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# Irrigation and Agriculture Pattern of Medak District in Papannapet Mandal

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**Abstract:** ***Cropping Pattern in India Introduction- Multiplicity of cropping systems has been one of the main features of Indian agriculture and it is attributed to rain fed agriculture and prevailing socio - economic situations of farming community. Cropping systems of a region are decided by and large, by a number of soils and climatic parameters which determine overall agro - ecological setting for nourishment and appropriateness of a crop or set of crops for cultivation. Nevertheless, at farmers' level, potential productivity and monetary benefits act as guiding principles while opting for a particular crop/cropping system at Medak District in Papannapet Mandal. These decisions with respect to choice of crops and cropping systems are further narrowed down under influence of several other forces related to infrastructure facilities, socio - economic factors and technological developments, all operating interactively at micro - level.***

**Keywords:** Irrigation, Agricultural pattern, cropping system, cultivation.

## 1. Introduction

Cropping Pattern in India Introduction - Multiplicity of cropping systems has been one of the main features of Indian agriculture and it is attributed to rain fed agriculture and prevailing socio- economic situations of farming community. Cropping systems of a region are decided by and large, by a number of soils and climatic parameters which determine overall agro- ecological setting for nourishment and appropriateness of a crop or set of crops for cultivation? Nevertheless, at farmers' level, potential productivity and monetary benefits act as guiding principles while opting for a particular crop/cropping system. These decisions with respect to choice of crops and cropping systems are further narrowed down under influence of several other forces related to infrastructure facilities, socio - economic factors and technological developments, all operating interactively at micro - level.

## 2. Statement of Problem

Ground - water and surface - water has been used for irrigation of crops throughout the ages and its importance as a dependable source of water has grown with time. Irrigation has acquired increasing importance in agriculture the world over. From just 8 million hectares in the year 1800, irrigated area across the world increased fivefold to 40 Million hectares in 1900, to 100 Million hectares in 1950 and to just over 255 Million hectares in 1995. With almost one fifth of that area, India has the highest irrigated land in the world (Postel, 1999). It is well - known that rainfall is confined to about four months in a year and is erratic both in space and time, causing severe droughts. In this context, irrigation is a must for agriculture in the country. Agriculture is the single largest sector of Indian's economy. It contributes one fifth in total national income, directly accounts for about 19.20 per cent of export earnings and employs nearly two - thirds of total labour force. Due to the arid and semi - arid conditions prevailing in most parts of India, direct rainfall contributes less than 20 per cent of the total crop demand. Therefore, irrigated farming is the most economical and remunerative form of agriculture (Hangaragi, 2013). Before the midsixties increase in food grain output in the country was attributed mostly to the growth of the cultivated area and the extension of irrigation. Since then, the new farming system symbolized by High Yielding Variety seeds, use of agro- chemical inputs and mechanization had the powerful impact on the food sector of the country. With the modernization of agricultural technology, irrigation has become imperative as it is one of the basic components of Green Revolution. In fact, the 'Green Revolution' was started in areas where reliable sources of irrigation existed. It is necessary not only for raising output but also for stabilizing the cropping pattern. Irrigation is the most important input required for the successful cultivation of High Yielding Variety seeds. The timing of irrigation and the quantity of water supplied are decisive for the performance of the crop. The associated inputs like chemical fertilizers, insecticides and pesticides also perform satisfactory only if timely irrigation is provided to the crop. It may be emphasized that excessive irrigation and inadequate irrigation are both injurious to High Yielding Variety seeds.

