumed greater significance for augmenting agricultural production. The importance of irrigation may be viewed from two aspects. First one is to Protective aspect to make up the moisture deficiency in soils, during the cropping season so as to ensure proper and sustained growth of crops grown. Another aspect is to Supplementary land use aspect to enable second or third crop being raised on the lands provided with irrigation on which could otherwise not be cultivated efficiently, more particularly during the post or pre monsoon period.

While the protective aspect helps in stabilizing agricultural production against droughts, the second aspect cannot be neglected by an alert agriculturist, irrigation has also a third aspect it helps in augmenting and preserving the
properties of soils by application of adequate supply of water. Irrigation studies in India are confined to relatively narrow issues in production economics. It is obvious that, viewed as an input rural development not merely agricultural production, irrigation has other points of contact with development economics as the irrigation in Indian rural economy begins to move from the wings towards the centre of the stage.

Wide distribution of the irrigation water implies a strategy of dispersing the development thrust of irrigation; it has to treat irrigation as only a component in a broader design for increasing Agricultural production and Rural Development. The function of irrigation in expanding crop output, in reducing output instability and in providing considerable protection to the farm sector against periodic drought. The benefits of irrigation have resulted in lower food prices, higher employment and a more rapid agricultural and economic development, increasing living standards of the farming communities.

After the independence Indian government felt the need for irrigation project as water is one of the most precious and finite agricultural input fundamental for the growth of plants as it is a prime component of cytoplasm. Further in the drought years of 1965 and 1966 famine in large tracts of the country was averted only by enormous administrative efforts and huge imports of food grains. These years brought into sharp focus the importance of the role of irrigation. Based on the recommendations of the irrigation commission and the National commission on agriculture, the whole concern of maximum and better utilization of irrigation. Potential was considered by government of India and it was decided to establish command area development authorities for irrigation projects.

Irrigation becomes a prerequisite for rising second and third crop in a year and influences. The cropping pattern by reducing the risk of crop failure and providing water security. This enhances the agricultural production and may have an input on food consumption basket, life quality and socio-economic status. Irrigation farming is another way of improving agricultural production both in subsistence and commercial farming. Large scale irrigation schemes comparatively are more profitable and have socio-economic advantages than small ones.
Irrigation has encouraged multiple cropping during the three cropping seasons and helped in maintaining required optimum soil, moisture during all stages of crop growth. One of the most important objectives of enquiry of the available resources is to define the regional pattern of their quantity, quality and utilization. Actually there are three kinds of water available on the earth, namely, Ocean water, Ground water and Surface water. Surface water in the form of rivers, streams and tanks, lakes, etc has been used for irrigation. Most of the successful green revolution areas in India are having high intensity irrigation. The problem of crops failure, low productivity can be tracked by the advanced irrigation facilities means, timely availability of water. Furthermore, it also enables substitution of each crop.

In all these ways irrigation introduces a factor of stability into agriculture and saves the farmers from uncertainty, anxiety and tension over the outlook of the failure of crops in the years of inadequate or too early rainfall, therefore irrigation has their own position in agriculture development.

1.8 FATHER OF INDIAN IRRIGATION

Father of irrigation in India was Kanuri Lakshmana Rao, well-known as K.L. Rao, designer of Nagarjunasagar and Bhakra Nangal dams, is acknowledged as the father of the Indian irrigation system that is providing livelihood to millions. K.L. Rao was severed as a Union Minister in the central government twice. He was also awarded the Padma Bhushan for his services to the nation.

1.9 DECLARATION OF YEAR 2007 AS ‘WATER YEAR’

Indian government felt the need of water utilization since many decades. India the year 2007 was declared by India as water year of the decade. The main objective of declaring water year was to sustain the water for next generation and also to avoid the famine, drought and to control the wastage of water at the possible ways. Earlier India suffered shortage of drinking water in some of the states, therefore Government took initiate to create awareness among the citizens.
1.10 NATIONAL WATER POLICY

National water policy is formulated by the Ministry of water resources of government of India, to administrate the planning and development of water resources and their optimum utilization. The first water policy came to existence in the year 1987. This policy was updated and modified and also reviewed in 2002 and 2012, as per countries need. India accounts 15% of the world population and having 4% of world water resources. India has been successfully creating live water storage capacity of about 253 Billion Cubic Meter till now.

