AGRO-CLIMATIC ANALYSIS FOR IRRIGATION WATER MANAGEMENT OF ANDHRA PRADESH

A DISSERTATION

Submitted in partial fulfillment of the requirements for the award of the degree of

MASTER OF TECHNOLOGY

in

IRRIGATION WATER MANAGEMENT

By

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CANDIDATE'S DECLARATION

I hereby certify that the work which is being presented in the thesis entitled **"AGRO-CLIMATIC ANALYSIS FOR IRRIGATION WATER MANAGEMENT OF ANDHRA PRADESH"** in partial fulfilment of the requirements for the award of the Degree of **Master of Technology** in **Irrigation Water Management** and submitted in the Department of Water Resources Development and Management (WRDM) Indian Institute of Technology Roorkee is an authentic record of my own work carried out during a period from 15th September 2011 to 15th June 2012, under the supervision of Dr.S.K.Tripathi, Professor, WRDM, Indian Institute of Technology, Roorkee.

The matter presented in the thesis has not been submitted by me for the award of any other degree of this or any other Institute.

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Place: Roorkee **(G VIJAYA KUMAR)**

Date: 15-06-2012.

This is to certify that the above statement made by the candidate is correct to the best of my (our) knowledge.

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DEDICATION

This work is dedicated to Poor Farmers in Andhra Pradesh and my family especially, my uncle G Sreenivasulu and Lord Balaji Their love and Blessings, encouragement and support has kept me going for my entire life.

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ABSTRACT

Agro-climatic characterization of AP for dry land Cultivation was performed using Rainfall and Potential Evapotraspiration indices in a GIS environment. Based on the total quantity and distribution of rainfall, irrigation, soil types and cropping patterns the state of AP is broadly divided into 22 agro-climatic zones. Using the criteria of Moisture Adequacy Index (MAI), AP in general is classified as moderately moisture deficit semi arid state. Moisture Adequacy Index (MAI) as suggested by Hargreaves (1971) using Precipitation and Potential Evapo Transpiration (PET) was used to delineate the climatic variability over AP. Weather data from the new LocClim of FAO was used to develop the Moisture Adequacy Index for States of AP. Contours were plotted on the map of AP using ArcGIS software.

The contours thus developed indicated that most of the stations were falling under the class/category of moderately deficit moisture (0.34 – 0.67). Pockets of high variability in the districts of Vizainagaram, west Godavari, Nizamabad, Srikakulam and Adilabad were observed. Sites of the pockets of very high MAI variability were identified through Google Earth and found that they were rich in water bodies and vegetation. Thus the pockets of intense MAI variability could be attributable to the presence of water bodies like minor irrigation tanks and reservoirs (small and large) in the context of AP.The small irrigation tanks frequently distributed in the district affected the variability pattern in Moisture Adequacy Index of a given location. The AP in general classified as semi arid tropic zone. In order to make available the water to different sectors viz. agriculture, drinking, industry etc a large number of major and minor reservoirs are constructed.

Since the staple food of people in AP is rice, whenever and wherever farmers get irrigation water opt for cultivation of rice. The spread of rice field in the state is also viewed as affecting the microclimatic condition in the state. Identification of this micro level variability is difficult to see with routine data being collected in different observatories. agro climatic zones classified for different crops in different (Kharif and Rabi) seasons were classified based on crop productivity of AP.

Keywords: Agro-climatic zoning, Climate, Precipitation, GIS, Evaptransiration, Moisture Adequacy Index (MAI), Crop Productivity, crop suitability Agro-Climatic Zoning.

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LIST OF SYMBOLS AND ABBREVIATIONS

AA	Arithmetic Averaging
Alt	Altitude
ACE	Atmosphere, Climate and Environment
CDF	Cumulative Distribution Function
DD	Degree days
ELEV	Elevation
FAO	Food and Agricultural Organization of United Nations
GDD	Growing Degree days
GI	Government of India
GIS	Geographic Information System
LAI	Leaf Area Index
Lat	Latitude
Lon	Longitude
MAE	Mean Absolute Error
MR	Multiple Regression
NR	Normal Ratio Method
O	Observed Value
P	Precipitation
PET	Potential Evapotraspiration
MAI	Moisture Availability Index
PAR	Photo synthetically Active Radiation
RRSU	Regional Remote Sensing Unit
SST	Sea Surface Temperatures
?	Probability value that denotes the significance level
ICRISAT	International Crops Research Institute for the Semi Arid Tropics
IMD	Indian Meteorological Department

CHAPTER 1

INTRODUCTION

The agricultural productivity of a geographic area is dependent on many factors including inherent soil and terrain characteristics and climatic constraints (Liu and Samal, 2002) and these factors are interdependent and constantly evolving in time and space. Agro climatic suitability studies of an area can help the farming community in making sound decisions on the crop selection for different localities. This research will focus on rainfall and Potential Evapotraspiration to identify suitable areas for the maize crop production in AP.

Limitations in water resources, climate variability together with the increase in population motivate one to choose a useful land-use to optimize the use of the available natural resources (Antonie, 1996). Sustainable management of land resources requires sound policies and planning based on knowledge of these resources, the demands of the use to which the resources are put, and the interactions between land and land-use (Antonie, 1996). In order to achieve all this, climatic investigations are necessary (Yazdanpanah *et al.*, 2001).

Climate is vital for the selection of correct crops for a given locality or site, the more detailed the knowledge, the more intelligently the land use can be planned on macro and on-farm scales according to Schulze *et al.* (1997). Climate largely determines which crops can be grown, where they are best grown, when they should be grown and the potential yields that may be expected (De Jager and Schulze, 1977).

To improve food security around the State of AP, it is of great importance to delineate the country into different zones according to the climatic requirements of a given crop in order that everyone (agronomist, agro meteorologists, extension workers, farmers, researchers etc) has a common goal of planting crops capable of succeeding in different areas of the country. For Andhra Pradesh it is impossible to increase financial returns by expanding cropped area as there is little available virgin land. Thus improvement can be attained by improving productivity of the available arable land by cultivation of crops with high potential in specific areas (Jayamaha, 1977). Therefore there is an urgent need for a comprehensive detailed study of the agro-climatologically characteristics of the country and the agro-climatic zoning for Rice as a staple food must be completed.

Zoning divides the area into smaller units based on distribution of soil, land surface and climate. The level of detail to which a zone is defined depends on the scale of the study, available data and sometimes on the power of the data processing facilities (Antoine, 1996).

