Irrigation is an age old practice in the cultivation of crops. For example, in Egypt it goes back to 4000 B.C. In other parts of the world it is equally old and is well described in various ancient literatures. Civilizations have risen on irrigated land; they have also decayed and disintegrated in irrigated region (Israelsen and Hansen, (1962). It develops to encounter the adverse condition of climate. Irrigation means artificial watering. Irrigation is essentially the artificial application of water to overcome deficiencies in rainfall for growing crops (Cantor, 1967). Irrigation implies a provision of water by artificial means to regulate the growth of plants and increase the yield per hectare.

In major parts of the world, irrigation is considered to be one of the most important and basic factors in the process of transformation of agriculture, especially in countries like India where rainfall is both inadequate and unpredictable. Irrigation is the basic determinant of agriculture because it's inadequacies are the most powerful constraints on the increase of agriculture production, particularly in the dry farming regions. In traditional agriculture, irrigation was recognized only for its protective role of insurance against the vagaries of the rain fall and drought. But with the adoption of high yielding varieties of seeds, chemical, fertilizer and multiple cropping, the controlled irrigation has
become the chief factor in agriculture productivity (Singh & Dhillon, 1984).

With about 73 percent of the population living in the villages and about forty percent of the national income coming from agriculture, it is rightly emphasized that nothing moves in India unless agriculture moves. And no input is more important than water which can move agriculture. Irrigation implies maintaining the storage of water in the soil required for plant growth at times and places of deficient water supply. Assured water supply makes possible double and multiple cropping. This is of particular importance in India where with adverse man-land ratio, very little can be expected besides irrigation helps very greatly because this enables the application from extensive cultivation in raising the yield of land, of other modern inputs like chemical fertilizers, HYV seeds, insecticides and pesticides, etc. This aspect has special significance where the present methods of production are not most modern and yields are low.

Extension of irrigation facilities in India received special attention during the successive plan periods. During 50 years after independence, the net irrigated area increased only twice e.g. from 17.55 percent in 1950-51 to 36.67 percent in 1993-94. During sixties canal irrigation (39.78%) in (1950-51) has been the prime means of irrigation followed by wells (28.66%) and tanks irrigation (17.33 %). Owing to the availability of power in rural areas the scenario in eighties got changed quickly,
comprising highest share of well irrigation (41.75% in 1975-76) followed by canal (38.87%) and tank irrigation (11.48%). In 1993-94 well irrigation contributed more than 50 percent (53.95%) share causing substantial reduction in canal (33.26%) and tank irrigation (6.13%). In some states of India, irrigation system is well developed while others need more intensive network of irrigation. The means of irrigation at state level also reveal variation.

About 63% Indian agriculture is rainfed but the dependability on rain is less. The average annual rainfall is 112 cm, little higher than the world average of 100 cm. But it shows considerable variability in spatial, temporal and seasonal terms. More than 74% rainfall in the country occurs only during 4 months between mid June to mid September by the south-west monsoon. It is very heartening to note that some parts of the country, including Rajasthan, Gujarat, Marathwada and Vidarbha of Maharashtra, Punjab, Haryana, M.P., U.P., Karnataka, A.P. and Tamilnadu, are permanently drought-prone due to scanty and erratic rainfall and inadequate development of irrigation system.

It is realized that the agricultural development should be assessed not only by the trends in the agricultural productivity which reflects essence of various agriculture development measures but also on the basis of various physical inputs like labour, irrigation, fertilizer, improved seeds, etc.
From development of agriculture point of view in particular and rural development in general, the study of irrigation systems forms the focal theme of present era especially in developing countries. In fact, the micro level study (district level) of means of irrigation, intensity and density of irrigation relationship between irrigation and crop productivity and its impact on agricultural innovation is utmost important.

**Review of Literature:**

In the field of agricultural geography substantial contributions have been made by the foreign and national geographers. In regard to national contributors mention may be made of Ganguly (1938), Chatterjee (1948), Ahmad (1956), Banerjee (1979), Singh (1986), Shafi (1984), etc. But pertaining to present theme a few studies have been conducted by the Indian agricultural Geographers whose reviews are given below.

The study made by Mohammed (1978) in Uttar Pradesh, takes notice of the significant correlation between irrigation and use of HYV seeds and chemical fertilizers. His study highlighted a positive relationship between irrigation facilities and adoption index viz., farmers with adequate irrigation facilities have higher adoption index of 2.917 whereas the adoption index of farmers having average irrigation facilities is 1.856 only. The farmers with inadequate irrigation facilities have a poor adoption index of merely 0.815.
Pawar and Shin-de (1979) observed that well irrigation is the dominant source which account for two-third of irrigated area in upland districts of South Maharashtra region. Although some of the watersheds in the region are fully exhausted and are in dire need of artificial recharge, there seems to be plenty of scope for digging additional wells. Irrigation can be further stepped up by providing technical and financial know how and assistance to the peasants. Authors feel that instead of giving cash loans, the government should take up the responsibility of sinking of well in such area for increasing the irrigation hectarage and yield of crops significantly.

