CHAPTER - I

Introduction

1.1 Introduction
1.2 Definition of Irrigation
1.3 Necessity of Irrigation in India
1.4 Advantages of Irrigation
1.5 Disadvantages of Irrigation
1.6 Types of Irrigation
1.7 Choice of the Region and Topic
1.8 Objectives of the Study
1.9 Data Base
1.10 Methodology
1.11 Limitations of the Study
1.12 Review of Literature
1.13 Organization of the Work
Chapter - I

Introduction

1.1 Introduction

Water is the greatest resource of humanity. It not only helps in survival but also helps in making life comfortable and luxurious. Besides various other uses of water, the largest use of water in the world is made for irrigating lands. Irrigation, infact, is nothing but “a continuous and reliable water supply to the different crops in accordance with their different needs”. When sufficient and timely water does not become available to the crops, the crops fade away, resulting in lesser crop yield, consequently creating famines and disasters. Irrigation can, thus, save us from such disasters.

The fact that the provisions of irrigation facilities can enhance our crops yield by large extent, can be found from the fact that in the state of Madhya Pradesh, the crops yield is only 40% more than that in Punjab State, While the area in Madhya Pradesh is about 3 times that in Punjab. The reason is that the irrigation facilities in Madhya Pradesh are only about 16% compared to about 80% in Punjab. (Garg S.K. 1995)

It can, therefore, be concluded that if the irrigation facilities are not developed, crop yield will be reduced. Virtually, the entire progress of the humanity shall be hampered. In the light of these facts, it can be easily emphasized that ‘irrigation’ is inevitable, at least in every tropical or subtropical country like India.

The adoption of irrigation practice in our country is not a new thing, as it appears to be, because sufficient proofs are
available in Indian history. Which confirm that irrigation was being practised not only during the periods of Mughals and Aryans, but even during the periods of Pandavas (about 3150 B.C.). Besides the various ancient books which confirm the above facts, there are ruins of various ancient irrigation works, a few of which are till today existing. For example, the most famous old irrigation work which is functioning even today, is the 'Grand Anicut' which was built by Chola rulers in the first centurary A.D. on the Cauvery river. At the site of the Anicut, the river divides into two branches; the right branch, which is a lower one, is called Coleroon. The Grand Anicut must have been constructed to prevent the flow of water into this low levelled branch (Celeroon) and that to ensure supplies into Cauvery river, so as to irrigate the fertile Tanajavoor delta land. The Importance of irrigation was well recognised by the Mughal rulers, and as such, the Western Yamuna Canal which was built by Ferozshah Tughlaq in the year 1355, was got renovated by Emperor Akbar for irrigating lands in the Hissar district (Haryana State) in the year 1558. Similarly, the Eastern Yamuna Canal, which was built by Emperor Mohammad Shah Abdali (1712-1748) was repaired and remodelled by the Britishers in the 19th Century A.D. During the British regime, considerable attention was paid towards utilizing waters for irrigation, so as to overcome the frequent famines that used to occur in our country. A lot of work was done on various rivers, such as Cauvery, Godavari, Krishna, Ganga, Chenab, etc. Besides the construction of various projects, such as, the Sirhind canal, the lower Chenab canal, the lower Ganga canal, the Agra canal, the Betwa canal, the
Periyar dam and its canal system, the Khadakvasla dam and its link canals, large scale planning was done and blue prints of various important project were drawn. The first irrigation Commission (1901-1903) was also appointed, which submitted its report in the year 1903.

The large scale efforts so made by the British Rulers resulted in bringing 24% of the country’s cropped area under Irrigation. However, with the unfortunate partition and creation of Pakistan, 31% of the country’s irrigated area stood transferred to Pakistan, as against the transfer of only 18% of its population. The independent India in the year 1947 was thus left high and dry with only 19% of its cropped area under irrigation; whereas Pakistan at the time of its creation found 44% of its cropped area under irrigation.

The Indian Government of the independent India, as its very outset, was thus faced to force acute famines and food grain shortages, because most of the country’s area was dependent upon natural rainfall, which proved highly unreliable and erratic.

