CHAPTER -1
IMPACT OF IRRIGATION ON LAND USE CHANGE IN BELLARY DISTRICT

‘The need for providing irrigation facilities to all villages cannot be emphasized too greatly. This is the foundation upon which agriculture depends for its progress, in the absence of which agriculture depends for progress in the absence of which it remains a gamble….

MAHATMA GANDHI – 1946

1.1 Introduction

Agricultural Practices, Worldwide, have served the Socio-Economic needs and motives of human beings, throughout, as seen in the history of mankind. And also agricultural practices, patterns have created formidable culture of their own in the past and have been on an ever refining mode throughout. Understanding these practices and modes of cultivation that served different purpose in the entire history of mankind helps us reason out the historical and socio-economic reasons and intents at different times in history of these practices. From a simple purpose of serving the food requirements of a family, a tribe, a community, a village economy till the emergence of commercialized agriculture, history has recorded the refinement and advancement in agricultural practices.

Growing population Worldwide creates a definite growth in the demand for food. Farmers cannot always depend solely on rainfall to sustain their crops. In fact, many of the world’s agricultural regions receive little or no precipitation. In these areas, water must be diverted from streams or lakes or drawn from wells. The result has been the development of irrigation systems; Irrigation has been instrumental in bringing out a vital change in agriculture and thereby providing a solution for the emerging problem of food security among nations. Technological changes in agriculture are needed to meet the emerging challenges of food security among these countries. Such dynamic changes are essential considering the limited capacity of the present area under cultivation, which cannot be expanded further. This adds dimensions to the agricultural practices. In the sense that a condition to produce more, aries with in the already shrinking agricultural land-thanks to modern Industrialisation.
The surge in the demand for food grains stands relevantly important to Indian given its ever growing population. Technological advancement and scientific practices stands as the most suitable options to meet such brisk demands. Irrigation as a practice stands further more significant to optimize and strengthen the motives of agricultural activities.

‘IRRIGATION’ is – “The process of supplying water to crops by artificial means such as canals, wells, tube wells, tanks, pounds or underground water is called as Irrigation.” And “Impact refers to the influence of irrigation in promoting the spatial change on land use, cropping pattern, agricultural inputs and also crop yield.”

Today, around 3800 km3 of fresh water is withdrawn annually from the world’s Lakes, Rivers, and aquifers. Among this agriculture accounts for about 67% of the withdraws. There are over 45,000 large dams in 150 countries. About one fifth of world’s agriculture land is irrigated. Irrigation is regarded as an integral part of sound infrastructure and is one of the basic ingredients of agricultural activities, and irrigated agriculture accounts agricultural production. Half of the world’s large dams were built exclusively or primarily for irrigation, which contribute to 12-16% of world food production Irrigation encourages farmers to adopt scientific techniques and go in for more intensive cropping thereby creating new opportunities for gainful employment.

Impact of irrigation has played a key role in bringing about the transformation i.e. agricultural production has increased substantially and cropping patterns in many areas have witnessed significant changes. Increased irrigation facilities had in fact begun to user in Green Revolution Scenario in quite a few areas in the country.

Civilizations were using different sources of irrigation depending upon the topography, soils, rainfall, availability of surface water, nature of rivers requirements of crops etc. The main sources of irrigation are (1) canals (2) well and tube wells (3) tanks (4) others (sprinkles, springs, drip irrigation).

India has one of the 1st largest irrigated area in the world. In India sustained and systematic programmed for development of irrigation facilities was taken up with the advent of planned development in 1951. The irrigation potential created during the Pre-plan period was 22.6 million hectors which rose to 89.42 million hectors in
the year 1995-96 and the year 2005-06 it was 105 million hectares. Further in the year 2010-11 it reaches 113.3 million hectares. Karnataka accounts for nearly 4.4% of the India’s net irrigated area. Five year plans provided the much needed assistance for irrigation in Karnataka. In the year 1955-56 the net irrigated area was 14.9 lakh hectares and in comparison in the year 2008-09 the net irrigated area has increased more than 30 lakh hectares and amounts to nearly 23.67% of the net sown area.