### Table 1.1 Agriculture land use in India

<table>
<thead>
<tr>
<th>Land Use Particulars 1950-51</th>
<th>Percentage of Share</th>
<th>Land Use Particulars 2012-13</th>
<th>Percentage of Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest</td>
<td>14%</td>
<td>Forest</td>
<td>21%</td>
</tr>
<tr>
<td>Not available for Cultivation</td>
<td>17%</td>
<td>Not available for Cultivation</td>
<td>18%</td>
</tr>
<tr>
<td>Net Area Sown Area</td>
<td>42%</td>
<td>Net Area Sown Area</td>
<td>43%</td>
</tr>
<tr>
<td>Fallow Lands</td>
<td>10%</td>
<td>Fallow Lands</td>
<td>8%</td>
</tr>
<tr>
<td>Other uncultivable land fallow</td>
<td>17%</td>
<td>Other uncultivable land excl fallow</td>
<td>10%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>

Source: Pocket Book of Agricultural Statistics 2015

The above table shows that the agriculture land use in India for two periods, forest land has been increased to 21% from 14%, overall 7% raised from 1951 to 2013. Not available for cultivation has increased 1% respectively. On the other hand other uncultivable land excl fallow reduced by 7% in 2013. Also fallow lands have reduced by 2% respectively. Net area sown has raised only 1% during 1950 to 2013.
1.4 Chart of Agriculture land use in India

1.11 LAND USE PATTERN

Changes in the land use pattern reflect the changes in the available land for cultivation. According to the available statistics there is a shift in the land use pattern in India. The reporting area increased from 284 Million hectares in 1950-51 to 305 million hectares in 2010-11. The percentage of area under forests has shown an increase over a period of five decades. Due to various measures to protect the forests, the share of forests in the available area has increased from 14.24% in 1950-51 to 22.89% by 2010-11. However the disturbing trend is that the share of area under non-agricultural use has been increasing over the same period. While it was only 3.29% in 1950-51, it increased to 8.63% by 2010-11. Similarly the area under the category of land under miscellaneous tree crops & groves not included in net area also decreased from 6.97% to 1.05%.
Table 1.2 Changes in the land use pattern in India

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographical Area</td>
<td>328.73</td>
<td>328.73</td>
<td>328.73</td>
<td>328.73</td>
<td>328.73</td>
<td>328.73</td>
<td>328.73</td>
</tr>
<tr>
<td>Reporting Area for Land Utilisation Statistic</td>
<td>284.32</td>
<td>298.46</td>
<td>303.75</td>
<td>304.16</td>
<td>304.86</td>
<td>305.18</td>
<td>305.69</td>
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<tr>
<td>Forest</td>
<td>40.48</td>
<td>54.05</td>
<td>63.83</td>
<td>67.46</td>
<td>67.81</td>
<td>69.84</td>
<td>70.01</td>
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<tr>
<td>%</td>
<td>14.24</td>
<td>18.11</td>
<td>21.01</td>
<td>22.18</td>
<td>22.24</td>
<td>22.88</td>
<td>22.89</td>
</tr>
<tr>
<td>Not Available for Cultivation</td>
<td>47.52</td>
<td>50.75</td>
<td>44.61</td>
<td>39.55</td>
<td>40.48</td>
<td>41.23</td>
<td>43.58</td>
</tr>
<tr>
<td>%</td>
<td>3.29</td>
<td>4.97</td>
<td>5.42</td>
<td>6.44</td>
<td>6.92</td>
<td>7.78</td>
<td>8.63</td>
</tr>
<tr>
<td>Land under Miscellaneous Tree Crops &amp; Groves not included in Net Area Sown</td>
<td>19.83</td>
<td>4.46</td>
<td>4.37</td>
<td>3.58</td>
<td>3.82</td>
<td>3.44</td>
<td>3.21</td>
</tr>
<tr>
<td>%</td>
<td>6.97</td>
<td>1.49</td>
<td>1.44</td>
<td>1.18</td>
<td>1.25</td>
<td>1.13</td>
<td>1.05</td>
</tr>
<tr>
<td>Cultivable Waste Land</td>
<td>22.94</td>
<td>19.21</td>
<td>17.50</td>
<td>16.74</td>
<td>15.00</td>
<td>13.63</td>
<td>12.65</td>
</tr>
<tr>
<td>%</td>
<td>8.07</td>
<td>6.44</td>
<td>5.76</td>
<td>5.51</td>
<td>4.92</td>
<td>4.47</td>
<td>4.14</td>
</tr>
</tbody>
</table>