Large scale efforts were then made by the Indian Government under the Prime ministership of our beloved leader Pt.Jawahar Lal Nehru, to develop and harness our vast water resources, so as to ensure collection of water during monsoons, and its subsequent use for irrigation during non-monsoon period. Several dams were therefore planned and constructed across various rivers to store water during rainy season to reduce the fury of floods, and long canal networks were constructed to move down the stored water during dry weather to the fields, to ensure irrigation supplies to the crops.
The zeal shown in the construction of dams can be gauged by the mere fact that Pt. Jawahar Lal Nehru used to call 'Dams' as the 'Temples' of modern India, and he did all what he could, to plain and implement several multi-purpose projects, by investing huge funds at a time when money was badly required for other important sectors like Education, Housing, Roads and Railways, Hospitals etc.

1.2 Definition of Irrigation

Plants are living beings and do require water and air for their survival, as do human beings require. Their Requirement of water varies with their types. Different types of plants require different quantities of water, and at different times, till they grow up completely. Water is normally supplied to these plants by nature through direct rain or thorough the flood waters of rivers which inundate large areas during floods. The flood water may saturate the land before the flood is subsided. The water absorbed by the land during floods, supplements the water requirement of the crop during dry season. These natural processes, whereby, the water is supplied to the crops for their growth, are dependent upon 'nature' or 'God' whatever we may call it. Sometimes, there may be very heavy rains creating serious floods and damaging the crops, and sometimes, there may not be any rains at all, creating scarcity of water for the crops. Thus famine and scarcity conditions are created. In his bid to control the nature, man discovered various methods by which the water can be stored during the periods of excess rainfall, and to use that extra water during the periods of 'no rainfall' or 'less rainfall'. The art or the science by which it is accomplished, is generally, termed, as
irrigation. Irrigation may, therefore, be defined as the science of artificial application of water to the land, in accordance with the ‘crop requirements’ throughout the ‘crop period’ for full-fledged nourishment of the crops. (Garg S.K. 1995)

1.3 Necessity of Irrigation in India

India is a tropical country with a vast diversity of climate, topography and vegetation. Rainfall varies considerably in its place of occurrence, as well as in its amount. Crops cannot, therefore, be raised successfully, over the entire land, without ensuring artificial irrigation of fields.

More than seventy percent of our population directly depends on agriculture, and the remaining depends indirectly on agriculture. Out of a total geographical area of about 328 million hectares about 180 million hectares is the cultivable area. In order to save this area from the complete wishes of nature, and to ensure full growth of crops, it is necessary that adequate artificial irrigation facilities are ensured. In order to achieve this, the Indian Government is trying hard and spending enormously to provide irrigation facilities for the entire cultivable land. The so far developed irrigation facilities in India have been shown under “Introduction” in the previous pages.

1.4 Advantages of Irrigation

Every irrigation project is designed, keeping in view of its economics, i.e. the expenditure likely to be incurred and the benefit likely to occur. There is a capital investment on the project and the future maintenance charges. The project estimate is generally sanctioned when the benefit gives at least about 6% interest on the capital outlay. Sometimes,
unproductive projects are also sanctioned in view of their general public benefits. (Garg S.K. 1995)

There is hardly any point in emphasizing the importance and advantages of irrigation during the times of acute food shortages and growing population of our country.

Even then, some of the advantages of irrigation are summarised below:

1) **Increase in Food Production**
   
   Irrigation helps to increasing crop yields, and hence, to attain self-sufficiency in food.

2) **Optimum Benefits**
   
   Optimum, utilisation of water is made possible by irrigation. By optimum utilization, we generally mean, obtaining maximum crop yield with any amount of water. In other words, yield will be smaller for any quantity lesser than or in excess of optimum quantity.

3) **Elimination of Mixes Cropping**
   
   In the areas, where irrigation is not ensured, generally mixed cropping is adopted. By mixed cropping, we mean, sowing together of two or more crops in the same field. If the weather conditions are not favorable to one of the crops, they may be better suitable for the other; and thus, the farmer gets at least some yield. Mixed cropping, is thus, found necessary and also economical when irrigation facilities are lacking, and especially during Crash programmes in under-developed countries. But if the irrigation is assured, mixed cropping can be eliminated or reduced.

