II. Review of Literature:

In this work for the study of the specific problem a reading of the available literature on agricultural geography is taken and then an attempt is made to analysis the up to date impact of irrigation on agriculture and economic changes in command area of kukadi canal irrigation project in western Maharashtra.

The geographical studies on land use and cropping pattern are plenty in India and abroad, but the studies with a special emphasis on irrigation are comparatively few in India. It must be mentioned that irrigation is also studied by geographers, economists, irrigation engineers, administrators and policy makers, from different angles. As a result, this subject has acquired multidisciplinary dimensions. Though the researcher has tried to refer to most of the available studies on the concerned problems and allied topics, yet only certain selected studies have been reviewed here to bring home some gaps in the already available studies and to trace out the possible areas of research for the present study.

The research scholar has studied irrigation development in India. He estimated percentage share of irrigated area to total area under major crops. Percentage share of rice wheat, jowar, sugarcane and cotton was 38.40, 54.30, 3.60, 70.40 and 17.30 in 1970-71, which had increased to 50.10, 85.00, 7.40, 90.70 and 35.90 during 1997-98, respectively. (Anonymous, 2003)

I have taken the review of ‘The effect of agriculture development on ecosystem and the sustainability of development’ for study. One of the several variants of global warming is the effect of agriculture development on ecosystem. In this study, a projection was made on discover possible levels of major elements of agricultural development such as chemical manure, irrigation water, and use of pesticide in 2020 years. Thus the effect of agriculture on ecosystem in the future was estimated on the basis of world scale and Turkey. (Arslan Zafer Gurler, 2005)

The scholar has studied ‘Future of global agriculture: an ecological evaluation’. In this study, environmental effects of agriculture has been tried to be revealed with use of climate changes until 2025 as data.
With this aim, forecasting results estimated with data of past 22 years back to year 2002 were included in the study. Subjects of projection were described as consumption of P, N pesticides and usage of irrigation water, agricultural area, population and GDP. (Arslan zafer Gurler, 2005)

The researcher deliberately studied the growth and utilization of irrigation water in Akola district of Vidarbha. The study revealed that irrigation had a crucial role in reducing uncertainty in agriculture and helped in stabilizing the production and income of the farmers. The results of the study indicated that well irrigation was a major source of irrigation in Akola district. The area had remained stagnant at around 3.50 percent of gross cropped area. In surface irrigation, hardly one fourth of the potential created was utilized. (Beaker and Bhole, 1997)

The researcher deliberately studied the irrigation potential created and its utilization during the last 35 years in Maharashtra state. The results of the study revealed that the proportion of net irrigated area to net sown area increased from 6 percent during the year 1960-61 to 15 percent during the year 1994-95. The increased irrigation facilities had favored the increased share of the crops like sugarcane and wheat. Though, the proportion of irrigated area under food grain crops increased in relation with total cropped area during the period under study. (Dangat and Yadav, 1997)

The scholar purposefully studied the contribution of irrigation and a chemical fertilizer on Chinese agricultural production growth is considerable. The main objective of this paper was to analyze whether irrigation have a significant impact on fertilizer use decision of farmers in china. He concluded that policies that improve irrigation water efficiency could also have impact on fertilizer use efficiency. (Fanus Asefaw Aregay, 2012)

The article entitled Maps of irrigated areas are essential for Ghana’s agricultural development. The goal of this was to map irrigated agricultural areas and explain methods and protocols using remote sensing. This study demonstrate significant strengths in using Landsat ETM+30 m Data (in fusion with time series MODIS data) in identifying fragmented and minor irrigation sources, such as surface irrigation (large, medium and small schemes), inland valleys, and shallow dug wells and dug outs.
However, dug wells, dug outs, inland valleys, and other fragmented irrigated areas are better mapped using very high resolution (<5m) data in fusion with time-series coarser resolution data. (Gumma M.K., 2011)

The article discloses an experiment to the effect of different irrigation levels on the yield of cotton under two showing methods was conducted at the Agronomic research area, university of agriculture, Faisalabad. The treatments were consisting of flat and ridge showing methods. It is concluded that irrigation at all stages and ridge showing appeared to be the most suitable for obtaining higher seed cotton yield under Faisalabad conditions. So this article is closely related with my research. (Hussain Tariq, 2003)

The research scholar has gone through the Performance of irrigation projects and their impacts on poverty reduction and empowerment in arid environment. Biophysical and socio-economic conditions of pre and post dam construction were assessed in one of the arid regions of Iran command by Minab dam. It highlighted that after many years of project completion, may be attributed to the management and implementation of the project. For effective project performance, a new institutional framework and guide lines are proposed in this article. (Irajpoor A.A., 2011)

