The significant aspect in Indian farming is regional and intra-regional disparities both in time and space governed largely by the physical, cultural and technological factors. India, being a second most populous country in the world, there is a need to speed up the food grain production in order to feed the millions of its people. At the same time there is also a need for the optimum utilization of every piece of cultivable land. In India, while population grows, the land is fixed and of this, only a certain proportion is available for cultivation. Further, scope for bringing extra land under the plough is limited. If more production is to be achieved from the existing area, the problem has to be tackled on a wide front.
The mounting pressure of population on existing resources has led to the rapid development of agriculture in the world. This has lead to the studies on various aspects of agriculture in the world. One of the earliest attempts to explain agricultural land use pattern in economic terms is contained in a model of agricultural location proposed by vonthunen, J.H in 1826 (Knowles, R, 1976). Later the main themes of studies in agricultural geography centered around regionalization, land use, cropping pattern, crop combinations, modernization of agriculture etc.

Between 1913 and 1940, regionalization and regional descriptions of agriculture were the common themes in agricultural geography. A number of studies were carried out with the central aim of delimiting agricultural regions in various continents and countries. Jonasson, O (1925-26) in Europe; Baker, O(1926) in North America; Jones (1928) in South America; Taylor, G (1930) in Australia; Valkenburg, V (1931-36) in Asian countries; Shantz (1946) in Africa studied the agricultural regions with reference to physical, social and economic factors and relationship between these factors.

Between 1930 and 1970 land use studies gained significance. The first landuse survey was carried out in Britain under the chairmanship of Dudley Stamp (1930-1939). Later landuse studies were attempted in many parts of world. Wellington (1932) in South Africa; buck, J.L (1937) in china; Beacon, N (1944) in Toronto; Kostrowicki (1947-53) in Poland; Shafi,M (1951) Uttar Pradesh in india; James Preston (1953) North-east Brazil; Coleman, A (1961) Britain and Foneska, H (1966) about the dry tracts of Srilanka are some of the landuse studies, worth mentioning.

The other studies in agricultural geography are made at micro level with a scientific framework of quantification and mathematical explanation. Weaver’s (1954) study of changing patterns of crop landuse in mid-west U.S.A was a pioneering work in this direction. Coppock’s (1964) work on “Agricultural atlas of England and wales” indicates not only the magnitude of agricultural data that is available but also the scope for scientific processing of such data for agricultural planning. A good number of studies on similar lines were attempted by many geographers all over the world to examine regional patterns of agriculture. They are Scott (1957), Buchanan (1959), Chisholm (1962), Thomas (1963), Reeds (1964),

Indian geographers have long been attracted to study the problems and prospects of Indian agricultural at various levels. Deshpande, C.D. (1942) made a descriptive study of the agricultural geography of the districts of Belgaum, Bijapur and Dharwar. Bhat, L.S (1956) studied some aspects of agriculture in the Kolhapur district of Maharashtra. Kaushik (1962) discussed the patterns of agriculture in Himalayan Ganga Basin. Misra, (1963) studied the agricultural geography of Himachal Pradesh. But all the studies are qualitative in nature. Recently the focus is shifted towards the application of quantitative techniques in the analysis of various agricultural phenomenon. Bhatia’s (1965) location Quotient method to ascertain the crop concentration in a region is worth mentioning in this connection as it was trend setting. Shafi’s (1972) works on various aspects of agricultural geography of Uttar Pradesh are profound in the analysis and worth mentioning in this direction. The publication of “An Agricultural Atlas of India” by Jasbir Singh (1974) may be considered as an outstanding contribution.


Irrigation in one form or another has been in vogue from the time immemorial. For instance, in Egypt, it goes back to 4000 BC or beyond and in other parts of the world it is equally old and is described, often in great detail, in ancient literatures such as the Rig-Veda or the records of ancient travelers and traders. It developed in response to conditions of climate, and the same holds good today in many parts of the world. Irrigation is essentially the artificial application of water to overcome deficiencies in rainfall for growing crops (Cantor, 1967). All the less used arable lands of the world, especially in India, are either too sandy or too dry for utilization.
If the ever-increasing world population is to be fed, especially in a country like India where an agricultural economy exists, food production has to be increased through more efficient use of the currently under-used, and unused fertile dry lands. In certain favorable tracts where land is being cultivated through irrigation since the hoary past, the saturation point has almost been reached, such as in Punjab plain in Pakistan. However, additional areas elsewhere can be brought under the plough through dry farming or additional irrigation or vertical expansion in cultivation. Water being a life giving agent to plants, assured water supply to them is must. Water requirements of different types of plants vary markedly both in the temporal and spatial perspective. Most of this requirement is met by the moisture stored in soils. Few climatic regimes can replenish soil moisture sufficiently to promote plant growth after according for potential evapotranspiration (Dhillon, 1973). 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, Pakistan etc. where rainfall is both inadequate and unpredictable. Irrigation is a basic determinant of agriculture because its inadequacies are the most powerful constraints on the increase of agricultural production, particularly in the dryland farming regions. In traditional agriculture, irrigation was recognized only for its protective role of insurance against the vagaries of rainfall and drought. But with the adoption of high-yielding varieties, chemical fertilization and multiple cropping, the controlled irrigation has become the chief factor in increasing productivity (Jasbir Singh, 2004).