Agro-climatologically zoning is defined as a division of a certain area into several zones, according to the degree of favourability for growing a given crop using climate factors (Todorov, 1981). As known, there was little or no trade of agricultural produce since people planted only for their own consumption. Gradually people began to realize that it was better for a farmer to grow agricultural crops for which suitable climatic conditions exist, and to exchange the excess of his produce with farmers from neighbouring areas with different climate. Thus, gradually certain zoning of agricultural crops has come into being Todorov (1981).The agro-climatologically zoning of a crop passes through three main stages which are (1) Studies of the agro-climatologically requirements of the crop, (2) Studies of the existing agro-climatologically conditions in the area and (3) Studies of the extent of satisfaction of the crop's requirements (Yazdanpanah et al., 2001).

1.1 Need of the work

The prominence of any sector is gauged by its contribution to the State or National economy. The income from agriculture sector of the state is only a little over 1/3 of the state's GSDP providing livelihood to about 70% of the population. This means that there is every need to focus our attention, well being and high quality of life for the people from the incomes generated in this sector. The important rational planning for effective land use to promote efficient is well recognized. The ever increasing need for food to support growing population in the country demand a systematic appraisal of our soil and climatic resources to recast effective land use plan. Since the soils and climatic conditions of a region largely determine the cropping pattern and crop yields. Reliable information on agro ecological regions homogeneity in soil site conditions is the basic to maximize agricultural production on sustainable basis.

1.2 Study area

Andhra Pradesh is the fourth largest state in India, accounting for 8.4 per cent of the country's geographical area. The state of Andhra Pradesh is situated on the globe in the tropical region between $12^0 14'$ and $19^0 54'$ North latitudes and $76^0 46'$ and $84^0 50'$ East

longitudes. It is bounded on the North by Maharashtra, on the North-East by Orissa and Madhya Pradesh, on the East by Bay of Bengal, on the South by Tamilnadu and on the West by Karnataka States. The state has a long coastal line extending over 960 km from Ichapuram sands in Srikakulam district to Pulicat Lake in Nellore district. Andhra Pradesh is the fourth largest state in India in terms of geographical area and 5th largest state by population comprising of 23 districts 1,105 revenue mandals, 29,994 villages spreading over 2,76,814 sq.km.The climate of Andhra Pradesh is very much governed by its geographical location and Thereby its position in relation to the general circulation of the atmosphere, Topographical Features influence the climate in many ways; winds are deflected and lifted by orographic Features thus affecting rainfall, temperature and the moisture content of air masses. The average annual rainfall varies from area to area from as low as 500mm in the District of Anantapur to as high as 1400 mm in a few localities in the Vizainagaram district and eastern border. The state has a tropical climate with moderate diffusion to subtropical weather. Humid to semi-humid conditions prevail in the coastal area while arid to semiarid situations pronounce in the interior parts of the state, particularly Rayalaseema and some districts of Telangana. The areas covered by Deccan Plateau are characterized by hot summers with relatively pleasant winters.Most of the rainfall comes in the seven- month period from June to September and rainfall Peaks from July to September when most of the country record over 100mm per Month.

1.2.1 General

The state has a tropical climate with moderate diffusion to subtropical weather. Humid to semi-humid conditions prevail in the coastal area while arid to semiarid situations pronounce in the interior parts of the state, particularly Rayalaseema and some districts of Telangana. The areas covered by Deccan Plateau are characterized by hot summers with relatively pleasant winters.

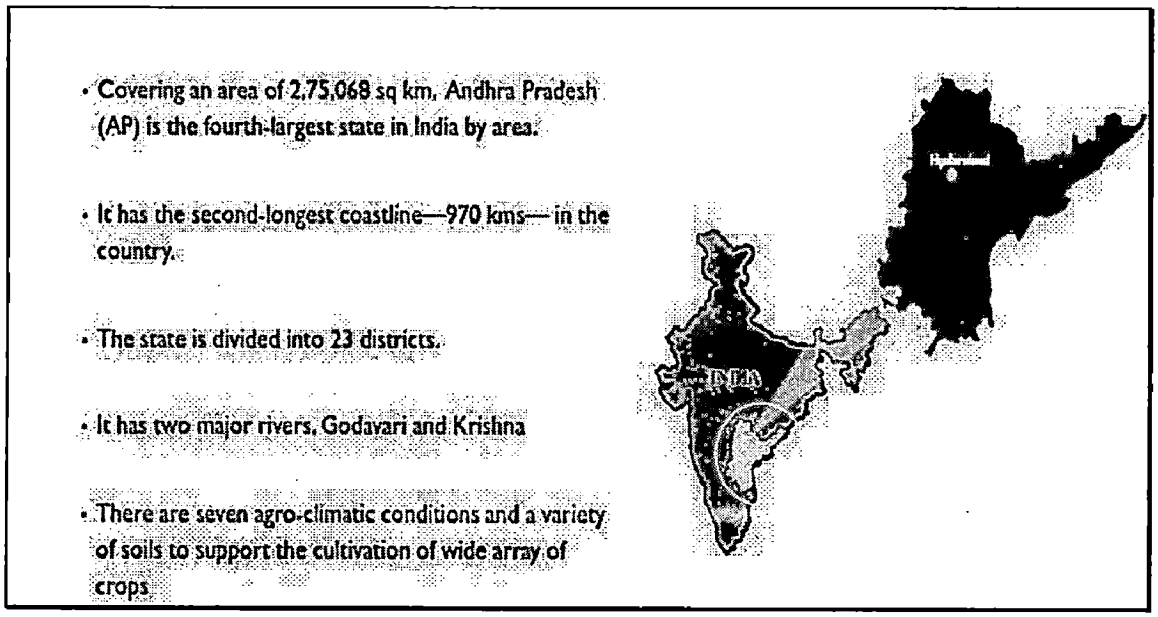
1.3 Physiography

Based on the topography the state can be divided into three major physiographic regions.

1.3.1 Coastal plains

A coastal plain corresponding to 0-150 meters covers almost entire coastal Andhra with some of the best agricultural land of the state. This area falls between two major river deltas,

Krishna and Godavari and is largely composed of riverine and coastal alluvial soils and in some places red loams.



1.3.2. Eastern Ghats

The Ghats (600 meters and above) consist of a series of broken hills and ridges covering about 13 per cent of the land area. These ghats are divided into two sections viz. northern and southern ridges by a delta of about 120- 140 km width in the middle.

1.3.3. Peninsular plateau

The plateau also known as Deccan plateau, corresponds to 150-600 meters covers almost the entire Rayalaseema and most parts of the Telangana regions with more than half the cultivated area of the state.The general terrain has a surface of red sandy soil with numerous hills and seasonal streams and tanks. The plateau slopes from the interior towards the east from elevation of less than one kilometre.