The research scholar intentionally studied the management options of water for the development of agriculture in dry areas. In this study a productive water-use system in arid and semiarid areas, where the annual rainfall is scanty, the evaporation rate is higher than precipitation and characterizes insufficient renewable water resources, is the urgent need of the farmers. This study reviews options available for improvement utilization and management of water resources and examines the future prospects of sustainable agriculture in water scarce areas. (Irshad M., 2007)

The scholar has studied Irrigation Frequencies and Corn Yield Relation in Northern Turkey, according to research results, the maximum corn grain yield was obtained when the corn plants were irrigated at 15% of available soil water capacity to field capacity. The above reviews have clearly indicated that there have been changes in crop mix over a period of time because of change in availability of irrigation water at different locations. Different cropping patterns have been observed in different regions. On availability of irrigation the cropping pattern had been diversified towards commercial crops like
sugarcane and cotton in western Maharashtra. In Marathwada, jowar contributed highest share in irrigated area. While in Konkan, it was under rice. Contribution of irrigation resulted in diversification. (Karatekin and Bibercigdem, 2008)

‘The economic value of tank irrigation water was determined through Contingency Valuation Method by analyzing farmers’ willingness to pay for irrigation water under improved water supply conditions during wet and dry seasons of paddy cultivation. Quadratic production function was also used to determine the value of irrigation water. The comparison of the economic value of water estimated using different methods strongly suggests that the present water use pattern will not lead to sustainable use of the resource in the tank command areas. Policy options for sustainable use of irrigation water and management of tanks in India were suggested. (Karthikeyan Chandrasekaran, 2009)

The scholar has studied region wise variation in development of irrigation and its utilization in Maharashtra. The study revealed that both gross and net irrigated area had significantly increased by the linear growth rate of 4.50 and 6.56 percent annum, respectively during the period from 1960-61 to 1996-97 in Maharashtra. The rate of growth in irrigation was significantly higher in period-I (1960-61 to 1977-78) than the period second-II (1978-79 to 1995-96). The wells have appeared to be the major source of irrigation the development of irrigation was quite conspicuous in western Maharashtra followed by Marathwada and Vidarbha, while it was poor in Konkan region. Of the total irrigable area during the year 1995-96, the share of these regions was 51.27, 26.05, 21.08 and 1.50 percent respectively in the state. (Kasar, 1997)

‘Open canal irrigation network optimization: A case study for Burdur-Turkey’ is written by Kemal F. In open canal irrigation networks, conveyance of water from the resource to plot through the best route under current topographical and ownership distribution restrictions is an important problem. In this study, the shortest path, minimum spanning tree, network flow and transshipment models were applied to a state-owned irrigation network in Burdur-Turkey. For open canal irrigation network optimization by taking the modifications required by the topography also into consideration and the results obtained from the models were compared with the current applications. (Kemal F., 2005)
I have gone through the article. A case study of mulai project stated that conflict management is easier if the water distribution is done by the staff employed by the group (i.e. farmers are involved) and answerable to the groups. Also when the group is cohesive, the conflicts are less and are managed by the members themselves. *(Kulkarni and Joglekar, 1190)*

The scholar intentionally studied irrigated agriculture monitoring by GIS and RS Techniques for southern part of Indus basin. In the present research study benefits to develop water management strategies, decision making presses and water use planning. By using this information different irrigated agricultural zones. *(Maik Z.H., 2003)*

‘Effect of irrigation on poverty among small-scale farmers in Limpopo province of South Africa’ is written by Majory O. Meliko. In this study the poverty incidence, depth and severity were found to be higher among non-irrigation household than among irrigation households. There was significant correlation between income poverty and capability and deprivation poverty. The key terms are directly related to my topic. *(Majory O. Meliko, 2010)*

The research scholar has studied the impact of water availability on land and water productivity: A temporal and spatial analysis of the case study region Khorezm, Uzbekistan. He analyzes the relationship between irrigation water access and rural welfare 2000-2007 by descriptive statistics. Analyses revealed not only the general dependency of agricultural revenue on irrigation water availability, but also occurrence of low land productivity during water scarce years and irrespective of the annual water availability, in some tail end regions each year. *(Makusud Bekchanov, 2010)*

I have studied the problems of dry land farming in Marathwada region of Maharashtra which will be helpful in my research. A case study of 100 farmers of Vaijapur and Gangapur was conducted by the scholar revealed that in the semi-arid zones; the dry land farming has become more complicated. There is need to change the policy taking in to account grass root situations. There is need of consolidation and integration of various schemes. The panchyatraj system must hold proper responsibility. Farmers must develop ancillary industries and an agricultural cooperative movement must be strengthened. Agricultural services sector must be strengthened, and program of action must be properly financed. *(Misal Dilip M., 2009)*
The research scholar has studied impact of irrigation on instability of production in Maharashtra. He found that at the state level, an average irrigated area under wheat, bajara, sugarcane, cotton and groundnut had increased by more than 100 percent (wheat 285 percent) in four years period ending 1979-80 over nine years period ending 1964-65. For jowar, the corresponding increase recorded was 75 percent. Indeed percentage increase in average irrigated area under most of the crops between the nine years period ending 1975-76 and four years period ending 1979-80 was quite impressive.