Although there is evidence to prove that farmers who are provided with irrigation facilities can innovate quickly, there is none to show the pattern followed by dry farmers (Harris, 1972). Output from a particular piece of arable land can be stepped up with the help of irrigation because it increases the possibility of multiplicity in cropping and of securing high yields per unit area. Therefore, among material inputs, irrigation is known to bear a significant influence on biological inputs, tractorization, net income per hectare, the degree of commercialization and the intensity of cropping. It would, therefore appear that the inter-cropping region and inter-size class differences in agricultural productivity are significantly association in the adequacy and efficiency of irrigation. Moreover in regions where the irrigated area barely constitutes 10 to 15 per cent of the net sown area, irrigation fails to
produce any material impact on the use of agricultural land, acceleration of agricultural productivity, commercialization of agriculture, etc.

On the whole, the development aspects of irrigation are:-

- **Those pertaining to protective measures----**
  
  (i) to make up for the soil moisture deficit,

  (ii) to ensure a proper and sustained growth of crops, and

  (iii) to make harvests safe.

- **Those pertaining to land utilization---**
  
  (i) to colonize the cultivable wasteland for horizontal expansion of cultivation,

  (ii) to shift from seasonal cultivation and to promote more intensive cultivation (i.e. to increase multiplicity in cropping or to attain the optimum level of vertical expansion.

  (iii) to improve the level of agricultural productivity by acting as a catalytic agent for the adoption of modern farm technology, and

  (iv) to lessen the regional and size-class inequalities in agricultural productivity which in turn will reduce socio-economic imbalances

In the dry lands of the tropics and the sub-tropics dryland farming is possible, given an annual rainfall of 50 to 75 cm. agriculture is precarious, and production is meagre where rainfall between 30 and 50 cm. Farming without irrigation is very limited and if the rainfall decreases to less than 30 cm, agriculture becomes impossible without irrigation (King, 1953). Rainfall is deficient in many agricultural areas of the word. When its distribution is unequal in spatio-temporal terms and soil moisture deficit persists, irrigation becomes indispensable for efficient utilization of existing land and for increasing food resources. Water is one of the primary bases of farming. Therefore, the rain which falls in abundance in the catchment areas and snow which melts in the mountains should not be allowed to drain into the sea without
being utilized by the peasantry in areas with scanty and highly unreliable rainfall. This is particularly applicable to many parts of India.

In India irrigation plays a pre-eminent role in minimizing the adverse influence of scanty and unreliable rainfall. Such a role acquires an added significance in the dry lands where it becomes impossible to grow crops without irrigation. Since in these enough water is rarely available for irrigation all the year the crops round, the crops grown on them are usually those that occupy the ground for only a part of the year. Moreover, it is not possible to utilize fully the favourable solar energy available for crop husbandry throughout the agricultural year. Recent developments in irrigation in India show that inter-seasonal stability of production and the total yield of the kharif, rabi and zaid crops can be increased substantially by exploiting the overall natural advantage of climate (other than rainfall) and soil potentials.

During the past four decades, the Punjab-Haryana plain in India, for instance, has made remarkable progress in agriculture. Colonization of the culturable wasteland, improvement in land-use efficiency dynamism in the cropping pattern, and increase in per hectare productivity are the unmistakable indicators of the progress made. All this was possible due mainly to the regional (canal) and local (minor irrigation) resources available for developing irrigation. Details of the mechanics of land-use show that large areas of wasteland have been turned into arable land and the net sown area more than once has significantly increased. Other related factors are: movement-minimization in terms of cost and energy, human element, new technology, services to support agricultural development, credit societies and the like. Lack of change in land-use mechanics in the pre-partition resulted in the region’s agricultural stagnation on account of large tracts remaining unirrigated.