   Mixed cropping is generally not acceptable, because different crops require different types of field preparations and
different types of waterings, manurings, etc. If two crops are mixed together, the field preparations, waterings, manurings, etc. cannot be made to suit the special need of either. Moreover, during the time of harvesting the crops get intermixed with each other, reducing the purity of each other. But when regular and permanent water supply is assured, a single superior crop can be sown, depending upon the conditions of the soil and the needs of the country.

4) General Prosperity

Revenue returns, are sometimes, quite high and helps in alround development of the country and prosperity of the entire nation and community.

5) Generation of Hydro-electric Power

Cheaper power generation can be obtained on projects, primarily designed for irrigation alone. Canal falls can be used for power generation. Ganga and Sarda Canals constructed for irrigation, are now generating hydro-electric power as a side product, up to about 80,000 kilo-watts.

6) Domestic Water Supply

Irrigation helps in augmenting the town water supply, where water is available with a great difficulty. It also provides water for swimming, bathing, cattle drinking, etc.

7) Facilities of Communication

Irrigation channels are generally provided with embankments and inspection roads. These inspection paths provide a good roadway to the villagers for walking, cycling or sometimes even for motoring.
8) **Inland Navigation**
   Sometimes, larger irrigation canals can be used and developed for navigation purposes.

9) **Afforestation**
   Trees are generally grown along the banks of the channels, which increase the timber wealth of the country and also help in reducing soil erosion.

1.5 **Disadvantages of Irrigation**
1) Irrigation may contribute in various ways to the problem of pollution. One of these is the seepage into the ground water of the nitrates, that has been applied to the soil as fertilizer. Sometimes, up to 50% of nitrates applied to the soil, sinks into the underground reservoir. The underground water may thus get polluted, and if consumed by people through wells, etc. it is likely to cause diseases such as anemia. Will it ultimately affect the fishing, as the tides carry the polluted water out into the ocean, is still a matter of research.

2) Irrigation may result in colder and damper climate, causing outbreak of diseases like malaria.

3) Over-irrigation may lead to water-logging and may reduce crop yields.

4) Irrigation is complex and expensive in itself. Sometimes, cheaper water is to be provided at the cost of the government and revenue returns are low.

1.6 **Types of irrigation**
   Irrigation may broadly be classified into:

   1. Surface irrigation; and
   2. Sub-surface irrigation
1) Surface irrigation can be further classified into:
   a) Flow irrigation; and
   b) Lift irrigation

When the water is available at a higher level and it is supplied to lower level, by the mere action of gravity, then it is called Flow Irrigation. But, if the water is lifted up by some mechanical or manual means, such as pumps, etc. and then supplied for irrigation, then it is called Lift Irrigation.

Flow irrigation can be further sub-divided into:
   i) Perennial irrigation, and
   ii) Flood irrigation

i) **Perennial Irrigation**

In perennial system of irrigation, constant and continuous water supply is ensured to the crops in accordance with the crop requirements, throughout the ‘crop period’. In this system of irrigation, water is supplied through storage canal head works and canal distribution system.

When the water is directed into the canal by constructing a weir or a barrage across the river, it is called, Direct Irrigation. Ganga Canal System is an example of this type of irrigation. But, if a dam is constructed across a river to store water during monsoons, so as to supply water in the off-taking channels during period of low flow, then it is termed as Storage Irrigation. Ram-Ganga Dam Project in U.P. is an example of this type of irrigation system. This perennial system of irrigation, is most important and is mostly practised in India.

ii) **Flood Irrigation**

This kind of irrigation, is sometimes called as Immddation
Irrigation. In this method of irrigation, soil is kept submerged and thoroughly flooded with water, so as to cause through saturation of the land. The moisture soaked by the soil, when occasionally supplemented by natural rainfall or minor waterings, brings the crop of maturity.