India's irrigated agriculture sector has been fundamental to India's economic development and poverty alleviation. Some 28 per cent of India's Gross Domestic Product (GDP) and 67 per cent of employment is based on agriculture. Agriculture is the primary source of livelihood in rural areas, which accounts for 75 per cent of India's population. The rapid expansion of irrigation and drainage infrastructure has been one of India's major achievements. From 1951 to 1997, gross irrigated area (GIA) expanded four - folds, from 23 million hectares to 90 million hectares. Infact, increase in irrigation intensity has contributed to the growth in the overall cropping intensity. As a result, India has moved from the spectre and actuality of food imports and periodic famines to self - sufficiency since the early 1970s. The basic benefits of irrigation are to increase the extent of area sown more than once or to accelerate the cropping intensity, reducing hectareage of land lying fellow and improving the level of agricultural productivity per hectare (Singh, 1997). Telangana is situated in a semi - arid region, where annual rainfall varies between 300 to 1000 mm. Hence a large part of the state experience soil moisture deficiency. During

rainy season, the rainfall is not sufficient to meet the soil moisture requirements. The cropping season during winter (Rabi) receives rainfall in a very small amount therefore; cultivation of crops on the sustained basis in areas like Telangana is only possible with the help of irrigation (King, 1953). Irrigation is an important aspect for agriculture development of any area. It plays very important role for agriculture development of Telangana as large area of state suffer from uncertainties of rainfall in terms of its volume and time. Therefore, in such a rainfall deficit area agriculture is not possible without irrigation. Irrigation is one of the primary foundations of farming. This water has sufficient 'Volitional command' over the location of commercial crops, improvement in agricultural production per unit area, swing in the cropping pattern and change in the mechanics of land - use in Telangana (Kumar, 1985). One of the important factors which contributed to success of new seeds in Telangana is the elaborate irrigation infrastructure in the form of canals, tube wells and pumping sets. The agriculture in Telangana is mechanized and ground - water with surface water is used for irrigation, through deep tube - wells and canals respectively. In the state irrigation is a decisive and primary factor and farming without irrigation is very limited. Telangana is predominantly an agriculture economy with preponderance of 3 wheat, rice, bajra, mustard, sugarcane and cotton. In the recent years, commercial orientation of the state agriculture is more associated with mustard, vegetables, fruits etc. and the area under pulses has declined considerably. The irrigation system of Telangana has transformed very fast after green revolution, but the agricultural innovations are not equally distributed throughout the state. There are wide spatial variations in sources and methods of irrigation. The condition of the southwestern part of the state continues to lag behind from rest of the state in terms of irrigation development. The planned efforts towards development of irrigation facilities in Telangana began after the independence in 1947. Advances in irrigation and farm practices have touched the basic problem of low agricultural productivity, inferior cropping pattern, subsistence agriculture and rural poverty in rain fed areas of Telangana. At present, the state has made considerable progress in terms of development of irrigation facilities, which in turn has transformed the agricultural economy of the state. Agriculture being the dominant primary activity of the study region it is essential to study important features of agriculture in the study area. Agriculture in an area is closely related to climatic conditions and topography. Bhalla and Singh (2001) have also noted that the investment in irrigation and tube - wells, and additional use of fertilizers and new seeds, helped in raising the productivity levels. Due to expansion of irrigation, the state has shifted from subsistent agriculture stage to the semi commercial one. The expansion of irrigation in Telangana is indeed a remarkable achievement. The Singuru Canal and the Ghanpur Canal systems have been linked to divert water from one system to another to optimize the use of limited canal water. In Telangana area under irrigation has increased from 12.93 lakh hectares during 2001 - 2002 to 31.77 lakh hectares during 2020 - 2022 and concerted efforts are on to bring other areas under irrigation. During 2020 - 2021, of the various sources of irrigation tube wells accounts for the largest share (62.79%) followed by canal (37.17%) and others (0.04%). During 2001 - 2002 net irrigated area to net sown area was 37.8 percent which increased to 90.8 per cent in 2020 - 2021. The irrigated area under various crops in the state varies widely with the wheat crop accounting for major share, i. e. about 29.51 per cent of the gross irrigated area during 2001 - 2002 which has increased by 44.6 4 percent in 2020 - 2021. The irrigated area of important crops like rice, wheat and cotton increased by 16.17, 15.09 and 10.28 per cent respectively, during the period 2001 - 2002to 2020 - 2021. It is interesting to note that irrigated area of the sugarcane decreased about 5.54 per cent during the same period. The production of wheat, rice and oilseeds has increased by 1059 thousand tonnes to 12384 thousand tonnes; 223 thousand tonnes to 4453 thousand tonnes and 92 thousand tonnes to 984.7 thousand tonnes respectively between 2001 - 2002 and 2020 - 2021.