More & Mustafa (1984) analysed the need and development of irrigation facilities in Maharashtra. An index of irrigation need has been developed by three variables namely percentage of rural population, percentage of cultivated area and average annual rainfall. The disparities in the irrigation development lead to imbalances in the income and food production and this can not be allowed to persist. To achieve equilibrium in agriculture production and availability of food grain in subsistence agriculture region, the imbalances in irrigation facilities must be reduced. This can be done by assigning greater priority to irrigation development in those areas which need it the most.

Kumar and Pal (1985) pointed out that without artificial irrigation, agriculture in Haryana is gamble. The data taken into
account reveal that a major part of agricultural land still awaits irrigation water. It is possible only if new potentials are created and surplus water from Himalayas and adjoining states are diverted towards the state. Equally important is the better utilization of the irrigation facilities already developed. So far the state has been failed in getting the maximum benefits of existing irrigation projects.

Mukerji (1985) opined that there is a commendable progress in pump-set irrigation in the country since the beginning of the planning era. It now needs investigation of this resource region by region, so that pump set irrigation can be well fitted into national irrigation development plans for the future.

Singh and Azam (1986) attempted to study the increase in crop output vis a vis increase of irrigation in the thirteen districts of Western Uttar Pradesh from 1960 to 1980. The study reveals that increase in irrigation is mainly due to the increase in the number of tube-wells (privately owned) in this region. Growth rates both in irrigated area and crop output have been higher in the period 1960-70 than in the period 1970-80. In eleven out of the thirteen districts, there has been high positive correlation coefficient between irrigation and crop output ranging from 0.6-0.9. High correlation coefficient suggests that irrigation a very important ingredient for agricultural production.
Pawar and Shinde (1986) In the study of Maharashtra highlighted the spatio-temporal development different sources of irrigation, intensity of irrigation growth and regional imbalance therein. The physiographic variations in Maharashtra have resulted in the dominance of particular source of irrigation in particular region. As such the Deccan plateau has a dominancy of well irrigation, eastern parts are endowed by tank irrigation, whereas lift irrigation is widespread in south-western part of the state. The canal irrigation is developed only along the lower part of major river basins. In her study, Chatterjee (1990) assessed the impact of irrigation on cropping intensity in West Bengal. The author has observed that cropping intensity is not highly related to gross irrigated area but rather, it has been considerably influenced by ecological setting and seasonal nature of functioning of the different irrigation types. Percent gross irrigated area is high along canal irrigated tracts followed by state tube-well irrigation in the Damodar-Hughli riverine plains. Maximum gross irrigated area is recorded along the humid, Damodar-Hughli riverine plains with their conjunctive use of mal and state tube-well irrigation.

Singh (1990) illustrated a great need and urgency of identifying and delimiting agro irrigation planning regions. These regions could provide a broad spectrum of the resource base and the problems associated with such identified regions for agricultural planning and its development on the regional basis.
Reddy and Reddy (1992) analysed the irrigation intensity and orientation in Rayalseema, A.P. In this study four irrigation orientation types have been identified. Well-based irrigation ranks first followed by canal, tank and other sources of irrigation.

Singh and Chandel (1994) pinpointed the wide ranging disparities in irrigation intensity at district level. Apart from this, irrigation has direct relationship with cropping intensity, crop yields and adoption of improved agricultural practices in Uttar Pradesh. In order to promote agricultural production, assured irrigation is the most important input as such development of assured irrigation should be made on priority basis.

Tiwari et al. (1995), delineated irrigation intensity regions and proposed new crop land use and irrigation potentials therefore. Small schemes of irrigation are suggested at village level to make the small units independent for their need. In this study conjunctive use of canal and tube-well water and conservation of irrigation water have been preferred to make irrigation more effective, dependable and economic.

Tiwari, Ray and Srivastava (1997) have reported very high degree of correlation between irrigated cropping and agricultural productivity in Trans-Yamuna Region of Allahabad district in 1973-74 and 1987-88. An enough scope for intensification and mechanization of agriculture in the region has been assessed.
New alluvium and black soils have capability of raising good agricultural harvesting if enriched by good fertilizers and scientific techniques of farming. During the interviews with the farmers the need of free boring by the government is highly felt in stony areas.