1.2 History of irrigation

Irrigation is the method of supplying water to land to support plant growth. This technology has had a powerful role in the history of civilization Mesopotamia, is considered as the cradle of civilization had one of the earliest water diversion systems. Agriculture began there about ten thousand years ago; Water channels helped divert water from the Tigris and Euphrates rivers during the dry months and also helped control the annual July floods. The Egyptians typically created with the idea of irrigation i.e about 5000 B.C. used the Nile River to create First Irrigation system. The civilization that developed in Egypt owed its existence to the water diversion schemes that delivered water to the fields from the Nile River and its delta. The ancient Egyptians invented the shaduf, a long pole with a bucket suspended at one end and a counterweight mounted at the other. The pole pivoted vertically to lift water in the bucket to a higher level. Shadufs are still in use. About 200 B.C., the Chinese were diverting water from the Hwang Ho and Yangtze rivers and building levees to keep their rice paddies flooded. In approximately 130 A.D Native Americans built canals, terraces, and check dams that are still visible today in the Sonoran desert of Mexico and Arizona.

The Roman Empire drew much of its stability from public works projects that included canals and aqueducts. The Romans had several methods of lifting water, including the treadmill-powered chain of buckets, the human-powered scoop wheel, the water-driven tympanum, and the Archimedean screw. Today, mechanical pumps raise water, while channels and sluice gates regulate its level and flow. Portable pumps are available to farmers who wish to irrigate on a short-term basis, as in a drought, and large permanent lift stations operate in larger irrigation schemes.

Irrigation networks have been constructed in many parts of the world, such as in the rice fields of eastern Arkansas, the olive groves of southern Spain, and the
wheat fields of Victoria and Australia. One of the most ambitious irrigation efforts has taken place in the Sacramento, San Joaquin, and Imperial Valleys of California. An important figure in the agricultural development of California was Harriet W.R. Strong. Left to fend for herself after her husband’s suicide in 1883, she acquired a number of patents for irrigation and flood control measures, including, in 1887, the construction of a series of dams so that water backed up from one helped support the dam immediately upstream from it. Irrigation methods also include the use of sprinkler systems. Field-length pipes supported by wheeled legs water the cornfields of the Midwestern United States. Similarly the potato fields of Idaho and Oregon are watered by mobile pipes that revolve in a circle. Irrigation has its environmental drawbacks, causing leaching in some areas. Water tables have been depleted from over-pumping, as in the cotton fields of west Texas. Water diversion also has fostered regional disputes over water rights, as is the case among the states of the upper and lower Missouri river valley. In spite of its financial and environmental costs, irrigation has been and will be a vital part of man’s existence for the foreseeable future.

1.3 Importance of the study

Water resources are important wealth and prosperity of any country largely depends on the efficient use of water resources for agricultural production and electricity generation. Crop production can be increased many folds when irrigation is provided in semi-arid tropics where rainfall is inadequate, erratic, equally distributed and often leads to drought conditions. Therefore, future crop production under irrigation conditions depends solely on efficient and judicious use of water to realize the cherished gains from irrigation.

Irrigation has proved beneficial to the country. In fact, “Irrigation forms the datum line for sustained successful agriculture.” It alleviates suffering, preserves life, averts famines, and advances the material prosperity of the country. In fact, as pointed out by Sir Charles Trevelyan, “Irrigation is everything in India; water is more valuable than land, because, when water is applied to land it increases its productiveness at least six fold and renders great extents of land productivity, which otherwise would produce nothing or next to nothing.” Dr. Knowles writes, “The irrigation works have increased the yields, and the value of the land and the revenue
derived from it. They have lessened the cost of famine relief and have helped to
civilize the whole region. In addition, they yield handsome profits to the government.