## 3. Review of Literature

The literature review has been organized in the available literature has been reviewed on both irrigation and cropping pattern context. Hester Biemans (2016) Crop - specific seasonal estimates of irrigation - water demand in South Asia. Especially in the Himalayan headwaters of the main rivers in South Asia, shifts in runoff are expected as a result of a rapidly changing climate. In recent years, our insight into these shifts and their impact on water availability has increased. However, a similar detailed understanding of the seasonal pattern in water demand is surprisingly absent. This hampers a proper assessment of water stress and ways to cope and adapt. In this study, the seasonal pattern of irrigation - water demand resulting from the typical practice of multiple cropping in South Asia was accounted for by introducing double cropping with monsoon - dependent planting dates in a hydrology and vegetation model. Crop yields were calibrated to the latest state - level statistics of India, Pakistan, Bangladesh and Nepal. The improvements in seasonal land use and cropping periods lead to lower estimates of irrigation - water demand compared to previous model - based studies, despite the net irrigated area being higher. Crop irrigation - water demand differs sharply between seasons and regions; in Pakistan, winter (rabi) and monsoon summer (kharif) irrigation demands are almost equal, whereas in Bangladesh the rabi demand is 100 times higher. Moreover, the relative importance of irrigation supply versus rain decreases sharply from west to east. Given the size and importance of South Asia improved regional estimates of food production and its irrigation - water demand will also affect global estimates. In models used for global water resources and food - security assessments, processes like multiple cropping and monsoon - dependent planting dates should not be ignored.

Kshudiram Chakraborty (2017) Irrigation System and Pattern of Crop Combination, Concentration and Diversification in Barddhaman District, West Bengal. In West Bengal, 53% of Net Shown Area (NSA) is cultivated under paddy. In Barddhaman, 97% of Gross Cropped Area (GCA) is used for cultivation of paddy and there is also an inter - block difference in the pattern of combination, intensification and diversification of crops. Using District Statistical Handbook, 2013 and Census report of Barddhaman, 2001, an attempt is made in this paper to find

out the suitable cropping pattern in Barddhaman, West Bengal. The paper argues that the type of irrigation and soil health determine the combination of crop in the district

**Akmal Kh. Karimov (2017)** Can a change in cropping patterns produce water savings and social gains: A case study from the Fergana Valley, Central Asia. The study examines possible water savings by replacing alfalfa with winter wheat in the Fergana Valley, located upstream of the Syrdarya River in Central Asia. Agricultural reforms since the 1990s have promoted this change in cropping patterns in the Central Asian states to enhance food security and social benefits. The water use of alfalfa, winter wheat/fallow, and winter wheat/green gram (double cropping) systems is compared for high - deficit, low - deficit, and full irrigation scenarios using hydrological modeling with the HYDRUS - 1D software package. Modeling results indicate that replacing alfalfa with winter wheat in the Fergana Valley released significant water resources, mainly by reducing productive crop transpiration when abandoning alfalfa in favor of alternative cropping systems. However, the winter wheat/fallow cropping system caused high evaporation losses from fallow land after harvesting of winter wheat. Double cropping (i.e., the cultivation of green gram as a short duration summer crop after winter wheat harvesting) reduced evaporation losses, enhanced crop output and hence food security, while generating water savings that make more water available for other productive uses. Beyond water savings, this paper also discusses the economic and social gains that double cropping produces for the public within a broader developmental context.