But where rainfall is uneven and inadequate and where underground water is brackish and unfit for raising crops, it is imperative to make all out efforts to harness surface water resources to irrigate large areas of parched lands lest these turn waste. In India organized and planned efforts towards irrigation development began in 1951, the year in which is first five-year plan was launched. Thereafter agriculture picked up.
Extension of irrigation facilities to drought areas of the country received special attention during the successive plan periods. Irrigation development and improved farm practices have tackled the basic problems of low agricultural productivity, inferior cropping pattern, subsistence agriculture and rural poverty in rainfed farming areas. Rightly, the plan accorded priority to programmes of agricultural development through irrigation—a policy which gave excellent dividends. Agriculture still being the backbone of the national economy, its stability and development depends in the availability of perennial supply, of water for irrigation.

It has been estimated that if the entire culturable area of Haryana (which is 86.59 per cent of the total area) is to be provided with irrigation (which will be sufficient for raising at least once crop a year), the total requirement of water would be 29 million acre feet. Presently, the state use 9 million acre feet of ground and surface water. If the unused water resources available in the state, including its share of 4.8 million acre feet of the Ravi-Beas waters are properly utilized, the state will be able to get some 8 million acre feet of ground and surface water. This would still leave it with deficit of 12 million acre feet of water. Therefore, it is necessary for the state to tap all possible water resources and also to save as much water as possible by avoiding seepage, excessive and injudicious irrigation etc. What is said of Haryana holds good for some other states of the country as well.

The situation in arid and semiarid areas of the tropical and sub-tropical latitudes is rather precarious as these are prone to drought and famine every second or third year. There are many factors such as scarcity of surface and groundwater that may obstruct the development of irrigation in these areas. However, producing agricultural commodities in arid and semiarid regions has many advantages. Among these are the relative freedom from insects and disease and almost a complete regulation of water. Yet the fact remains that availability of water at a cost which farmers can afford is the main determinant of the feasibility of using arid areas for agriculture (Anderson, 1970). These areas could be provided with a protective irrigation system. The sufferings of people living in drought-ridden areas can, however, be alleviated through the initiative of the farmers and a liberal help from government agencies for developing the needed irrigation facilities.
India provides an example of regional imbalances in the form of variations in the level of irrigation facilities. Moreover, spatial differences in irrigation development are not uncommon. These regional variations in the distributional patterns of controls may be governed by a number of factors that guide the geography of irrigation. In view of the regional differences in topography, water-table, quality of groundwater, soil, etc., it is but natural that irrigation facilities would not be uniform throughout the country. The distribution pattern too is never exactly alike. Therefore, it is essential to map and measure the range of differences in regional distribution of irrigation. This is the primary business of an agricultural geographer, the secondary being to review and discuss these patterns. Such a composite investigation of geography of irrigation will be of great help in any future agricultural planning and development.

Irrigation is an agricultural strategy designed to reduce moisture deficiency, i.e., the imbalance between the moisture supplied by rainfall and the evaportranspiratory demand. Moreover, the adverse results of unreliability of rainfall are well encountered through irrigation. If the rate of depletion by evaportranspiration is such that water status of the soil reaches a critical level adversely affecting plant growth, and at the same time, the rainfall unreliability is high, the need for irrigation and harnessing of water resources increases. In such a situation, influence of climate on water balance of crops or evaportranspiration, and thus on irrigation and management patterns, will depend on the physical properties of the soils and consumptive-use of the crops. Therefore, we must define in broad terms the dependence of seasonal irrigation requirements on seasonal change and moisture balance patterns in different climatic types.

The fact is that much of the present arable land is inefficiently used can be attributed to a number of factors, namely, that these are either too dry or too sandy, or that these are tilled by poor peasantry. If the increasing population is to be adequately fed, especially in a country like India, where a subsistence grain-farming economy dominates, maximum possible food production must be achieved by making more efficient use of the presently under-used and unused lands which, though adequately rainfed, suffer from seasonal soil moisture deficit.
The development of rainfed areas must be undertaken to remove the socio-economic imbalances in countries with an agriculture-oriented economy. This can be achieved by reducing population pressure and reducing unemployment, through expansion of those areas which are under profitable cropping systems. Additional areas must be brought under cultivation and double or triple crops are to be raised. While the protective irrigation intensity for an average agricultural production is 100 per cent, it should be twice this for benefits accruing from use of chemical fertilizers, high-yielding seeds and scientific farm technology. Without an assured pivotal input-irrigation-biochemical techniques which are costly inputs cannot be used with any degree of confidence by farmers. Thus, it becomes all the more imperative to develop irrigation. Basically, development of irrigation depends on the existence of three factors, namely: (i) the need for irrigation, (ii) the facilities and resources and, (iii) an organization to utilize resources, such as a state or central authority.