Source: Directorate of Economics & Statistics, Ministry of Agriculture

1.12 CHANGES IN CROPPING PATTERN

Cropping pattern refers to the proportion of area under different crops at a particular period of time. A change in cropping pattern implies a change in the proportion of area under different crops. The changes in cropping pattern are the result of the adoption of new crops of and the intensification of cultivation through multiple cropping.

Cropping pattern keeps on changing over years due to so many reasons. Cropping pattern is mainly influenced by a number of soil and climate parameters as well as by the policies of the government. An analysis of changes in the area under food and non–food crops gives us a clear idea about shifts in cropping pattern before and after the announcement of agriculture policy of India 2000.
Table 1.3 Trends in area under food and non food crops in India

<table>
<thead>
<tr>
<th>Year</th>
<th>Food crops</th>
<th>% to total</th>
<th>Non Food crops</th>
<th>% to total</th>
<th>Year</th>
<th>Food crops</th>
<th>% to total</th>
<th>Non Food crops</th>
<th>% to total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1987-88</td>
<td>133.04</td>
<td>77.92</td>
<td>37.69</td>
<td>22.08</td>
<td>2000-01</td>
<td>138.49</td>
<td>74.53</td>
<td>47.32</td>
<td>25.47</td>
</tr>
<tr>
<td>1988-89</td>
<td>140.09</td>
<td>76.86</td>
<td>42.18</td>
<td>23.14</td>
<td>2001-02</td>
<td>141.06</td>
<td>74.21</td>
<td>49.01</td>
<td>25.79</td>
</tr>
<tr>
<td>1989-90</td>
<td>139.31</td>
<td>76.43</td>
<td>42.95</td>
<td>23.37</td>
<td>2002-03</td>
<td>132.24</td>
<td>75.16</td>
<td>43.71</td>
<td>24.84</td>
</tr>
<tr>
<td>1990-91</td>
<td>140.03</td>
<td>75.93</td>
<td>44.71</td>
<td>24.07</td>
<td>2003-04</td>
<td>142.12</td>
<td>74.31</td>
<td>49.14</td>
<td>25.69</td>
</tr>
<tr>
<td>1991-92</td>
<td>136.03</td>
<td>74.65</td>
<td>46.20</td>
<td>25.35</td>
<td>2004-05</td>
<td>139.85</td>
<td>73.18</td>
<td>51.26</td>
<td>26.82</td>
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<td>1992-93</td>
<td>139.01</td>
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<td>1993-94</td>
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<td>47.85</td>
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<td>142.14</td>
<td>73.88</td>
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<tr>
<td>1994-95</td>
<td>140.54</td>
<td>74.74</td>
<td>47.51</td>
<td>25.26</td>
<td>2007-08</td>
<td>144.33</td>
<td>73.97</td>
<td>50.8</td>
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<tr>
<td>1995-96</td>
<td>138.27</td>
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<td>49.19</td>
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<td>142.95</td>
<td>73.18</td>
<td>52.39</td>
<td>26.82</td>
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<tr>
<td>1996-97</td>
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<td>1997-98</td>
<td>140.79</td>
<td>73.80</td>
<td>49.97</td>
<td>26.20</td>
<td>2010-11</td>
<td>146.26</td>
<td>73.51</td>
<td>52.7</td>
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<td>1998-99</td>
<td>142.55</td>
<td>73.72</td>
<td>50.81</td>
<td>26.28</td>
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<td>72.74</td>
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<td>140.51</td>
<td>74.33</td>
<td>48.53</td>
<td>25.67</td>
<td>2012-13</td>
<td>139.17</td>
<td>71.59</td>
<td>55.22</td>
<td>28.41</td>
</tr>
<tr>
<td>Average</td>
<td>139.24</td>
<td>75.02</td>
<td>46.45</td>
<td>24.98</td>
<td>Average</td>
<td>141.01</td>
<td>73.60</td>
<td>50.6</td>
<td>26.39</td>
</tr>
</tbody>
</table>