A similar picture was found in the four regions of Maharashtra state. In Bombay region wheat, rice and sugarcane were the irrigated crops during the period 1956-57 to 1964-65. Even in eighties, these crops accounted for major irrigated area with substantial increase in average area irrigated. In Pune region, jowar and sugarcane were the major irrigated crops during the period 1956-57 to 1964-65, whereas in eighties the average irrigated area under sugarcane had increased vary substantially. In Aurangabad region jowar followed by wheat were the two major irrigated crops during 1956-57 to 1964-65, but by 1980s, an average irrigated area under wheat had increased very substantially. In Nagpur region rice was the only irrigated crop during 1956-57 to 1964-65, but by period ending 1979-80, wheat and cotton had recorded increase in average area irrigated. On the whole in the state an average irrigated area under different cropshad recorded impressive increase, especially in four years ending 1979-80. (Mitra, 1990)

The scholar has studied the Micro Irrigation Systems in Andhra Pradesh. Multi-stages sampling method has followed for conducting this study. One districts each from the drought-prone Rayalaseema and Telangana region in Andhra Pradesh. The optimization of benefits from micro irrigation system, which would, intern, contributes to the expenditures adoption of the systems by more number of potential farmers. (Murali Raja S., 2008)

The scholar deals with ‘Remote Sensing of Irrigated Agriculture: Opportunities and Challenges’. Over the last decades, remote sensing has emerged as an effective tool to monitor irrigated lands over a variety of climatic conditions and locations. This review identifies passive and active microwave observations advanced images classification methods and data
fusion including optical and radar sensors or with information from sources with multiple spatial and temporal characteristics as key areas where additional research is needed. (Mutlu Ozdogan, 2010)

The researcher has stated about Accurate geospatial information on the extent of irrigated land improves our understanding of agricultural water use, local land surface processes, conservation or depletion of water resources, and components of the hydrological budget which may be helpful in my study. He developed a method in a geospatial modeling framework that assimilates irrigation statistics with remotely sensed parameters describing vegetation growth conditions in areas with agricultural land cover to spatially identified irrigated lands at 250m cell size across the conterminous united states for 2002. (Pervez Shahriar Md, 2010)

Impact of Irrigation on Food Security in Bangladesh for the Past Three Decades is written by Rahaman Wakilur M. Bangladesh has made impressive progress in agriculture sector in the last three decades and has almost become self-sufficient in food grain production. The study suggested for expansion of irrigated areas (ground water and surface water), adoption of modern technologies and formulation of farmers friendly policy. These key words are directly associated with irrigation. (Rahaman Wakilur M., 2009)

I have gone through the article entitled as Qualitative Characterization of Groundwater Resources for Irrigation- A Case Study from Srikakulam Area, Andhra Pradesh, India. The rapid growth in the population caused unprecedented increase in demand of water resources.

Most of the ground waters are generally suitable for irrigation, but when compared with SAR. Salinity and sodium hazard, ground waters in some parts fall in doubtful and categories for irrigation. (Reddy K.S.S.N., 2011)

The scholar deals with Irrigation and Economic Development in Telangana. The neglect of agriculture, rural development and the social sections in the post-liberalization period and the consequent rise in rural distress brought into sharp focus the rise in regional disparities and development. Telangana want equitable share in water, resources, jobs, opportunities for enterprise and career advancement and adequate voice in political decision making. So to achieve these, in this region people in favors of separate Telangana. (Reddy Yadagiri, 2008)
I have explored the idea of the comparative marketing and advantages and farm size relationship for major agricultural commodities in irrigated and rain fed areas of Ahmednagar district. The investigation was based on the cross sectional farm level data obtained by survey method from the sample of 198 farms respectively from 12 and 6 villages of rain fed and irrigated regions of the Ahmednagar district in Maharashtra. Shete estimated share of irrigated area of different crops in gross irrigated in Maharashtra state area during the period of 1956-1990. For the Maharashtra state as a whole, the proportion of area irrigated in the total area under paddy, wheat, gram, and rabbi jowar were increased from 20.87 to 27.42 percent, from 15.50 to 58.13 percent, from 9.19 to 16.00 percent, and from 6.67 to 10.98 percent respectively during the study period. The pattern of allocating irrigation water to all these crops, however, varied greatly among different regions. There was no significant change in the area irrigated of most of the crops in Konkan region during the period under consideration. The irrigated area of paddy, wheat, and gram crops had increased at a faster rate in western Maharashtra, Marathwada, and Vidarbha regions over the period of time. (Shete S.M., 2001)

The article Irrigation development in western Maharashtra is written by Shinde. The results revealed that there was a creation of massive irrigation potential and huge expenditure was made on irrigation since inception of planning area.