1.3.4 Climate

Andhra presents a transition from tropical to sub-tropi- cal India.The coastal belt is humid to sub-humid while the rest of the state is semi arid to arid. The annual rainfall of the state varies from 500 mm in south western A.P. to 1400 mm in north eastern areas with an average of 890mm. Nearly 70 per cent of the total rainfall is received during south west monsoon, 20% during north-east monsoon and the rest during the non monsoon period. During the monsoon, depressions in the Bay of Bengal lash the coast with cyclonic rains and gusty winds.

1.3.5 Land Utilization:

The word "Land" is used in agricultural relativity, with reference to the cropped or cultivated land. It is a precious resource provided by the nature to the state.

Table 1.1: Land Utilisation in Andhra Pradesh 2009-2010 (Area in lakh hect).

S.No	Item	Coastal Andhra	Rayalaseema Region	Telangana Region	Andhra Pradesh Total
1	Total Geographical area	9253	6710	11477	27440
2	Forests	1983	1471	2745	6199
3	Barren & Uncultivable land	813	675	621	2109
4	Land put to non Agricultural use	1154	570	772	2496
5	Cultivable Waste	300	271	203	774
6	Permanent Pastures and other grazing lands	257	81	348	686
7	Land under Misc. Tree crops	121	48	72	241
8	Other fallow Lands	310	375	843	1528
9	Current fallow	336	429	1568	2333
10	Net area sown	3883	2790	4305	10978
11	Area sown more than once	1486	291	870	2647
12	Total cropped area	5369	3081	5175	13625

1.3.6 LAND USE STATISTICS

The total Geographical area of the State is 275.04 lakhs hectares. It has been classified into Nine Categories of Land Use during 2009-2010 and presented in the table- 1.2.

Table 1.2: Land Utilisation in Andhra Pradesh 2008-2010 (Area in lakh hect).

S.No.	LAND UTILISATION IN ANDHRA PRADESH 2009-2010				
	CATEGORY	2009-2010		2009-2008	
		Area (ha)	%	Area (ha)	%
1	Forest	62	23	62.1	23
2	Barren & uncultivable land	20	7.4	20.6	7.5
3	Land put to non-agri.uses	27	9.7	26.5	9.6
4	Culturable waste	6.5	2.3	6.5	2.4
5	Per. Pastures & other grazing lands	5.7	2.1	5.69	2.1
6	Tree crops,groves,not included in net area	3	1.1	2.98	1
7	Other fallow lands	16	5.9	14.9	5.4
8	Current fallow lands	34	12	26.2	9.6
9	Net area sown(including fish culture)	101	37	110	40
10	Total geographical area	275	100	275	100
11	Gross area sown	126	46	138	50
12	Area sown more than once	26	9.3	29.6	11
	Net area sown under:i)crops 99.92 lakhs hect.ii)fish ponds 0.93 lakhs hect				

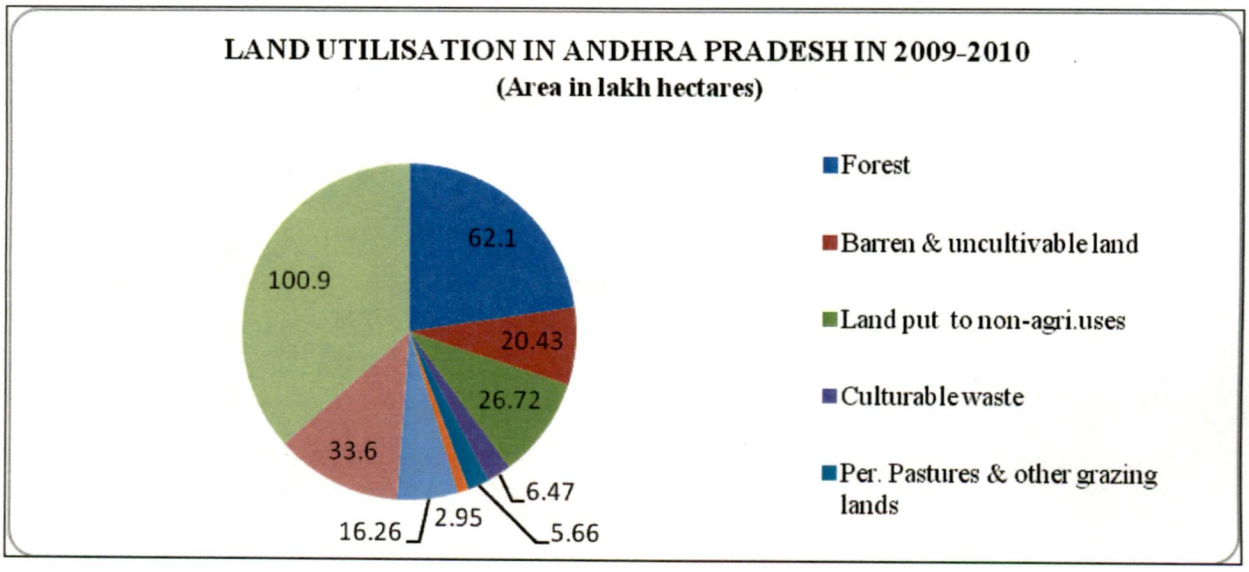
The total Geographical area of 275.04 lakhs hectares, the Areable land i.e. the cultivable land (i.e. Net Area Sown, Current fallow and Other fallow lands) was 150.71 lakhs hectares and it accounts for 54.8 percent of the total Geographical area of the state and land available for cultivation but not cultivated (i.e. colourable waste, permanent pasture and other grazing lands and Miscellaneous tree crops and groves not included in Net area sown) was 15.08 lakhs hectares and it account for 5.5 percent and land not available for cultivation (forests, Barren and uncultivable land and land put to non-agriculture uses) was 109.25 lakhs hectares and it accounted for 39.7 percent during 2009-2010. The Classification of Geographical area in Andhra Pradesh by districts 2009-2010 are given in detailed table-II.