As a rule, lower the rainfall greater is its variability and more is the need for irrigation. Variability in excess of 20 per cent implies great risk in farming (Williamson, 1925). The coefficient of variability of annual rainfall is over 20 per cent in greater parts of India. Even in two seasons the magnitude of variability is significant. Moreover, the potential evapotranspiration exceeds precipitation during major part of the year, with the result that arid and semiarid conditions prevail. Under such conditions of drought, only millets can be grown since these are drought-resistant. Agriculture is thus reduced to chance, and farmers have to face and ever-present threat of economic distress and famine.

The socio-economic need for the irrigation has also been recognized for supporting the growing population, rehabilitating the poor sections of society and narrowing the gap of regional imbalances. These can, however, be achieved only through irrigation in rainfed areas. Moreover, the shift from subsistence to agriculturalization, and subsequently to commercialization of agriculture, may be achieved by introducing high-yielding crops. These require more water and cannot thrive without irrigation. The high-yielding wheat variety, for instance, needs seven to eight irrigations which must be made available at particular stages of plant growth, such as, stalking, earring, grain formation and grain filling, to get optimum yield per unit area.
Where the courses are approximately north-south, the rivers tend to cut into their right banks. Right banks are, therefore, generally higher than the left banks (Rawson, 1963). This is very much evident in the Punjab-Haryana plain, which is shaped like a flat pan-cake—a fact which gives the plain a great advantage. Consequently, it is one of the most favoured plains of India for irrigation. The absence of any great irregularity of surface enables the main canals, whence lateral branches run-off, to become the backbone of the needy, potential agricultural areas, with least expenditure. The watersheds which supply water to these plains are favourably situated. The rivers (Ravi, Beas, Sutlej and Yamuna) get water from the melting snow and heavy rains of the Himalayas. The rivers give an inexhaustible supply of water to the canal systems.

If the rainfall is highly erratic in a region, then other climatic have to be favorable for the cultivation of variety of crops with the help of irrigation. The soil must be soft and deep so as to make it easy to dig canals and distributaries at low cost. When soils are fairly deep and there is no hard pan near the surface, waterlogged conditions do not exist. Otherwise there is every possibility that the shallow soils may get profusely waterlogged. Therefore, when planning irrigation scheme it is desirable to keep in mind the properties of soils, such as moisture deficiency, texture, structure, alkalinity-salinity, etc.

Moreover, percolation from existing perennial and seasonal rivers, seepage from unlined canals and distributaries and intake of rainwater in the adjacent hilly or elevated tracts may together contribute to raising the sub-soil water-table to a level at which it can be easily tapped through sweet water wells or tube wells. The Punjab-Haryana plain is an excellent example where the water-table has been utilized for irrigation with the help of mechanical and non-mechanical lifts.

Also, the peasantry on these soils must be hardy and capable of withstanding extreme climatic conditions. The farmers of the plains of Northwest India who have these qualities in abundance have brought about an agricultural revolution in this region.

Construction of canals and installation of tubewells in a region, so also distribution of water and the regulation of its supply, need cooperation from the
people of the region. Government agencies can then help them to launch major agricultural projects. India may be cited as an outstanding example where, during the post-independence period, political stability has stimulated irrigation development which eventually brought about the green revolution. On the other hand, Vietnam could not carry out her ambitious schemes because of lack of political stability, even though there existed conditions which were conducive to irrigation development.

Arid and semiarid areas may become capable of land-use if provided with perennial irrigation. Yet there are certain limitations in development if irrigation which must be borne in mind. In some parts of the world, the volume of water in the rivers is subject to extreme fluctuation and the perennial rivers are irregular in flow. As a result the discharges in the canals vary, which is a prohibiting factor in successful crop production. The uncontrollable fluctuations in the water-table and canal discharges during the period of drought affect agriculture. It is most disconcerting to farmers. If the variations in the volume of water can be adequately predicted, the task of the cultivations to plan their cropping patterns in advance will become much easier (Jasbir Singh, 2004).