2) **Sub-surface Irrigation**

It is termed as sub-surface irrigation, because in this type of irrigation, water does not wet the soil surface. The underground water nourishes the plant roots by capillarity. It may be divided into the following two types:

a) Natural sub-Irrigation; and

b) Artificial sub-Irrigation

a) **Natural sub-region**

Leakage water from channels etc., goes underground, and during passage through the sub-soil. It may irrigate crops, sown on lower lands, by capillarity. Sometimes, leakage causes the watertable to rise up, which helps in irrigation of crops by capillarity. When underground irrigation is achieved simply by natural processes, without any additional extra efforts, it is called natural sub-irrigation.

b) **Artificial sub-irrigation**

When a system of open jointed drains is artificially laid below the soil, so as to supply water to the crops by capillarity, then it is known as artificial sub-irrigation. It is a very costly process and hence, not adopted in India. It may be recommended only in some special cases with favorable soil conditions and for cash crops of very high return. Sometimes, irrigation water may be intentionally collected in some ditches
near the fields the percolation water may then come up to the roots through capillarity.

1.7 Choice of the Region and Topic

So far as the choice of the region and topic is considered the study is primarily concerned with the impact of irrigation on agriculture in Latur district of Maharashtra State. Recently the Latur district comprises 10 tahsils, notwithstanding before 15th August 1982 it had only five tahsils. In 1995 two new tahsils Renapur and Chakur came into existence later on in 1999, three more tahsils came into existence i.e. Deoni, Jalkot and Sirur Anantpal.

The other considerations which influenced the choice of the region and topic under investigation are that, the district itself is predominantly agricultural in character, consequently more population is directly depended upon agriculture. The total geographical area of the district is 715700 hectar, and average rainfall of the study region is 813.6 mm, and the area under cultivation is 6,68,400 hectares out of which the area about 78,051 hectares is irrigated. To make all comprehensive study of irrigation system and its impact of the agricultural development in Latur district, the researcher has chosen the region and topic, “Spatio-Temporal Analysis of irrigation and its Impact on Agriculture in Latur District.”

1.8 Objectives of the Study:

In the present work an attempt has been made to study the ‘Spatio-Temporal Analysis of irrigation and it’s impact on agriculture in Latur district’, 1985-2000. Latur district has been selected as the study area because this region is under developing region in agriculture. Today majority of the people
have close relationship with the primary activities which concern with land.

The present study has certain specific research objectives:

1) To assess the historical, physical nature of the district.
2) To give the present geographical situation of Latur district.
3) To examine the general land use pattern under various categories of land use.
4) To assess the growth of net, total and source-wise irrigated area-growth and changes in surface and ground water irrigation.
5) To assess the crop-wise growth in irrigation and to find out the intensity of irrigation.
6) To identify the tahsil-wise variations in the levels of irrigation on the basis of four indicators.
7) To attempt to delineate homogeneous regions for the purpose of planning for development of irrigation.
8) To assess the influence of irrigation on agricultural development growth of cultivated area, changes in cropping pattern and crop yields, impact of different sources of irrigation on cropping pattern and crop yields, intensity of cropping and correlation between crop production and total irrigated area

1.9 Data Base:

This study is the outcome of field work done by the writer during the years 2005-06. The data is collected both from the primary and secondary sources.
Data from primary sources have been collected through (i) field surveys, (ii) interviews with farmers and (iii) discussions with the Government officials. For getting accurate information the farms were visited frequently.

Data from secondary sources have been collected principally from various bulletins:


Since the study is from 1985, district level published data was available from 1985 onwards to 2000. All the analysis has been done for the ten tahsils of the district.

1.10 Methodology:

The following statistical methods have been used in the present study:

1) The intensity of irrigation and cropping both were computed by the following formula:

\[
\text{Irrigation Intensity Index} = \frac{\text{Gross Irrigated Area}}{\text{Net Irrigated Area}} \times 100
\]

\[
\text{Cropping Intensity Index} = \frac{\text{Gross Cropped Area}}{\text{Net Cropped Area}} \times 100
\]

2) Correlation coefficients were calculated between total irrigated area and total crop production, irrigated area under food grains and foodgrains production, irrigated area under fertilizer consumption, irrigated area under
jowar and area under high yielding variety of jowar and irrigated area under sugarcane and area under high yielding variety of sugarcane with the following formula:

\[
\text{Correlation coefficient or } r = \frac{1 - \frac{6 \sum d^2}{m(n^2 - 1)}}
\]

The basic source of data for studying the impact of different sources of irrigation on cropping pattern, yield, farm practices; use of different sources of irrigation under different farm categories, use of high yielding variety seeds, fertilizers and irrigation water under different sources and different farm categories, cost and benefits of canal and tube well irrigation and income generation through irrigation were drawn from the survey of 300 farms of different villages in the study region during 2005-06.