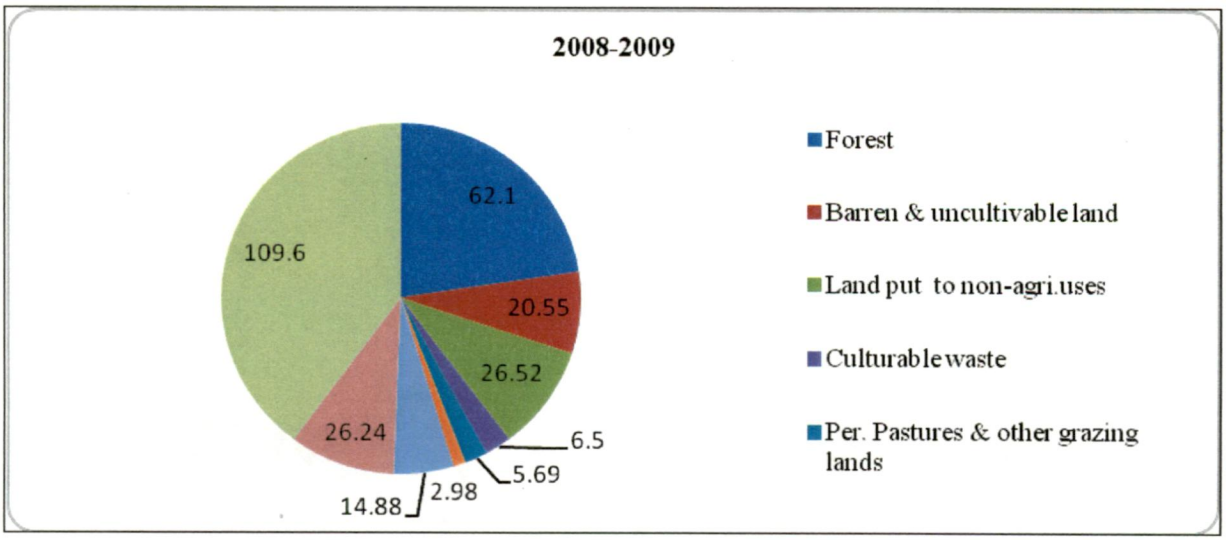
1.4 Distribution of Land Use:

1.4.1 Forests

Area under forests, includes all lands classified as forests under any legal enactment dealing with forests or administered as forests, whether state owned or private and whether weeded or maintained as potential forest land. The area of crop raised in the forest and grazing lands or area open for grazing within the forests should remain included under the forest area. The Forest area of the State during 2009-2010 is 62.10 lakhs hectares accounting for 22.6 percent of the total Geographical area in the State. Visakhapatnam, East Godavari, Prakasam, Chittoor, Kadapa, Kurnool, Adilabad, Warangal and Khammam districts have proportionally

Fig.1.1: Land use pattern category-wise during (2008-2010) is shown in Andhra Pradesh.





More area under forests and these districts together accounted to nearly 69.6 percent of the total forest area in the State during 2009-2010. The percentage of area under forests to total geographical area in each district during 2009-2010 is shown in map.

1.4.2 Land Put to Non - Agricultural Uses:

This stands for all lands occupied by buildings, roads, and railways or under water i.e. rivers, canals and other land put to uses other than agriculture. The area under this classification is 26.72 lakhs hectares accounting for 9.7 percent of the total Geographical area in the State during 2009-2010 as against 26.52 lakhs hectares in 2008-2009, recording a marginal increase of 0.7 percent.

1.4.3 Barren and Uncultivable Land:

This covers all barren and uncultivable land like mountains, deserts, etc., Land which cannot be brought under cultivation unless at a high cost shall be classified as uncultivable, whether such land is in isolated blocks or within 14 cultivated holdings. An extent of 20.43 lakhs hectares of land comes under Barren and uncultivable land which represents 7.4 percent of the total Geographical area in the State during 2009-2010.

1.4.4 Permanent Pastures and Other Grazing Lands:

This covers all grazing lands, whether they are permanent pastures and meadows or not. Village common grazing lands under the head common grazing lands shall be included under this head.

An extent of 5.66 lakhs hectares of land comes under permanent pastures and other grazing lands which accounts for 2.1 percent of the Geographical area in the State, during 2009-2010.

1.4.5 Miscellaneous Tree Crops and Groves not included in the Net Area Sown:

Under this class is included all cultivable land which is not included under net area sown but is put to some agricultural use. Lands under casuarinas trees, thatching grass, bamboo bushes and other groves for fuel etc. which are not included under orchards shall be included under this category. An extent under this category was 2.95 lakhs hectares or 1.1 percent of the Geographical area in the State during 2009-2010.

1.4.6 Culturable Waste:

These include all lands available for cultivation whether not taken up for cultivation or taken up for cultivation once but not cultivated during the current year and last five years or more in succession for one reason or other classified as culturable waste. It formed 2.3 percent of the total Geographical area in the state during 2009-2010. The area under culturable waste in 2009-2010 was 6.47 lakhs hectares as against 6.50 lakhs hectares in 2008-2009, showing marginal decline of 0.5 percent.

1.4.7 Other Fallow Lands:

This implies all lands, which were taken up for cultivation but are temporarily out of cultivation for a period not less than a year and not more than five years.An extent of 16.26 lakhs hectares which is 5.9 percent of the total Geographical area was recorded under this category.The area under other fallow lands was 16.26 lakhs hectares during 2009-2010 as against 14.88 lakhs hectares in 2008-2009. There was an increase of 9.3 percent.

1.4.8 Current Fallows:

This class comprises cropped areas, which are kept fallow during the current year. If any, seeding area is not cropped in the current year, it may be treated as current fallow. The area under current fallow during 2009-2010 was 33.60 lakhs hectares as against 26.24 lakhs hectares in 2008-2009 showing a increase of 28.0 percent.

1.4.9 Net Area Sown

Net Area sown represents total area sown with the crops and orchards counting area sown more than once in the same year only once.

The Net Area sown during 2009-2010 was 100.85 lakhs hectares or 36.7 percent of total Geographical area.This includes an area of 0.93 lakhs hectares under Fish ponds. The Net Area sown during 2009-2010 is 100.85 lakhs hectares as against 109.58 lakhs hectares showing a decrease 8.0 percent. The percentage of net area sown to geographical area by districts during 2009-2010 is shown in map 1.1

1.4.10 Gross Area Sown

Gross Area Sown represents total area cultivated under all food and non-food crops, including the Area sown more than once during the agricultural year. The gross area sown or Gross cropped area during 2009-2010 is 125.61 lakhs hectares as against 138.30 lakhs hectares in 2008-2009, recording a decrease of 9.2 percent, due to unfavourable seasonal conditions in 2009-2010.

1.4.11 Area Sown More Than Once

Area on which crops are cultivated more than once during the agricultural year.2009-2010 was 25.69 lakhs hectares as against 29.62 lakhs hectares in 2008-2009 showing, a decrease 13.3 percent. The area had sown more than once constituted 25.47 Percent of net area sown in the state.