Pragathi and Ramanaiah (1997) analysed the orientation of irrigation types and their combinations in Andhra Pradesh by employing Kostrowicki's Method. The authors have shown concern to tap all the minor river basins of the upland areas effectively rather than going for major irrigation projects concentrating and benefiting a few locations. If the total surface and subsurface water is fully tapped, the present status of irrigation can be raised into two folds.
Objectives of the Study:

On account of significant differences in physiography, geology and soils of Sonbhadra district, a notable variation in irrigation system as well as its consequences on cropping system is found. Since no systematic and comprehensive study of the means of irrigation, growth of irrigation and its relationship with numerous aspects of agriculture in Sonbhadra district has been made so far, the researcher has chosen the present topic and the district for fulfilling the said gap. The chief objectives of this study are:

i. to analyse the physical and cultural factors which influence the agricultural growth over space and time;

ii. to analyse the trends of means of irrigation, growth of irrigation and irrigation orientation;

iii. to analyse the irrigation intensity and growth in irrigation intensity;

iv. to analyse the land use pattern, the changes occurred in different time-frames, crop diversification, intensity and growth in cropping intensity.

v. to explain the level of agricultural mechanization, use of cropping chemical fertilizers and HYV seeds and its relationship with irrigation;
vi. to explain the agriculture productivity and its relationship with irrigation.

vii. to suggest the measures for overcoming the irrigation problems and better management of irrigation system.

Hypotheses:

The following hypotheses are being proposed to firm their relevance and applicability in the study area:

i. an increase in irrigation intensity leads to increase in net cropped and total cropped area.

ii. Expansion of irrigation system in any area leads to crop diversification.

iii. With the increase in irrigation intensity, cropping intensity increases considerably.

iv. The higher the irrigation intensity, the greater the use of mechanization, chemical fertilizers and high yielding variety of seeds.

v. An increase in irrigation intensity results in the higher agricultural productivity.
Organisation of Chapters and Methodology:

Irrigation is a prime input in the agricultural economy of a developing country like India. But the development of irrigation in India has been quite uneven in terms of areas overage as well as technology of water use. The efficient use of water permits the application of modern agriculture practices which, Altogether, used in the right combination can lead to very successful agriculture as demonstrated by the use of high yielding varieties of seeds. There is an evidence to prove that farmers who are provided with irrigation facilities can innovate quickly, there; none to show the pattern followed by dry farmers (Harris 1972).

It may be worthwhile to assess the progress of irrigation facilities and its impact on agricultural innovation and output on small areal unit (district) which helps in explaining this diversity in a more effective way. In order to have a detailed study for the above mentioned purpose, the entire work will be organized into seven chapters.

The chapter I will be related to the physical and cultural background of the study area, which will include the salient geographical features, location and extent, physiography, drainage system, soils, etc, and population characteristics: growth, distribution and density of population, literacy, sex composition, occupational structure and size of land holding. The chapter II will be a comprehensive survey of the sources of
irrigation such as canals, wells, tube-well, and other, density of irrigation sources and orientation of irrigation.

The chapter III will deal with the intensity of irrigation growth in intensity of irrigation. Kharif and Rabi level intensity of irrigation etc., various land use categories, irrigated area under different crops, crop-diversification, cropping intensity and its association with cropping intensity will form the theme of chapter IV. The chapter V will try to analyse the component of mechanization, use of HYV seeds and chemical fertilizers and association of irrigation intensity with the said aspects.

The chapter VI will illustrate an overall agricultural productivity as well as the productivity of rice, wheat, cereals, pulses, and oil seeds and growth in agricultural productivity. The last chapter will be devoted to the problem and planning of irrigation system, paying due attention upon the blockwise assessment of priority for irrigation development and the measures to be adopted for overcoming the irrigation problems and for better management of irrigation water.

Data related to population will be obtained from various census reports (1961, 1971, 1981, 1991 and 2001) of India, Uttar Pradesh and Sonbhadra district. Data pertaining to infrastructure, socio-economic condition, agriculture and irrigation will be collected at development Block level from district statistical office, Sonbhadra, Joint Director Statistics, District magistrate.
office, Irrigation office, Plant protection office, Sonbhadra information related and to Block Headquarters offices. The Increase in agricultural innovation, productivity, problems related to irrigation and measures to be adopted for better irrigation management through will be generated the questionnaire based survey.

Most of the data collected for above purposes will pertain to 5 points of time e.g. 1961, 1971, 1981, 1991 and 1999. The above mentioned respondents survey will be based on various castes, education groups, age-groups and land holding sizes.

Thus the total information and data collected will be analysed and tabulated, which will provide base for preparation of maps and diagrams to explain the availability of irrigation facilities, irrigation intensity, cropping intensity, level of mechanization and agricultural productivity. Several quantitative techniques will also be used to work out the irrigation intensity and density, irrigation orientation, crops diversification, agricultural productivity, mechanization, priority development for irrigation, etc. The detailed account of such techniques will be available in respective chapters.