Source: Directorate of Economics & Statistics, Ministry of Agriculture and Indiastat.com. P- Provisional (Food crops= total cereals & millets, total pulses, sugarcane, total condiments & spices, total fruits & vegetables, other food crops) (Non food crops= total oilseeds, total fibres, indigo, opium, tobacco, tea, coffee, fodder crops, other non food crops)

The above table shows the area under food crops and non-food crops in India. The data reveals that there is a shift in the area in favour of non-food crops from food crops. While the average area under food crops between 1987-88 and 1999-00 was 139.24 million hectares, it increased marginally to 141.01 million hectares between 2000-01 and 2012-13. But the area under non-food crops increased from 46.45 million hectares to 50.60 million hectares during the same period. The area under food crops has registered an increase of only 1.77 million hectares, whereas the area under non-food crops has registered an increase of 4.15 million hectare. The share of area under non-food crops increased from 24.98% to 26.39%.

1.13 OVERVIEW OF LAND USE IN KARNATAKA

Karnataka is the 8\textsuperscript{th} largest state in the country having an area of 191,791 sq. km. There are four divisions i.e. Mysuru, Bengaluru, Belagavi and Kalburgi. There are 30 districts and 176 taluks in the state. According to 2011 census the total
population of the state is 6.11 crores, which accounts for 5.05% of India’s population. The state stands in the middle status in terms of literacy. The average literacy level of the state is 75.40%, female literacy level is 68.1% and male literacy level is 82.5%.

Agriculture sector play a major role in Karnataka economy, as per the agriculture census 2010-11, the state has about 121.62 lakh hectares of cultivable area accounting to 64% of the total geographical area. While in agriculture census of 2000-01 the cultivable area was 123.07 lakh hectares accounting for 64.60% of total geographical area. This shows that cultivable land has decreased marginally in 2010-11 as compared to 2000-01.

1.14 AGRICULTURE LAND USE IN KARNATAKA

Karnataka is one of the agricultural based state, most of the population depended on primary sector. GDP contribution of primary sector was 13.57 during 2013-14. According to 2010-11 agricultural census a total of 78.32 lakh land holders listed out, including all categories of land holdings.

1.14.1 Land Distribution in Karnataka

Agriculture sector in Karnataka is dominated by marginal and small farmers. According to agriculture census of 2010-11, out of the total land holders of 78.32 lakh, 38.49 lakh (49.14%) are marginal farmers owning less than 1 ha. Small farmers with 1 to 2 ha constitute 21.38 lakh (27.29%) of the total land owners. Semi medium farmers with 2 to 4 ha constitute 12.67 lakh (16.17%) and medium farmers with 4 to 10 ha are 5.11 lakh (6.52%). Large farmers with more than 10 ha constitutes 68 thousand (0.86%) of the land owners.

In terms of operational area, marginal farmers constitute 18.51 lakh ha (15.22%). Operational area of small farmers constitutes 30.20% lakh ha (24.83%), semi medium farmers 33.93% lakh ha (27.90%), medium farmers 29.04 lakh ha (23.87%) and large farmers constitutes 9.94 lakh ha (8.17%). While average land holdings of marginal farmers is 0.48 hectares, small farmers is 1.41 ha, medium farmers’ is2.68 ha. Average size of operational holdings of semi medium farmers is 5.69 ha and large farmers are 14.71% ha. According to 2010-11 agriculture census
small and marginal holdings accounts for 76.44% of total holdings. While semi – medium, medium and large holdings account for 23.57% of the total holdings and their operational land holding is 59.95% out of the total operational area.