Nilphamari (2018) Crops pattern change and agricultural diversification: A case study of Domar Upazila. Cropping pattern means the proportions of area under various crops at a point of time. This paper provides a comprehensive assessment of crop pattern, crop productivity using climate, and water and crop yield models. The existing studies present that climate change models with higher spatial resolution can be a way forward for future projections. Various types of statistics, other secondary data and primary questionnaire method were applied to measure and analysis the problem. The cropping pattern differs from macro to micro region, both in space and time and is governed largely by the physical, cultural and technological factors. For the purpose of agricultural regionalization and planning, it is necessary to divide the area/ region into homogeneous region on some well - defined basis. Increased crop production could be expected if the irrigated areas expansion prevails. In addition, it will lead degradation of the environmental phenomenon. The different crop pattern of this region varies the diversification of several discussed strength including soil, erosion, flooding, water logging, precipitation, source of irrigation and others. The areal unit of crop ranking is the dominant variables for first, second and third ranking. The importance of adoption of suitable cropping patterns in a developing country cannot be over emphasized. The horizontal expansion of agriculture is not possible without heavy capital investments. If the encouraging method does not get proper result for two or multiple crop pattern for extended areas of land then the food security could be ensured by zonation of crop pattern or judicious regulation.

Anand Kumar, Kuljit Singh (2018) An Analysis of Crop Diversification in Rup Nagar District of Punjab. After green revolution era there is continuous changes in crop pattern of Punjab which focused only on wheat paddy circle because of technical development in both crops like HYV seeds, fertilizers, pesticides, insecticides etc. No doubt this diminished the food problem of the country and enhances the income of farmers. The shift from traditional crops to these food crops also leads to the problems like depletion of ground water, soil degradation and ecological imbalance (Sidhu et al 2010). Because paddy crop needs huge water but in Punjab the ground water and canal irrigated area is relatively less. The burning of residue of paddy is also challenge for the government because of air pollution and soil degradation (Sharma 2008). Irrigation facilities are the reason for adoption of this crop cycle and decline of area gram, oilseeds, cotton, vegetables and pulses. Wheat and paddy are economically secured because having MSP and other crops have fluctuations every year (Sharma 2008). Cost of production is increases because of diseases and soil degradation but there is stagnation in production and growth rate of agriculture. After 1980s every decade decline in growth rate of agriculture (Kumar and Singh 2010). The monoculture of wheat - paddy leads to excessive use natural resources and chemical use which results the depletion of ground water, soil degradation and steady growth of agriculture. The diversification will be the solution for this. Government adopts many schemes for this but there is very steady growth in this diversification.

Hasibur Rahaman (2019) Diversified cropping pattern and Agricultural Development in Malda District, West Bengal. In India, the sense of agricultural development came into the academic discussion only after the Green Revolution. Extended irrigation facilities, HYV seeds, new implement and machinery, fertilizers and pesticides had transformed Indian agriculture from low subsistence to intensive subsistence cum slow commercial agriculture with necessary output. It was the need of hour. At a cost of bumper production and productivity soil sustainability drastically decreased, as a result, salinity and alkalinity become new reality of green revolution in India. The swelling drawback of green revolution, increasing population and new food security policy has been slowing down agricultural contribution in the national economy (Misra, 2011). According to 2015 - 16 Agricultural Census, Malda district of West Bengal becomes a home of more than 96 percent (included 83% - marginal and 13% small) farmer having a land size less than two hectares. Intensive subsistence cum low commercial agriculture is only boost to their income and livelihood. The decreasing groundwater table, macro and micro soil nutrients, climate change and variability, erratic monsoon rainfall, low level of inputs and technological adaptation, instability and volatility agro - products price and slow down public investments have been identified as major constraints in the district. In this context present work on 'Diversified Cropping Pattern and Agriculture Development in Malda District' becomes interesting subject of discussion. Being an important dimensions of agriculture development, crop diversification not simply mean growing multiple crops on same field rather it also considered crop rotation which promise, stabilize and generate income, increase employment, minimize risk and uncertainty,

improve, preserve, augment natural resources, enhance soil sustainability and therefore, crop diversification assume better agricultural output across different land size class categories in the district.