An irrigation project confers a number of benefits, both direct and indirect on
the nation. By direct benefits we mean increases in all farm production as a result of
provision of irrigation facility. In addition to direct benefits, irrigation may also give
indirect benefits to the region irrigated by creating opportunities for processing
activities as a result of increased agricultural productivity. It may create certain
newer activates, providing more investment, employment, income and other benefits.
The greatest benefit of irrigation, however, is the sense of security engendered in the
minds of the farmers and stability of agricultural business, which an irrigation system
confers on the area irrigated. The direct benefits of irrigated area, by and large, are
calculable in quantitative terms. But it is not easy to do so in case of indirect benefits
because development of trading and industrial activities in the area might have
simultaneously been influenced partially by other economic forces.

1.4 Relevance of the problem

Indian economy is agricultural in the sense that at present about 22% of
National income is contributed by the agricultural sector and nearly 59% population
earns its livelihood from agriculture. And also along with this about 26.10%
population lives below poverty line. Agriculture backward and increase in population
at the rapid rate of 1.27% per annum have created a severe problem of acute food
shortage. The result is underfed population, under nutritional food and the mass
poverty, inadequacy of food necessitated imports of food grains from the period of
the second five year plan till a few years in the recent past. This exerted a heavy
pressure on foreign exchange resources and to that extent retarded economic
development.

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.
Agricultural development mainly depends on two basic pre-requisites; soil and water. Deep black soil which hold moisture for a period long enough to promote plan growth is limited. The natural source of water for agriculture is the rain. Indian agriculture depends largely on vagaries of monsoon, which is uncertain, irregular, and unevenly distributed throughout the year and overran area. In heavy rainfall areas the rivers drain out the water and hence it is wasted for want of strong and preserving devices. In addition, it creates problems of soil erosion and flood damage. In scanty rainfall areas, however, there is an acute shortage of water for agriculture.

Water shortage for agricultural 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 agricultural development. The planning commission has, therefore, attached a marked significance to the problem of irrigation right from the first five year plan. Mr. Morarji Desai, as the Chief Minister of the Bombay State, emphasized this point in a radio talk on January 14, 1953. He said, “I have no doubt the planning commission has indicated a right order of priorities by emphasizing the development of agriculture, particularly irrigation, with a view to securing self-sufficiency in food and development of power and certain basic industries for our industrial expansion.

Agriculture needs assured and regular supply of water cannot be left to the vagaries of monsoon. Dependable source of water can be had from irrigation facilities alone. Irrigation implies a deliberate human effort to carry water off the natural water sources to the crops in fields. Irrigation implies a deliberate human effort to carry water off the natural water sources to the crops in fields. Irrigation brings about a drastic change in the soil. This facilitates the use of manure which gives high yield even in comparatively poor soils. Intensive use of lands, double and treble cropping, and introduction of cash crops bring not only stability to agriculture but also create surplus in the economy. It generates more income to rural population and paves the way to economic prosperity.”

Bellary district is not exceptional to this as a rain fed region. The district has by and large dry agricultural Terrain having scarce uncertain rainfall. The geographical conditions especially the nature of monsoon rainfall (uncertain,
unreliable, and irregular) makes irrigation indispensable for sustainable agricultural development. A few negative aspects due to environmental degradation associated with irrigation such as emergence of saline and alkaline soils, water logging lands etc., are the focus of present inquired. But certainly irrigation is not only important for stabilization of agriculture, it is the sinequanon for all-round economic development.

1.5 Significance of Irrigation Impact Study

The present study is not only relevant, but it is the most essential to know the expansion in gross cropped area by making double and multiple cropping possible. It analyses yield per unit area by inducing the use of other complementary yield raising inputs viz., high yielding verities of seeds, fertilizers, and pesticides. It helps to understand the ability of farmers to allocate their lands to high yielding and high valued crops. It adds a significant knowledge in the field of agriculture and agricultural development planning. Therefore the union and all state governments are attempting to make optimum use of irrigation potential and source of irrigation.