STUDY AREA

The present study area is confined to Anantapur District, which is a chronically drought prone district. The frequent droughts, arid and semi arid conditions of the area influence irrigation crop farming, methods of farming and farm output, very strongly. Even after more than about 50 years of Green revolution and a substantial increase in agriculture, still, in some areas, the stink of agricultural under development and shortage food, especially in drought affected areas, alarm the rulers and planners. Though, there are umpteen numbers of plans and programs to uplift these areas, the fate of these areas have not been changed, yet, significantly. Due to the concentration of high growth of agricultural production only in few pockets, the regional imbalances have cropped up unimaginably. So, there need to be change the policies and approaches, especially for the facelift of problem areas in the state (or) any region. In this contest, here an attempt is made to study the geographical perspectives of irrigation and farming in the drought prone Anantapur District of Andhra Pradesh.
OBJECTIVES OF THE PRESENT STUDY

i) to study the distributional patterns of different types of irrigation in Anantapur District.

ii) to study the intensity of irrigation.

iii) to analyse the degree of intensity of irrigation.

iv) to study the irrigation orientation and combination of irrigation types in the district.

v) to study the spatial farming patterns of major crops in the district.

vi) to study the share of irrigated area of the major crops in the district.

vii) to study the other modern agricultural inputs in the district.

viii) to analyse the crop yield levels of the district in relation to the state crop yields.

ix) suggesting suitable planning strategy for the sustainable development of agriculture in the district.

SCOPE OF THE STUDY

The present study clearly brings forth the existing spatial patterns of different types of irrigation sources. Based on these the gaps in irrigation can be found out which helps in planning for suitable crop farming in different parts of the district. The study of spatial distribution of crop farming helps to understand arrangement and distribution of agricultural phenomena at spatio-temporal scale, so that further improvements can be taken up, if any. This study will help us how and why particular crops have developed in particular pockets. One can also understand the direction and with what volume the changes in the agriculture are taking place. To identify weaker areas in terms of agricultural productivity of the district can also be identified with this study. With all these, the study could form the basis for planning and policy making of agriculturally backward areas.
DATA AND METHODOLOGY

In any study, methodology pertaining to collection, tabulation, analysis, mapping and interpretation of data is very important. In the present study, only secondary data were used to fulfill the objectives. Statistics pertaining to different types of irrigation, such as Tube wells, Canals, Tanks, Drywells and other sources were collected for the entire Anantapuram district taking mandal as spatial unit for the year 2010-11. For the measurement of intensity and degree of intensity of irrigation data regarding to total irrigated area, total cropped area, net irrigated area were collected for all the 63 mandals of the district for the year 2010-11. The crop data pertaining to area under major crops (more than 1 percent to the gross cropped area) was also collected for the study area. Data regarding modern agricultural inputs such as agricultural machinery & implements, consumption of chemical fertilizers, seed subsidies, area irrigated by sprinklers and drip irrigation has been collected for all the mandals to know the level of usage of modern agricultural inputs in the district. Finally data related to yields and production of different crops in Anantapuram district has been collected for the year 2010-11. All the data is collected from District Planning Office and Hand Book of Statistics, Anantapuram District, 2011.

TECHNIQUES USED

In the present study both cartographic and statistical techniques were used. Simple averages and the percentage analysis are used to measure intensity of irrigation under different sources, intensity of irrigation to the total cropped area, degree of intensity of irrigation, and individual crop concentrations to the total cropped area. The concentrations of modern agricultural inputs have also been studied with the percentage analysis. Kostrowicki’s method to identify orientation and combination of irrigation types in Anantapur district. Using Arc GIS software, mapping of physical features, population, irrigation, cropping pattern, Agricultural inputs, yield levels etc has been taken up for the study area.

LIMITATIONS

To bring out trends and changes of irrigation and cropping pattern, agricultural inputs previous data for a decade or two were not collected due to personal reasons.
Had it been collected it would have helped to understand more clearly about the direction and volume of change in different aspects of agriculture. However the study has been successfully completed and the results obtained based on the data are good and highly satisfactory.

ORGANIZATION OF THESIS

The entire study is divided into 6 chapters. In chapter II, the geographical background of the study area, Anantapuram district is attempted in order to throw light on the understanding of the different parameters of the study. Hence, physiography, climate, vegetation, soil, drainage, population, transport etc are being described in nutshell.

The spatial concentration of irrigation types, Intensity of Irrigation, Degree of Intensity of Irrigation, orientation and combinations of irrigation types were discussed in chapter III. In chapter IV, spatial distribution of cropping pattern in Anantapuram district is attempted for year 2010-11.

Usage of modern agricultural inputs, such as Agricultural machinery & implements, consumption of chemical fertilizers, distribution of subsidized seeds, area irrigated by sprinklers & Drips and spatial patterns of crop yields and production have been studied in chapter V. In chapter VI, summary and conclusions with suitable planning strategy for the development of Irrigation and crop farming in Anantapuram district is attempted.

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