1.11 Limitations of the Study:

The present study work undertaken has certain limitation as follows:

1) Osmanabad district is divided into two district i.e Latur and Osmanabad. Due to the formation of Latur as a new district the adequate information is not available.

2) There are new tahsils emerged in the study region. So the tahsil wise necessary information is not available adequately.

3) The relevant maps are not available in concerning offices for the study.

4) Enough literature is not available on agriculture and irrigation in Latur district.
Above said all and minor difficulties have put limitations on the study of analysis of irrigation and its impact on agriculture in the study region.

1.12 Review of Literature

1) C.T. Pawar (1989) has made a detailed study of the impact of irrigation on agriculture with special reference to upper Krishna basin of Maharashtra state. The patterns of irrigation in the basin of Krishna river, the major inputs and irrigation, agricultural landuse, land degradation, agricultural regionalization has been studied and analyzed by the author. A micro level analysis of the impact of irrigation on agriculture has done by the author of the concerning region.

2) Dr. S.F. Azam (1998) In his study "Irrigation and agricultural development" considers the area of Western Uttar Pradesh and shows the influence of irrigation facilities on the agriculture and its development of Uttar Pradesh. An attempt is made by the author to present the development of irrigation growth of irrigated area, source wise growth of irrigation, crop and season-wise growth, agriculture transformation through irrigation in western Uttar Pradesh, impact of irrigation on farm practices and socio-economic aspects of irrigation in Uttar Pradesh.

3) S.K. Shukla and P.R. Srivastava (1992) in their book: "Water Resources: Planning and development" has tried to present the developing ground water resources, water cycle with its hydrological survey, water resources planning, water in industry for the whole country i.e
India. The authors have also analyzed the whole water resource system in India.

4) Fukuda, Hitoshi (1976) in his work “Irrigation in the world, comprehensive development” tried to give an all compressive view of the development of irrigation and its sources all over the world.

5) Madhusudan Bhattarai and A. Narayanmoorthy (2003) in their study of “Impact of irrigation on agricultural growth and poverty Alleviation: Macro level analyses in India” have given improved information and understanding of the scale of incremental benefit of irrigation and other factor inputs to agricultural growth and to poverty alleviation has large public policy implications on setting rural development policy. Analysis of data from 1970 to 1974 for fourteen major states of India has been shown the improvement in irrigation and rural literacy rate are two most important factors for agricultural growth and rural poverty reduction in India by the author. The authors also have presented that extending access to irrigation to a large number of farmers and investing in human capital development are crucial to increasing agricultural productivity and reducing poverty in India.

6) Ram Singh (1991) in his study examine the role of variations in irrigation facilities on cropping pattern in assured irrigated and poorly irrigated regions, of the Haryana State. Here south western Sirsa and Bhiwani districts of Haryana have been selected by author for a comprehensive study of the existing cropping patterns. Author examined the role of irrigation intensity on
cropping patterns in the areas of similar types of soils and climate. The intensity of irrigation has been determined as the net irrigated area as the percentage of net area sown. The overall cropping patterns of different categories of intensity of irrigation were analyzed on the basis of percentage of the area under different crops to the total cropped area.

7) Nandini Chaterjee (1995) Studied irrigated agriculture: A case study of West Bengal. Author has used linear regression technique for calculating trends and probability of rainfall in West Bengal. Impact of irrigation on Landuse cropping intensity and crop yields have been depicted by the pearsonian co-relation co-efficient. She used Wilconxon ranked pair text to test the significance of change between 1960 and 1980.

Author found that irrigation potential of West Bengal was not fully utilized. During the period of investigation only 36 percent of gross cropped area was available for irrigation facilities. Author has pointed out that the growth rate of irrigation during the period of 1995 has some what sluggish.

8) Daya Ram (1977) Analysed “Relationship of rainfall water balance and crop maturity in Western Himalaya” The secondary data was used for the study. Author has calculated season wise percentage of matures area, relative variability of crop maturity, co-efficient of seasonal rainfall and crop maturity etc.