The net irrigated area and gross irrigated area had increased considerably since 1960-61 to 1990-91 in all districts of western Maharashtra. However, there was no significant increase in net sown area in western Maharashtra. In Nasik district, maximum proportionate change in net irrigated area to net sown area was observed from 4.83 to 13.83 per cent during the period 1960-61 to 1990-91. The proportion of net irrigated area was highest (20.39 percent) in Satara and lowest in Dhule (8.69 percent) districts. The proportion of area irrigated by surface irrigation showed considerable increase in Sangali (18.11 percent), Pune (8.98 percent) and Jalgaon (5.29 percent) districts, while in other districts of region, the well irrigation was the only major source of irrigation. (Shinde et al., 1994)
The research scholar has studied Indian Agriculture and Economic Reforms which is closely attached with my research. It summarized that share of agriculture in GDP of India declined after the reforms. Growth rate of agriculture and allied sector was +4.8 before the reforms and it was declined on an average +3.74 after post reforms period. Overall growth of country's GDP and GDP of agriculture and allied sectors are closely interlinked. As the growth rate of agriculture and allied sectors increases, it leads to increase of growth rate of overall Indian GDP. (Shinde S.N., 2009)

The scholar has highlighted the performance of agriculture since the green revolution in the state Punjab. Production, Productivity and net returns of farmers increased during 70s and 80s, but after this initial phase, there has been a steady decline in profitability of crops and the over-use of natural resources has led to environmental degradation. As a result, Punjab’s economy is beset with many problems and the state is facing a virtual socio-economic crisis. (Sukhpal Singh, 2009)

The research scholar has analyzed the problems faced by farmers in the existing farming systems revealed that all the categories of farmers to the facing scarcity of family labor due to involvements in non-farm activities and fragmentation of land. As dry-land farming system is entirely dependent on rainfall changes in the amount of rainfall bring about changes in the income level of farmers. Lack of transportation and marketing facilities are also faced by all the categories of farmers. (Sujatha S.A., 2010)

Irrigated Area Maps and Statistics of India Using Remote Sensing and National Statistics are written by Thenkabail Prasad S. The goal of this research was to compare the remote-sensing derived irrigated areas with census-derived statistics reported in the national system. India, which has nearly 30% of global annualized irrigated areas (AlAs), and is the leading irrigated area country in the World, along with China, was chosen for the study. Irrigated areas were derived for nominal year 2000 using time-series remote sensing at two spatial resolutions: (a) 10-km Advanced Very High Resolution Radiometer (AVHRR) and (b) 500-m Moderate Resolution Imaging Spectra radiometer (MODIS). These areas were compared with the Indian National Statistical Data on irrigated areas.
The study clearly established the existing uncertainties in irrigated area estimates and indicates that both remote sensing and national statistical approaches require further refinement. The need for accurate estimates of irrigated areas is crucial for water use assessments and food security studies and requires high emphasis. (Thenkabail Prasad S., 2009)

I have gone through the article which is based on the mahaboobnagar district, which is predominantly drought prone area, has no major streams or sub-river basins, its precarious minor irrigation water resources, there is normal rainfall. Availability of water and development of water resource facility enabled the development of different regions. Regions lacking such development remained underdeveloped and in fact have degraded their natural resources. Mahaboobnagar is a classic example of such situation which is closely related with my research. (Venkatesh E., 2008)

The research scholar discusses regional imbalance has been conceptualized and conceived as having two major dimensions and is viewed in terms of material or physical and social conditions of the existence of people in a region. Karnataka is one of the leading states in the union of India in terms of growth and development indices; it has not been able to ward off the problems of regional imbalances. (Vithob.B. 2009)

The researcher discusses in his paper the deterioration of indigenous irrigation system traditionally developed in the past to serve the urban agricultural lands that have been affected by rapid urbanization in the Bangkok Metropolitan region. The study is based on data collection from mapping, field survey and interview analyses and identifies current canal deteriorating conditions in four categories. Such canal deterioration essentially reduces their ability to convey a water supply to feed agriculture and its eventual transformation in to urban developments. (Vudipong Davivongs, 2012)