**Niharika Narayan (2019)** Cropping Pattern in India Introduction - Multiplicity of cropping systems has been one of main features of Indian agriculture and it is attributed to rain fed agriculture and prevailing socio - economic situations of farming community. Cropping systems of a region are decided by and large, by a number of soils and climatic parameters which determine overall agro - ecological setting for nourishment and appropriateness of a crop or set of crops for cultivation? Nevertheless, at farmers' level, potential productivity and monetary benefits act as guiding principles while opting for a particular crop/ cropping system. These decisions with respect to choice of crops and cropping systems are further narrowed down under influence of several other forces related to infrastructure facilities, socio- economic factors and technological developments, all operating interactively at micro - level.

**Ujjal Deka Baruah (2020)** Assessment of Spatial Pattern And Distribution Of Major Crops in Assam, India. Various indicators such as production, yield, mechanization of farms, workforce engaged in farming are generally used for the evaluation of the status of the agricultural sector in a region. Of these, the cropping pattern is one such indicator that signifies how developed the farming system of a region is. To assess the cropping pattern, a number of statistical indices are available—cropping intensity, crop combination, crop concentration, and crop diversification. This research seeks to evaluate the cropping pattern in Assam, India and examines the status of its agricultural sector. It was found that the cropping intensity increased at a gradual rate of 3% per decade. A total of nine statistical indices were used to estimate crop diversification. These indices were compared amongst themselves to determine the most optimal method for the study area. It was found that the give and entropy methods were best suited to Assam in an evaluation of its crop diversification. Further, these crop diversification values were ranked and thereafter, a composite score (Kendall's method) was derived. The composite score indicated that much of western and northern Assam had a high degree of crop diversification.

## 4. Research Gaps

A critical evaluation and review of the available literature is highly essential in order to identify the research gaps.

- Many studies have been conducted on irrigation and cropping pattern but hardly any systematic and exhaustive study covering cropping pattern, intensity of cropping, crop wise area irrigated and different sources of irrigation in the state has so far been conducted. The present study is directed to fill this gap in a small way.
- Most of the studies have used percentage share to analyse the irrigation and cropping pattern changes. But the present study has calculated canal and tube well concentration index of irrigated area.
- The majority of studies have considered only major crops, the subsidiary crops which occupy a significant proportion of the cropped area are left out. But this study has focused on ten crops of both Rabi and Kharif seasons.

## 5. Theoretical Framework

There are a number of theories and models related to agricultural development. Technological change and population pressure are the driving force for the agricultural development. In agricultural development of any area, irrigation facilities and double cropped area must be given top priority. Theories and models such as Input - Output model by Kantorovitch, Thunen's theory of Landuse and Agricultural Location, Bose up's Model of Agricultural Development, Mellor's the Economics of Agricultural development, Reddy's Location Quotient Index etc. are Highly relevant to agricultural and irrigation development. However for the present study Reddy's Location Quotient Index is considered for irrigation development.

Reddy (1992) applied location quotient index for the concentration of canal and tube - well irrigation. The study of concentration aspect brings out clearly the areas having more/less than their legitimate share of particular type of irrigation. If the total irrigated area are under particular category is evenly distributed the index value is unity. If a region has a location quotient index more, it has a higher concentration of that type of irrigation and if the index value is less the concentration is low. The above stated index has direct relationship with the present research work. To show the development of irrigation location quotient index has been used.