1.6 Role of irrigation in the study area

Irrigation is the obvious method of making the agriculture relatively independent of the vagaries of rains. It promotes agricultural Vis-à-vis overall economic development and raises the standard of living of a long established agricultural population. Economic and social development to a great extent depends upon the creation of surplus agricultural produce; this often requires extension of agriculture through irrigation projects and practices to ensure optimum land utilization.

In the study area agriculture mainly depends on monsoons, which are mostly uncertain. The natural supply of water through rainfall is inadequate and unevenly distributed geographically and also over time, and irrigation is the only resort. Major portion of land remains thirsty for want of irrigation facilities. In view of the importance of water for agriculture, emphasis on irrigation has become an issue of inescapable importance in study area. The role of irrigation is as follows;

1. Irrigation provides production against vagaries of Monsoons i.e. both famine and floods.
2. Irrigation increases the optimum use of land and consequently, it increases agricultural production and promotes better cropping pattern. And also it generates farm income by increasing the productivity of land.

3. Irrigation is important for increasing of the production of commercial crops and for increasing the employment in agriculture as well as in industries.

4. Irrigation helps the rural families, to cross the poverty line and protects the cultivator from risk and uncertainty of crop harvest during the drought year.

5. Irrigation supports modern agricultural inputs like HYV seeds. Chemical fertilizers, pesticides, implements, etc.

6. Irrigation promotes consumption expenditure and investment expenditure of the farmers. And also it improves education, health, and hygienic conditions of farmers.

7. Irrigation changes the attitude of farmers. It is also conducive to other effects such as town planning, tourism development, etc.

The development of irrigation thus has a very important role in the growth of agriculture.

**The problem of Analysis**

The present study has a purpose of examining the salient changes in the land use and cropping patterns in the study area of Bellary district, Karnataka. The study therefore is intended to analyze the source of irrigation, intensity of irrigation, land-use cropping pattern and population and socio-economic impacts.

**Conceptual Background**

Two features of analysis require conceptualization. The first is that of agricultural land use so as to make explicit the meaning of it in the present context. The second is that of irrigation impact itself, to provide for a framework for analysis in the present study.

**Agricultural Land use:** Land use is considered a cyclic human intervention to satisfy human needs from a complex of natural and artificial resources which is called land (Vink, 1975; Krishnamurthy, 1982:34; Somashekar, 1992). Land use is a truly
geographical concept. It can be viewed from a broad, holistic viewpoint. Agricultural land use is that use of land which permits the growth of crops to obtain the needed food grains and other agricultural commodities. Present land use is the result of different causes, which are directly related to nature and quantity and quality of land resources and others that have their origin in human, cultural, social and economic conditions of the past. In the analysis of agricultural land use, the focus thus turns to cropping systems, land conditions, irrigation, cropping intensities, input, output and productivity, for all these in some way are impacted upon by such technical inputs as that of irrigation. So conceptually, the analysis of impact on agricultural land uses includes all of the above.

**Irrigation Impact:** Several conceptual models of irrigation impact exist in modern geographic literature and they can be usefully adopted in the analysis of impacts (see field, 1974: Racine, 1989: Mahadev, 1982). Field (1974:173) is of the opinion that, in the understanding of the multiplicity of human relationships, (a) geographers have tended to avoid broad commitment to questions which assume that single variables (such as irrigation) provide causes to which (social) changes are the effects and that (b) a single element, causal and linear approach to a search for general principles seems less fruitful than ever. She however agrees that the one important element of change in irrigation dependent systems, once they have expanded to the perceived limits of land space or water supply. And once intensification (because it is too broad a concept to include many things that happen in agriculture) begins, then the impacts are almost a certainty. Irrigation systems not only integrate man, water and land over time but also over space. The stage-by-stage impact of irrigation modeled by Mahadev (1982:73-76) provides clear insights into the environmental impacts (water logging, salination), societal changes (land transactions resulting in changing tenure configurations) – stage one: land use changes (cropping patterns, intensification and diversifications), population changes (distributional, density and culture related), settlement changes (patterns, types and functions) – stage two: industrial, infrastructural and behavioral changes-stage three; and developmental impacts (on physical, economic, cultural and infrastructural elements) – stage four. The present study is in a sense the analysis of impacts that occur in stage one and two with field based data for contemporary verification.
Land use is considered in the widest possible meaning, as indicated above so that impact analysis encompasses at least three broad areas, namely, (1) land uses and cropping patterns (2) concentration and combination and (3) Settlements, socio-economic and development impacts of irrigation, over time and space. In its entirety, however, the study analyses irrigation impacts arising out of the Tungabhadra Project.