1.4.12 Cropping Intensity

Cropping intensity is one of the indices for assessing the efficiency of agriculture sectors. The cropping intensity is the ratio of gross area sown to Net area sown. It was 1.26 in 2009-2010 and 1.27 in 2008-2009. The cropping intensity is highest in Nizamabad Dist (1.63) and it was followed by East Godavari (1.57), West Godavari (1.56), Krishna (1.56) and Karimnagar (1.43).

1.5 Rainfall:

The rainfall of Andhra Pradesh is influenced by both the South-West and North-West and North-East mansoons. The normal annual rainfall of the state is 925 mm. Major portion (68.5%) of the rainfall is contributed by South-West mansoon (June-Sept) followed by North-East mansoon (Oct.-Dec. 22.3%). The rest (9.2%) of the rainfall is received during the winter and summer months. The rainfall distribution in the three regions of the state of the state differs with the season and monsoon.

The influence of south west monsoon is predominant in Telangana region (764.5 mm) followed by Coastal Andhra (602.26 mm) and Rayalaseema (378.5 mm.Whereas the the North-East monsoon provides a high amount of rainfall (316.8 mm) to Coastal Andhra area followed by Rayalaseema (224.3) and Telangana (97.1 mm). There are no significant differences in the distribution of rainfall during the winter and hot weather periods among the three regions. The following Table gives a detailed picture of the rainfall distribution (monsoon wise and region wise) during 1997-98.

Table 1.3: Rainfall pattern of Andhra Pradesh.

Monsoon	Coastal Andhra	Rayalaseema	Telangana	Andhra Pradesh
S.W Monsoon	**(June to Sept)**			
Actual	601.7	368.2	506.1	519.5
Normal	602.6	378.5	764.5	634.0
N.E Monsoon	**(October to December)**			
Actual	299.8	245.8	166.3	232.4
Normal	316.8	224.3	97.1	206.0
Winter Period	**(January to February)**			
Actual	35.1	0.0	11.5	18.7
Normal	20.4	12.2	10.8	13.0
Hot Weather				
Actual	71.1	77	44	60.3
Normal	94.7	79	56	72
Total Rainfall	**(June to May)**			
Actual	1008	691	728	831
Normal	1034	694	928	925
Source: BES, AP				

1.5.1 Rainfall and seasonal conditions

The seasonal conditions during the year 2009-10 on the whole were Normal. During the South -West monsoon period, the State received deficient rainfall of 27 percent against normal. However, in North-East season Rainfall was deficient by 17 percent. Deficit rainfall was witnessed during the South-West and North-East period. As such, 19 percent deficit rainfall was received in the year when compared to the normal. During the year 2009-10 an average rainfall of 760 mm was recorded as against the normal of 940 mm.

The Gross area sown in the State during 2009-2010 is 125.61 lakhs hectares as against 138.30 lakhs hectares in 2008-2009, recording, and a decrease of 9.2 percent.The Net area sown in the State also a decreased to 100.85 lakhs hectares (include 0.93 lakhs hectares under fish

ponds) in 2009-2010 as against 109.58 lakhs hectares (include 0.90 lakhs hectares under fish ponds) in 2008- 2009, thereby showing, a decrease of 8.0 percent.

Table 1.4:Rainfall pattern during 2009-2010 in Andhra Pradesh.

S.NO	SEASON	NORMAL	2009-10	%DEV.OVER NORMAL	STATUS
1	South West Monsoon (June to September)	624	454	-27	Deficient
2	North-East Monsoon (October to December)	224	185	-17	Normal
3	Winter Period (January to February)	14	15	7	Normal
4	Hot Weather period (March to May)	78	106	37	Excess
	GRAND TOTAL	**940**	**760**	-19	Normal

The Total Production of Food Grains in the State was estimated at 155.99 lakhs tonnes in 2009-2010 as against 204.21 lakhs tonnes in 2008-2009, showing a decrease of 23.6 percent. The un-favourable seasonal conditions and insufficient rainfall prevailing in the State are largely responsible for decrease in production of food grains.

1.5 Monsoon Wise Rainfall:

Pre-Monsoon Rainfall

During the month of May 2009, the state received an average rainfall of 38.3 mm. as against the normal rainfall of 52 mm, deficit being 26 percent. During this month the rainfall was excess in Krishna, Ananthapur and Kurnool districts and Normal in Guntur, Prakasam, Kadapa, Nizamabad, Karimnagar and Khammam districts and Deficient in11 districts and Scanty in 3Districts.

South West Monsoon 2009(June to September) :

The Southwest monsoon arrived close to southern Andhra Pradesh on 26-05-2009. The South west monsoon further advanced into Rayalaseema and South coastal Andhra Pradesh on 1st June 2009. During the month of June'09 the state received an average rainfall of 64.6 mm. as against the normal rainfall of 108.4mm, deficit being 40 percent. During the month of July'09, the state received an average rainfall of 85.8mm as against the normal rainfall of 188.7mm.Deficit being 55 percent. During the month of July due to non receipt of rains the standing dry cops were almost dried up throughout the State.

During the month of August'09, the state has received an average rainfall of 151.0mm as against the normal rainfall of 184.4mm, deficit being 18 percent. During the month of September 2009, the state has received an average rainfall of 152.7mm. As against the normal rainfall of 142.6mm, excess being 7 percent.

During the **South West Monsoon 2009** the State has received an Average rainfall of 454 mm as against the normal rainfall of 624 mm, deficit Being 27 percent. The rainfall was deficient in East Godavari, West Godavari, Krishna, Guntur, Prakasam, Medak, Nizamabad, Adilabad, Karimnagar, Warangal, Khammam and Nalgonda districts. And the rain fall was normal in the remaining districts of the State.

North East Monsoon 2009 (October to December):

The South West monsoon has withdrawn from Andhra Pradesh on 23- 10-2009. Simultaneously North East monsoon rains have commenced Costal Andhra and Rayalaseema. During the month of October'09 the state received an average rainfall of 79 mm. as against the normal rainfall of 138 mm, deficit being 43 percent.

During the month of November'09, the state received an average rainfall of 95 mm as against the normal rainfall of 69 mm. excess being 37 percent. During the month of December'09 the state received an average rainfall of 11 mm.As against the normal rainfall of 17 mm, deficit being 32 percent.During the **North East monsoon 2009**, the average rainfall received was 185 mm. as against the normal rainfall of 224 mm, deficit being 17 percent. The rainfall was Excess in Kurnool and Mahabubnagar. The rainfall was normal in Vizainagaram, Nellore, Ananthapur, Rangareddy, Karimnagar, and Warangal. Khammam and Nalgonda district, deficit rainfall was recorded in the remaining districts of the state.