## 6. Objectives

The main objectives of the present study are:

1) To study the physical and non - physical determinants of agriculture in Telangana.
2) To analyse the spatio - temporal patterns of irrigation in terms of:
   - Sources of irrigation
   - Crop wise area under irrigation
   - Intensity of irrigation
3) To examine the spatial variations and temporal changes in:
   - Cropping pattern
   - Intensity of cropping

**Research Questions**

In the light of above stated objectives, the following research questions have been framed for their answers with the help of data analysis:

1) How has the physical and non - physical factors affected the development of irrigation and cropping pattern?
2) What are the different sources of irrigation which lead the development of agriculture as well as intensity of irrigation?
3) Does development of irrigation plays a role in changing of cropping pattern and intensity of cropping?

**Hypotheses**

The study has proposed to examine the following hypotheses during the course of this research plan:

1) Provision of irrigation has led to the substitution of less profitable crops like jowar, bajra, maize and barley by more lucrative crops like wheat, rice and oilseeds.
2) Development of irrigational facilities has helped in change in the cropping intensity.

**Locale, Time Period and Scope of the Study**

The main focus of this study is on analyzing irrigation development and cropping pattern. It also tries to examine the pattern between crop wise irrigated area and intensity of cropping in Telangana, Medak district, paapannapet mandal. Telangana is a state in India situated on the south - central stretch of the Indian peninsula on the high Deccan Plateau. It is the eleventh - largest state and the twelfth - most populated state in India with a geographical area of 112, 077 $km^2$ (43, 273 sq mi) and 35, 193, 978 residents as per 2011 census. On 2 June 2014, the area was separated from the northwestern part of Andhra Pradesh as the newly formed state with Hyderabad as its capital. Its other major cities include Warangal, Nizamabad, Khammam, Karimnagar and Ramagundam. Telangana is bordered by the states of Maharashtra to the north, Chhattisgarh to the northeast, Karnataka to the west, and Andhra Pradesh to the east and south. The terrain of Telangana region consists mostly of hills, mountain ranges, and thick dense forests covering an area of 27, 292 $km^2$ (10, 538 sq mi). As of 2019, the state of Telangana is divided into 33 districts.

Medak was originally known as “Methukudurgam” which subsequently changed into Methukur due to growth of fine and coarse variety of rice in this area. It is one of the thirty three districts of Telangana Region a geographical area of 9, 699 km2. It forms a part of Deccan Plateau under Godavari basin and lies between North Latitudes 170 27’ and 180 18’ and East longitudes 770 28’ and 790 10’ falling in topographical sheet nos.56 F, G, J and K of Survey of India. The district is divided into 46 revenue mandals, with its Headquarters at Sangareddy. The district has a population of 3031877 (as per 2011 census). The population density is 313 persons per sq. km. The forest cover is 91, 390 hectares and the net area sown is 4, 80, 841 ha.

Though the Manjira River is a perennial river, a major project Singoor which is dedicated to drinking water supply. There are no major irrigation projects in the District. An area of 9325 ha is being irrigated by surface water sources and an area of 1, 45, 452 ha is being irrigated by ground water, which indicates that ground water plays a major roles when compared to surface water. The various crops raised are rice, jowar, bajra, sugarcane, black gram, red gram, Bengal gram, cotton, groundnut. Borewell irrigation is increased to 55% whereas canal irrigation is decreased to 25% as well as 117% decreased in tanks irrigation.

The findings of the study have provided micro level detailed information which is further being helpful for the policy makers and planners for taking right decisions regarding irrigation development projects.

## 7. Data Sources and Methodology

The methodology of this study is in consonance with the proposed objectives. Mandal has been taken as unit of study. The data has been taken from both secondary as well as primary sources.