Author observed that the relationship of rainfall and crop maturity was positive in both kharif and rabi seasons. But the positive relationship of stronger in the rabi than in the kharif
season. Author concludes that the seasonal water balance is more suitable for maturity of bajara and cluster beem than cotton-desi in the kharif season. The crop maturity seems to be directly related not only to the seasonal rainfall and water balance but also to the rainfall and water balance in certain months of the related harvest season.

9) Singh, S.P. and Sing, B. (1972): examined the impact of tubewell irrigation on cropping patterns and production efficiency. The data was collected from a sample of 34 farmers in a village in Bichpury Block in U.P. in 1970-71. The average intensity of cropping was found to be higher on owned tube well irrigated farms being 180 percent on hired tubewell irrigated farms and well irrigated farms respectively. The production of high yielding varieties actively. The production of high yielding varieties of wheat was high at 34 quintals per hectare on owned tubewell irrigation farms as against 27 and 25 quintals per hectare respectively on hired tubewell irrigated and well irrigated farms.

10) T.Penchalaiah and Y.V. Ramanaiah (1992): Studied the spatial analysis of rainfall in the draught prone area of cuddapah district Andhra Pradesh. In this study an attempt is made to describe the spatial distribution of rainfall, rainfall intensity, rainfall ratio, rainfall variability and rainfall frequency in cuddapah district on seasonal and annual basis. Rainfall from 1901 to 1988 was taken for nine rain-guage stations and analyzed.
Author found that the decadal analysis of rainfall intensity of the winter season was low during 1931-40 and 1951-80. During summer season the decadal variation in rainfall intensity showed an increasing trend in 1910, 1920, 1940, 1950 and 1960. During south-west monsoon period the trend analysis of intensity of rainfall indicated an increase during 1929, 1930 and 1960. During 1950 and 1970 the intensity of rainfall was low.

11) T.C.Sharma (1999) examined the technological change in Indian Agriculture. The book provides an interesting narrative of agrarian change in Karnataka by analyzing in depth the spatial patterns of the change and trends in agricultural land use, use of modern inputs, development of irrigation and area, yield and production of all the principal crops.

1.13 Organization of the work:

The present study entitled 'Spatio-Temporal Analysis of Irrigation and It's Impact on Agriculture in Latur District' is organized into eight chapters including conclusion and recommendations.

The First Chapter 'Introduction' is dealing with importance of the study of selected topic, the objectives, database, methodology, brief review of the literature and selection of the topic and study region. The Second Chapter deals with 'Physical and Socio-economic Setting' of the study region. This includes the location and extension of region, physiographic regions, drainage pattern, climate, the soil types, forest, general land use, agriculture, irrigation, natural transport and communication.
Chapter number three is devoted to general land use pattern in Latur district. In this chapter an attempt is made to assess the land use, i.e. area under forest, area not available for cultivation, other uncultivable land, fallow land and net sown area.

Fourth Chapter is devoted to the sources and modes of irrigation in Latur district. This chapter deals with source-wise growth of irrigation and it assess the need of irrigation, major and medium irrigation projects, minor irrigation projects and well irrigation.

Fifth Chapter is devoted to crop-wise growth of irrigation and levels of development. This chapter deals with crop wise growth of irrigation, intensity of irrigation. In this chapter an attempt is also made to measure the levels of irrigation development. An attempt is also made to delineate homogeneous regions for further planning for irrigation development.

Sixth Chapter deals with impact of irrigation on agricultural development. In this chapter an attempt is made to assess irrigation and agricultural development, change in net, total, double cropped area and cropping pattern in kharif and rabi season crops, intensity of cropping and correlation between irrigation and crop production.

Seventh Chapter is devoted to ‘Impact of Irrigation on farm practices’. This chapter deals with the use of different sources of irrigation under different farm categories, consumption of high yielding variety of seeds, use of high yielding variety of seeds under different sources and different farm categories, consumption of fertilizers, use of fertilizers
under different sources and different farm categories has been dealt with. An attempt is also made to measure the levels of agricultural development.

A brief conclusion based on the results obtained, has been discussed in chapter number Eighth.
REFERENCES