Winter Period 2010 (Jan & Feb):

During the winter period 2010 the average rainfall received was 15 mm, as against normal rainfall of 14 mm, excess being 7 percent.

Hot Weather Period 2010(Mar to May):

During the Hot weather period 2010 the average rainfall received was 106 mm, as against normal rainfall of 78 mm, excess being 37 percent.

Annual Rainfall 2009-2010 (June 09 to May 10):

During the year 2009-10 the average rainfall received was 760 mm, as against normal rainfall of 940 mm; deficit being 19 percent. Excess rainfall was received in Mahabubnagar District. Deficient rainfall was received in East Godavari, West Godavari, Medak, Nizamabad, Adilabad, Karimnagar, and Warangal. Khammam and Nalgonda districts and the rainfall were normal in the remaining districts of the State.

1.6 Soils:

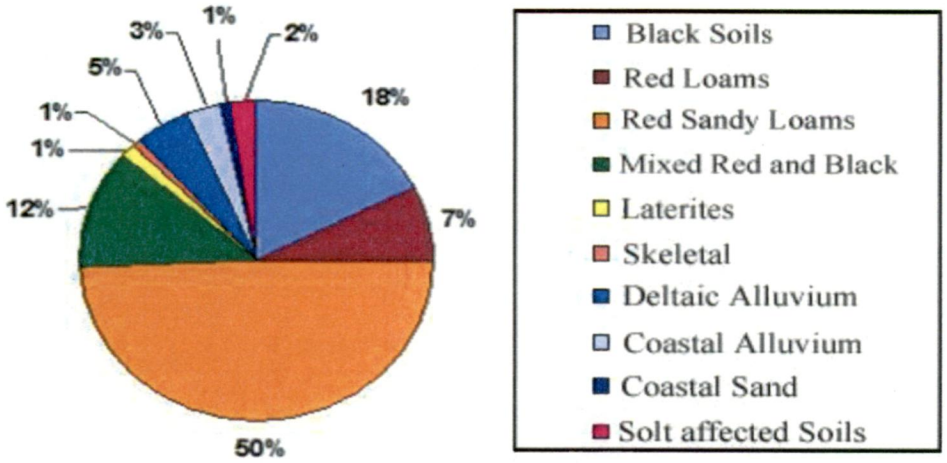
Andhra Pradesh is endowed with a variety of soils ranging from poor coastal sands to highly fertile deltaic alluviums. Red soils occupy over 66% of the cultivated area and are mostly situated in Rayalaseema districts. These soils have a low nutrient status. Red earths which are commonly termed as Red soils can be sub-classified as (a) Dubba soils (loamy sands to sandy loams) (b) Chalkas (Sandy loam soils) (c) Sandy clay loams (d) Loams including silty soils (e) Deep loamy sands and (f) Sandy loams with clay sub-soil.

Chalkas occur mostly in the Telangana districts while red loams combined with sands are present in the upland regions of coastal districts. Black soils cover nearly 25% of the cultivated area and are generally associated with poor drainage. They are also called as Regurs or Vertisols and are of two types. The first category in-situ soils while the other one is transported soils. While the first category can be noticed in the coastal districts and parts of Telangana and Rayalaseema, the second category occurs in the valley regions of the slopes with calcareous concentrations.

The in-situ soils are generally heavy in texture and high in salt concentration. The alluvial loamy clay soils found in Krishna and Godavari deltas cover 5% of the cultivated area. The coastal sands occupy only 3% while the remaining 1% is covered by late rite soils in certain packets of the state.

Soil health plays a vital role to ensure Agricultural production in a sustainable manner. In Andhra Pradesh, soil sampling and soil programme organized in a systematic manner to evaluate the fertility status and to identify the soil problems (salinity/sodicity) if any to improve fertility and to reclaim the problematic soils.

Fig 1.2: Distribution of soils in Andhra Pradesh.



1.8 Objectives:

It is now patently clear that for deriving the maximum yield from agriculture (including horticulture) and silviculture, one must have a proper knowledge of agro climatic conditions without which the most effective cropping pattern and development of supplemental irrigation necessary for different zones cannot be planned.

This research is concerned with the spatial interpolation of meteorological data as a preliminary step prior to use in the climatic zoning as layers in a GIS. To fully complete the process of the zoning, different indices have to be developed depending on the requirements of the crop (Joerin *et al.*, 2001). For each of the indices a coverage layer should be prepared using interpolation techniques in a GIS environment. In the second stage, coverage layers are overlayed to obtaining an agro-climatic map of an area. The final agro-climatic suitability map will be reclassed to highly favourable, favourable, weak and not suitable area (Yazdanpanah *et al.,* 2001).

The main goal of this research is to delineate the suitable areas for the crops within a GIS context, using climate indices. Although the crops has certain requirements for all meteorological elements, precipitation (P) and Potential Evapotraspiration (PET) are of greatest importance and therefore the study will concentrate on them.

CHAPTER 2

REVIEW OF LITERATURE

2.1 Climate

Climate is the composite of all the many varied, day-to-day weather conditions in a Region over a considerable time (Buckle, 1996; UKMET, undated). This time period should ideally be long enough to establish relevant statistical information necessary to describe the variations in a region's weather (Buckle, 1996; Schulze et al., 1997). Kendrew (1949) as quoted by Schulze et al. (1997) described climate as more than average weather for it includes the dynamic and intricate variations occurring diurnally, daily, monthly, seasonally and annually and also includes evaluations of extreme events and the variability about the mean. According to Holden and Brereton (2004), climate also includes concepts of probabilities of occurrence of specific events (e.g. frosts, specific winds etc).

Climate is determined by three key factors: the amount of energy the climatic system receives from the sun; the way in which this energy is distributed throughout the system and the degree of interaction between the various components of the system (Buckle, 1996). Climate of a place on earth is controlled first by the region's location with respect to the major pressure belts and prevailing wind systems of the general global circulation.

The general global circulation is mostly responsible for the distribution of the main climatic belts. The hot and dry climate in the subtropics Corresponds to the descending limbs of the Hadley circulation (Schulze, 1965; Buckle, 1996). The second influence on a region's climate is the modifications to the general circulation that results from conditions at the surface. This include it's position relative to the distribution of land and sea and the height of the location above sea level, vegetation cover, the general nature of the surface (soil type, water, snow, ice) and orientation relative to hills or mountains (Schulze, 1965; Buckle, 1996).