- The data of area under source - wise irrigation and area under crop - wise irrigation has been collected from District Statistical Abstract published from Department of Economic and Statistical Analysis, Telangana.
- The data related to total cropped area and net sown area has been collected from Economics of Farming in Telangana issued by Economic and Statistical Organization, Planning Department, Telangana.
- The secondary data concerning gross cropped area and area under various crops has been collected from the revenue records available at the various Mandals and district headquarters.
- Secondary data from different sources like Census of Telangana, Survey of India, Department of Irrigation, Revenue Department, Department of Agriculture etc. has been used for the preparation of thematic maps.
- The primary data has been generated through the field survey regarding net sown area, net irrigated area, sources of irrigation, crop wise irrigation and cropping pattern. The information has been collected with the interview schedules through household survey.
- In order to achieve the objectives and test the hypotheses various statistical techniques like mean and average, correlation and scatter diagram has been used with the help of computer by using SPSS package to draw inferences of the study. For compilation, tabulation, mapping and analysis of data various cartographic and statistical tools and technique such as Location Quotient has been used.
- For this research work the data of two trienniums have been analyzed. Two trienniums data i. e.1980 - 83 and 2010 - 13 has been taken for revealing the spatio - temporal patterns of irrigation and cropping pattern.
- The Green Revolution had covered most of the parts of the state by 1980 - 83.2010 - 13, refers to the period for knowing the present situation of irrigation and cropping pattern.
- Generally speaking, whenever a new Mandal is created, no attempt is made to generate data series for the new Mandals for the earlier period. Therefore, in order to study the changes in the level and growth, one has either to generate necessary data for the newly created Mandals for the earlier years or merge the newly created Mandals with their original constituent Mandal (Bhalla and Singh, 2001). It was not possible to generate data for earlier years and it was also very difficult to merge the newly created Mandals because the new Mandals were created by taking areas from two or more than two Mandals. Therefore, in present study, the changing patterns have been shown through separate triennium maps of 2013 - 2014 and 2016 - 21.
- Intensity of irrigation is the ratio of net irrigated area to net sown area expressed in terms of percentage. High score of the index means high level of irrigation development and vice - versa. It refers to the number of watering on the same field during an agricultural year. It

is one of the very important indicators of level of agricultural development.

- Intensity of cropping is the ratio of total cropped area to net sown area expressed in terms of percentage. It is an indicator of land use efficiency. The higher the index of the intensity of cropping, the higher the land use efficiency and lower the index, the lower the land use efficiency. It refers to the number of crops grown on the same field during an agricultural year. It is also one of the very important indicators of level of agricultural development of an area.

## 8. Sample Design

The state of Telangana exhibits a considerable diversity in terms of relief characteristics, climate and edaphic conditions. To assure the regional representation, a three tier sample design has been adopted. Stratified random sampling method has been used to select the villages for primary survey. The state has been divided into four agro - ecological regions (Kumar, 2000). Secondly, four Mandals in total, one from each agro - ecological region has been selected randomly on the basis of random number table. Finally, one village has been selected randomly from the selected Mandal from each agro - ecological region. These villages have been termed as the sample villages of the concerned agro - ecological region.

**Organization of the Study**

The chapter scheme of the study is as under:

**Chapter - I. Introduction**
It covers statement of problem, review of literature, theoretical framework, objectives, hypotheses, research methodology, and locale and time period of the study, sample design and organization of chapter scheme.

**Chapter - II. Physical and Non - Physical Determinants**
This chapter will dealt with the pattern of physical and nonphysical factors such as relief, drainage, rainfall, soils, and groundwater resources, HYV of food grains, consumption of chemical fertilizers, pesticides, tractorization, pumping sets, cultivators and agricultural labourers in Telangana.

**Chapter - III. Development of Irrigation in Telangana**
This chapter will studied the irrigation facilities, sources of irrigation, crop - wise area under irrigation and irrigation intensity in Telangana.

**Chapter- IV. Impact of Irrigation on Cropping Pattern**
This chapter will examine the cropping pattern and intensity of cropping in Telangana.

**Chapter– V. Conclusion and discussion**
This chapter is devoted to primary study. Four villages have selected for primary survey. Summary of Conclusions It presents the concluding remarks and will try to sum up the research work.

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