**Table 1.4 Changes in number and area operated by different size group of farmers in Karnataka**

(Number in 000 and area in 000 hectares)

<table>
<thead>
<tr>
<th>Size class</th>
<th>1995-96</th>
<th></th>
<th></th>
<th>2010-11</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>%</td>
<td>Area</td>
<td>Number</td>
<td>%</td>
<td>Area</td>
</tr>
<tr>
<td>Marginal (below 1 Ha)</td>
<td>2610</td>
<td>41.95</td>
<td>1248</td>
<td>10.30</td>
<td>3849</td>
<td>49.14</td>
</tr>
<tr>
<td>Small (1 to 2 ha)</td>
<td>1707</td>
<td>27.48</td>
<td>2480</td>
<td>20.48</td>
<td>2138</td>
<td>27.29</td>
</tr>
<tr>
<td>Semi medium (2 to 4 ha)</td>
<td>1204</td>
<td>19.35</td>
<td>3298</td>
<td>27.23</td>
<td>1267</td>
<td>16.17</td>
</tr>
<tr>
<td>Medium (4 to 10 ha)</td>
<td>594</td>
<td>9.54</td>
<td>3490</td>
<td>28.82</td>
<td>511</td>
<td>6.52</td>
</tr>
<tr>
<td>Large (Above 10 ha)</td>
<td>106</td>
<td>1.70</td>
<td>1593</td>
<td>13.15</td>
<td>68</td>
<td>0.86</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6221</td>
<td>100</td>
<td>12109</td>
<td>100</td>
<td>7832</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Economic Survey of Karnataka 2014-15

Between 1995-96 and 2010-11 the share of marginal farmers in the total number of land holdings has increased from 41.95% to 49.14%. Similarly their share in the area also increased from 10.30% to 15.22%. Accordingly the share of large farmers with more than 10 ha has decreased from 1.70% to 0.86%. The share of large farmers in the area declined from 13.15% to 8.17% during the same period. The share of small farmers in the area increased from 20.48% to 24.83%. The share of medium farmers declined from 28.82% to 23.87%.

**1.14.2 Land Use Pattern in Karnataka**

Land is used for different purposes. As the availability of land is limited, the usage of land for one purpose affects the availability land for the other purposes. Over a period of time land used for different purposes changes due to several factors. The following table provides data about changes in land use pattern in Karnataka between 1960-61 to 2011-12.
Table 1.5 Changes in land use pattern in Karnataka

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Geographical Area</td>
<td>187.80</td>
<td>189.43</td>
<td>190.50</td>
<td>190.50</td>
<td>190.50</td>
<td>190.50</td>
</tr>
<tr>
<td>Forest</td>
<td>27.09</td>
<td>28.90</td>
<td>30.33</td>
<td>30.74</td>
<td>30.68</td>
<td>30.72</td>
</tr>
<tr>
<td>Not available for cultivation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barren &amp; uncultivable land</td>
<td>9.22</td>
<td>8.39</td>
<td>8.44</td>
<td>7.99</td>
<td>7.94</td>
<td>7.87</td>
</tr>
<tr>
<td>Cultivable waste</td>
<td>6.56</td>
<td>6.15</td>
<td>5.02</td>
<td>4.46</td>
<td>4.27</td>
<td>4.13</td>
</tr>
<tr>
<td>Uncultivated land excluding fallow land</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permanent pastures &amp; other grazing land</td>
<td>17.39</td>
<td>16.19</td>
<td>13.46</td>
<td>10.98</td>
<td>9.59</td>
<td>9.08</td>
</tr>
<tr>
<td>Misc. Tree crops, Groves</td>
<td>3.66</td>
<td>3.11</td>
<td>3.42</td>
<td>3.16</td>
<td>3.03</td>
<td>2.85</td>
</tr>
<tr>
<td>Fallow Land</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current fallow</td>
<td>8.35</td>
<td>8.11</td>
<td>14.59</td>
<td>12.90</td>
<td>13.67</td>
<td>16.72</td>
</tr>
<tr>
<td>Other fallow land</td>
<td>5.13</td>
<td>6.72</td>
<td>5.58</td>
<td>4.57</td>
<td>4.08</td>
<td>5.39</td>
</tr>
<tr>
<td>Net Area Sown</td>
<td>102.28</td>
<td>102.48</td>
<td>98.99</td>
<td>103.81</td>
<td>104.10</td>
<td>99.41</td>
</tr>
<tr>
<td>Total Cropped Area</td>
<td>105.88</td>
<td>108.87</td>
<td>106.60</td>
<td>117.59</td>
<td>122.84</td>
<td>120.59</td>
</tr>
<tr>
<td>Area sown more than once</td>
<td>3.60</td>
<td>6.39</td>
<td>7.61</td>
<td>13.78</td>
<td>18.74</td>
<td>21.18</td>
</tr>
<tr>
<td>Cropping Intensity - %</td>
<td>103.52</td>
<td>106.24</td>
<td>107.69</td>
<td>113.27</td>
<td>118.00</td>
<td>121.30</td>
</tr>
</tbody>
</table>