The worldwide system of winds, which transports energy, moisture, momentum and mass, is called the general circulation of the atmosphere, and it gives rise to the Earth's climate zones (ACE, undated; Buckle, 1996). For example, warm air from the equator where solar heating is greatest moves towards the higher latitudes, without such latitudinal redistribution of heat, the equator would be much hotter than it is whilst the poles would be much colder.

The general circulation of air is broken up into a number of cells, the most common of which is called the Hadley cell (Fig 2.1). Solar radiation is strongest nearer the equator. Air heated there rises and spreads out north and south. After cooling the air sinks back to the Earth's surface within the sub-tropical climate zone between latitudes 25° and 40° (ACE, undated; Buckle, 1996; Hyden, 1996). Located at the descending limb are Sub-tropical High Pressure Belts that dictate surface wind patterns and also influence rainfall and temperature regimes on the continent. Consequently, many of the world's desert climates can be found in the sub-tropical climate zone. Surface air from sub-tropical regions returns towards the equator to replace the rising air, so completing the cycle of air circulation within the Hadley cell (ACE, undated).

The Sub-tropical High Pressure Systems on both sides of the Equator generate two wind systems that converge on the equator in a zone termed Inter-Tropical Convergence Zone (ITCZ). ITCZ is an area of low atmospheric pressure, which is generally marked by a band of cumulonimbus clouds over the ocean, formed by the rapid upward convection of ITCZ moist air (Hyden, 1996).The ITCZ shifts with the seasonal movement of the sun across the tropics, In June, in the southern hemisphere winter season, the ITCZ is located few degrees north of the equator while in December: southern hemisphere summer season, the ITCZ is located south of the equator. ITCZ affects the distribution of rainfall and climatic zones (Hobbs et al., 1998; Hyden, 1996).

2.2 Climate and crops:

Knowledge of climatology is an invaluable aid in the agricultural development and Planning of a region and climate and weather are key factors in agricultural production (De Jager and Schulze, 1977; Jones and Thornton, 2000). In some cases, it has been stated that as much as 80% of the variability of agricultural production is due to the variability in weather conditions, especially for rain fed production systems (Hoogenboom, 2000).

Climate is one of the most important limiting factors for agricultural production, frost risk during the growing period and low and irregular precipitation with high risks of drought during the growing period, are common problems in agriculture (Moonen et al., 2002). The critical agro meteorological variables associated with agricultural production are precipitation, air temperature and solar radiation (Hoogenboom, 2000).

Because of the influence of temperature, precipitation, frost-free days, and growing degree-days on crop growth, long-term data on climatic variables are needed to predict which crops might be suitable (Young et al., 2000). For example, they influence what crops can be grown in a region, the annual variation in crop and pasture Production and the amount of water available for livestock. Interrelations between Climatic factors and crop characteristics are an important part of agro-climatological zoning.

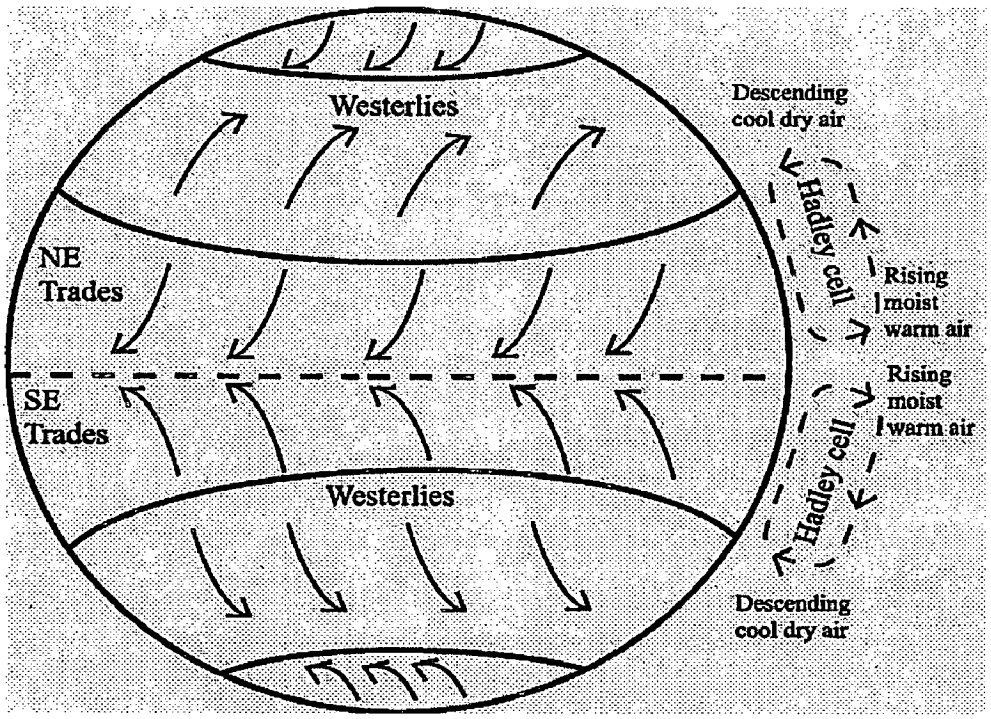


Fig 2.1: Hadley cells and the global wind systems showing the movement of air around the globe, (Source: California State Institute).

By relating and comparing the agro-climatological requirements of the crop with the existing agro-climatic conditions in an area, one can find the extent to which the requirements are satisfied during the different phases of the crop's development (Todorov, 1981). Solar radiation provides the energy for the processes that drive photosynthesis, affecting carbohydrate partitioning and biomass growth of the individual plant components (Hoogenboom, 2000). FAO (1978) states that, photosynthesis produces the source of assimilates which plants use for growth. Furthermore, plants have an obligatory developmental pattern in time (and space) which must be met if the photosynthetic tic

assimilates are to be converted into economically useful yields of satisfactory quantity and quality.

This developmental sequence of crop growth in relation to the calendar (i.e. crop phenology) is influenced by climatic factors. Duration of solar radiation is one of the important environment factors for maize growth and development, for the individual leaves as well as the entire canopy (Hatfield, 1977). Some crops are very sensitive to the length of day. Short-day plants would flower only when exposed to short periods of radiation while long–day plants flower only when exposed to long periods of light without interruption. Some plants are day neutral; that is, flowering is not regulated by photoperiod. Photoperiodism also explains why some plant species can be grown only at certain latitudes (Gardner et al., 1985).

In general, temperature determines the rate of growth and development; but in some Crops temperature may also determine whether a particular developmental process will Begin or not (e.g. chilling requirement for initiating flower buds in Pyrethrum), the time when it will begin, subsequent rate of development and the time when the process stops (FAO, 1978).It is not temperature alone that is sufficient but precipitation must also be taken into account since the magnitude and seasonal variation of either or both can limit the growth and development of crops (ICRISAT, 1980).