1.7. Objectives of the study:

The main objectives of the present study are:

1. To know the efficiency of different types of irrigation systems in the study area
2. To analyze the impact of irrigation on land use pattern in the study area
3. To examine the impact of irrigation on cropping pattern in the study area
4. To study the demography and impact of irrigation on socio-economic life of the study area
5. To suggest strategy for policy matters in the field of agriculture irrigation development and planning

1.8 Methodology:

The detail methodology followed for the study is given in following flowchart in general and objective wise methodology in particular in the respective chapters.

The present work is based on primary and secondary data.

Secondary data regarding source wise irrigated area, land use, cropped area and population are procured from the different departments i.e. department of irrigation statistical department, and agricultural department etc.

The data collected for source wise irrigation is for three decade that is from 1991, 2001 and 2011. For land use and agricultural land use for two decade of 2001 and 2011. The collected data has been converted in to percentage to know the change in growth, change in percentage and to know the volume of change in the concerned variables. Various statistical techniques, like t-test, Anova, correlation and regression techniques have been employed to prove the hypothesis and to know the significance and correlation between variables. Crop ranking and crop combination techniques have been employed to know the ranking and combination of crops.
Arc GIS applications are used for preparation of maps and graphs. Primary data is collected by the farmers of all the taluks through questionnaire survey to assess the socio economic condition of the farmers due to impact of irrigation. Random sampling techniques have been employed for 5% of sample survey.

Flow Chart no: 1.1
1.9 Limitations of the study:

- The area covered by the study is restricted to Bellary district consisting seven taluks.
- The study will be carried out for the period from 1991 to 2011, and consisting the developments and data pertaining to the said period.
- .The main thrust of the study is impact of irrigation on land use, cropping pattern and productivity.

1.10 Organization of the study: - The present study is designed in Eight chapters and they are as follows:-

**Chapter -I: Introduction to study:** - It consists of brief introduction to the topic, history, importance of irrigation and relevance of the study. The objectives and methodology and organization of the study also discussed in ten sub headings in this chapter.

**Chapter –II Review of literature:** - Realizing the importance of literature, International, National and Local review of literature has been done this chapter

**Chapter –III: Geographical background of the study area:**-In this chapter location of the study area, historical background, and environs of the study has been discussed in nine sub headings.

**Chapter –IV: Water resources and irrigation:** - This chapter consists of 38 sub headings which includes development, problem, and prospects of irrigation, different source, and Spatio temporal analysis of irrigation have been discussed apart from discussing the intensity of irrigation. This chapter fulfills the first objective of the study.

**Chapter –V: Impact of irrigation on land use:** - This chapter helps to fulfill the second, objectives of the study which discusses the impact of irrigation on general land use of the study area with Anova and t-test results.

**Chapter –VI: Impact of irrigation on agricultural land use:**- This chapter helps to fulfill the third and fourth, objectives of the study which discusses the impact of irrigation on agricultural land use, cropping pattern and results of Anova and t-test
results with crop ranking, crop combination and correlation and regression techniques of crops of the study area

Chapter –VII: Irrigation development and population: - The fifth objective of the study has been fulfilled in this chapter while discussing the growth and distribution of population, urban-rural population and correlation between intensity of irrigation and density of population and impact of irrigation on socio economic life of the farmers.

Chapter –VIII: Summary and conclusion: - The whole summary of the thesis has been given in this last chapter apart giving valuable suggestion and conclusion. This chapter helps in achieving the sixth objective of the study.