Source: Department of Agriculture Karnataka and Annual Season & Crop Reports of DE&S, Bangalore.

The data shows that area under forests has increased over a period of time. While it was 27.09 lakh hectares in 1960-61, it has increased to 30.72 lakh hectares in 2011-12. An increase of 3.63 lakh hectares. Land put to non-agricultural uses has increased from 8.12 lakh hectares in 1960-61 to 14.33 lakh hectares in 2011-12. Barren and uncultivable land, miscellaneous, tree crops, groves have decreased. Total cropped area has increased to 120.29 lakh hectares in 2011-12 from 105.88 lakh hectares in 1960-61. Cropping intensity has also increased from 103.52% to 121.30%. Net area shown has decreased marginally to 99.41 lakh hectares from 102.28 lakh hectares in 1960-61.
1.15 RESEARCH GAP

In order to understand the problems and prospects of irrigation in India several studies attempted. Still there looms problem of inter-state water disputes, shortage of rain water. In this regard, government has been implementing various irrigation development programmes in rain fed areas. In this connection several studies have been conducted in different irrigation projects in the state in connection with the contribution made by irrigation development in agriculture. However, there is no other micro level study such as Impact of Hemavati Irrigation on the Socio-Economic Conditions of Farmers – A Study of Hassan District conducted at the district level. In this view, there is a need for this kind of research at district level, which would be very useful for changing or increase agriculture development and also increase the potentiality of irrigation development in that particular district.

1.16 SCOPE AND COVERAGE

The need for irrigation in the agricultural development cannot be ignored. Major irrigation works involve huge investment and take a long period for completion but they have high capacity and can benefit large areas of land, sometimes running into millions of acres. Moreover, in recent years, major works are multipurpose projects are designed not only for irrigation but also flood prevention, navigation, hydropower etc. The features of surface irrigation works are that they require large investments, it requires a long period to be completed and that the outcome on agricultural production will take time to realize. Therefore, the study concentrates only on one of the sources of irrigation, namely canal irrigation. It covers the four taluks of Hassan district of Karnataka for the purpose of analysis. The reference of year for the purpose of primary data is – 2014-15. Information has been collected from 404 farmers from 40 villages belonging to four taluks of Hassan district.
1.17 OBJECTIVES OF THE STUDY

The present study is undertaken with the following objectives

- To identify the development of irrigation in India and Karnataka
- To study the changing cropping pattern after irrigation development in the study area.
- To evaluate the impact of irrigation on the socio-economic conditions of the farmers in Hassan district.
- To assess the Quality of life index of farming community after accessibility of irrigation facilities.
- To find out the problems of farmers of irrigation users in the study area.

1.18 HYPOTHESIS OF THE STUDY

- There is an impact of irrigation and crops sown.
- There is a significant difference in income levels between irrigated and non-Irrigated groups.
- Irrigation changes the life style of farming communities.

1.19 METHODOLOGY

The study uses survey method to gather the data where the primary sources for the data are the farmers of Hemavati reservoir area. A pilot study was conducted before commencing the primary survey. The purpose and the need for the study were explained to the Hemavati canal irrigation farmers to gain the confidence so as to make them furnish the required information. Further the village accountants and district statistical officers were consulted in collecting general information about the villages and canal irrigation farmers. Information collected through the district enquires from the canal irrigation farmers constituted the data base for the study.
The present study has been carried out by an empirical investigation using a structured questionnaire. The questionnaire was structured into three parts looking at demographic, cropping pattern and socio-economic conditions of the respondents in the research area. The survey method was used to collect data because ‘surveys are an important tool for collecting and analyzing information from selected individuals’. They are widely accepted as a key tool for conducting and applying basic social science research methodology (Rossi, Wright, and Anderson, 1983).

1.2.0 SAMPLE DESIGN

The present study is carried out in Hassan district of Karnataka. A three stage random sampling technique is adopted to select the taluk, villages and the farmers. Accordingly, out of the eight taluks in the district, only four taluks i.e. Arkalgud, Channarayapatna, Hassan and Holenarasipura were selected. The First stage of sampling represents irrigated taluks of the district which were selected based on few economic parameters. For the selection of sample villages in the stage two, all the villages were listed out and 40 villages were selected on the basis of random sampling procedure. Once the 40 villages were selected all the farmers using canal irrigation in those particular villages were listed out. Again, using simple random sampling from each sample village 10 respondents was selected out of the listed lot.

1.2.0.1 Sample size determination method

\[ E = \frac{z\alpha/2}{\sqrt{n}} \]

Where

E = margin error

\( z\alpha/2 \) = Value of the standard Variate at a given Confidence Level (CL)

P = Probability

n = Sample size for a given

E = 0.05 or 5%

\( z\alpha/2 = 95\% \text{ CL i.e., 1.96} \)

P = 0.5
Sample Size has been worked out as follows;

\[ 0.05 = \frac{1.96 \sqrt{0.5(1-0.5)}}{\sqrt{n}} \]

\[ \sqrt{n} = 1.96(0.5)/0.05 \]

\[ \sqrt{n} = 0.98/0.05 \]

\[ n = (19.6)^2 \]

\[ n = 384.16 \]

Or

The total population size is 2,74,048 from this population size 10% is 27,404.

Confidence Level is CL -95%.

Confidence Interval is CI-5%.

Finally, Sample size is 384

The sample size for the survey has been 384 respondents were selected from four taluks. Respondents are all cultivators including large, medium and small and marginal farmers. To avoid the sampling error the researcher did a survey on 404 respondents which means an increase in 20 respondents. This was done to get the data as accurately as possible. The researcher used the standard formula to derive the sample size.

Appropriate statistical tools were used in accordance with needs to analyze various aspects of canal irrigation and socio-economic conditions in the course of research. ‘t’ test and paired ‘t’ test and standard deviation were used for analysis. Care has been taken the present survey to reduce the non-sampling errors.

The secondary data was collected from records of the assistant directors of statistics, census reports and irrigation information reports. Reports of the bureau of economics and statistics, agricultural statistics and district at a glance are also considered. Government of India publications on irrigation, economic survey of India and Karnataka, Journals and books were also studied.
1.21 LIMITATION OF THE STUDY

The limitations of the present study are

1. Study is confined to only one district of Karnataka.

2. Primary data was collected from the respondents who are involved in the farm activities within the study area.
1.22 PLAN OF THE THESIS

The presented study is designed in five chapters and they are as follows.

Chapter – I: The first chapter contains introduction, importance of irrigation, methods of irrigation and the issues of the study objectives and hypothesis, the scope and coverage.

Chapter - II: The second chapter gives a picture of the conceptual frame work and review of literature.

Chapter – III: Third chapter deals with an overview of irrigation in India as well as Karnataka.

Chapter – IV: The fourth chapter introduces an economic profile of the Hassan district and deals with the growth and pattern of the canal irrigation in the study area and the socio-economic conditions of the respondents and analysis of the data.

Chapter – V: The fifth chapter highlights the summary, major findings of the study, suggestions for accelerating agriculture development.