The temperature regime is a key Factor in maize adaptation and the use of the accumulated heat units (growing degree days) is of great importance (Crane et al., 1977). In the equatorial and tropical regions (FAO, 1978) where temperatures are high and uniform throughout the year, soil water Availability is the sole determining factor, while in the higher latitudes where water use is low due to low temperatures, the actual temperature may limit the growing season for Crops.

In the tropics and equatorial regions, Evapotraspiration is high and thus more water is lost to the atmosphere while at the higher latitudes there is less evaporation, but in the regions within the sub-tropical high pressure zone soil water availability coupled with temperatures determines the success of the crops. Most methods of accumulating temperature in the form of day-degree are based on air temperature, but during the early Stages of growth when the apical meristem is below or close to the soil surface, it is the temperature of the soil which is more important and differences of 1°C at 5cm depth can Induce large changes in the early

stages of the growth of crops (Milbourn and Carr, 1977).Precipitation does not directly control any of the plant processes. It is considered to be a Modifier that indirectly affects many of the plant growth and developmental processes.in the agro-climatological evaluation of rainfall, the most important considerations are the stability of agricultural water resources, the water requirements of agricultural plants and the identification and prediction of various agriculturally significant rainfall characteristics (Green, 1966). Drought occurs during periods of insufficient rainfall, while water-logging occurs during periods of extensive rainfall (Hoogenboom, 2000).

Drought can cause an increase or decrease in developmental rates, depending on the stage of development. In many cases, the response to drought stress is also a function of Species or cultivar, as some species or cultivars are more drought-tolerant than others. Drought can also reduce gross carbon assimilation through stomata closure, causing a Modification of biomass partitioning to the different plant components (Hoogenboom, 2000).

Water-logging stress is caused by flooding or intense rainfall events causing a lack of oxygen in the rooting zone, which is required for root growth and respiration? A Decrease in oxygen content in the soil can result in a decrease in root activities, causing increase in root senescence and root death rates. The overall effect of water- logging is a Reduction in water uptake; the ultimate impact is similar to the drought stress effects (Lauer, 1998; Hoogenboom, 2000).

Other weather factors that can affect crop production include soil temperature, wind, and Relative humidity or dew point temperature. In many regions, soil temperature is important during the early part of the growing season, as it affects planting and germination.For winter crops, such as winter wheat, the soil temperature can also affect vernalization (Hoogenboom, 2000). Relative humidity, dew point temperature or vapour pressure deficit are similar agro meteorological factors, that express the amount of moisture present in the air. They affect transpiration and the amount of water lost by the canopy, causing drought stress under water-limited conditions. At harvest or maturity, both air and dew point temperature affect the dry down time of the harvestable product.

Wind can also have multiple impacts on crop production. First of all, it can affect the rate of transpirational water loss by the leaves. In addition, it can affect the transport and the

distribution of insects and diseases in the atmosphere, and subsequent presence in the plant canopy.Extreme wind can also affect the potential for lodging, especially for tall crops (Hoogenboom, 2000). Microclimates influence crop growth and development (Bishnoi, 1989). For example, winds delay flower fertilization, slow down growth and causes frosty conditions. According to Bishnoi (1989), winds are also a strong factor in the spread of insects and diseases like rust and aphids. Microclimatic conditions may further generate specific Problems due to topographic, physical and physiographic conditions of the region making it necessary to further delineate into areas with specific problems for agro climatic exploitation.

2.3 Agro-climatological Descriptions:

2.3.1 Growing season

The growing season is the period of time each year during which perennial crops such as Pastures and forages and annual crops on the whole can grow (GA, 2003). The growing Season is different for different species. It depends on water, temperature and radiation Conditions (Hakanson and Boulion, 2001). White et al. (2001) described the length of the Growing period as the time available when water and temperature permit plant growth, based on estimates of available soil water.

The growing season is not necessarily the frost- free period, but for a particular plant which has the lower threshold of 0°C its growing season corresponds to frost- free period. It is important to determine the growing Season of an area or station so as to investigate whether it can match the optimum growing period of a particular crop. Caldiz et al. (2001) used the temperature constraints for the identification of the potential growing seasons and length of growing period for Potatoes in North India.

The growing season or period is sometimes referred to as the rainy season. When rainfall is the main constraint for agricultural production, the rainy season can be considered as the growing season. The rainy season's start and its duration have been previously investigated for agricultural, botanical, and ecological purposes:To define the effective time to plant, to estimate the growing season's length, germination and seedling emergence (Benoit, 1977). When using rainfall to define the growing season, a long dry spell after the start of the rains causes a "false start" (Veenendaal *et al.*1996).

2.3.2 Frost

The greatest agricultural risk in connection with low temperatures is frost, which can Cause severe destruction of fruit, vegetables and crops. The sensitivity of a crop to low Temperatures depends on many factors; including the severity of the temperature drop and length of time the cold persists. Plant species differ greatly in their susceptibility to Chilling injury (Teitel *et al.*, 1996).Normally, two types of frost situations can be distinguished, radiation and advective frost. Advection frost occurs during situations where cold air intrudes into an area.

This results in the lowest temperatures at the elevated sites. Radiation frost on the other hand, occurs on clear nights when a large amount of heat is radiated towards the sky, and its occurrence is generally patchy (Lindkvist et al., 2000; Teitel et al., 1996). The damage due to radiation frost differs from that due to advection frost mainly in its degree. Usually, plants that would be killed by advection frost are usually only partially damaged by radiation frost (Critchfield, 1966).Prevention of crop damage due to radiation frost is more feasible than advection frost.

During radiation frost, only a thin layer of air immediately above the ground is cooled while the overlaying layers are warmer (Rosenberg et al., 1983; Oke, 1987). One way of estimating the local frost risk for a specific location is by accumulating the Number of occurrence with temperatures below 0°C. Calculations of frost sum and coldness sum (cold units) below a certain threshold value are commonly used methods for quantifying the frost risk at different areas (Lindkvist et al., 2000).

The frost-free Period is the number of days between the last date of 0°C in the spring and the first date of 0°C in autumn. It provides a measure of the period during which plant growth can occur uninterrupted by frost, and it provides a way to compare growing conditions. The first frost date is the date when the air temperature drops to 0°C. Although the screen temperature is used to estimate frost dates, the difference between the air temperature at Screen level and at crop level does not generally create large discrepancies in determining the frost- free period for most crops. Actual frost damage depends on the temperature, Crop type and crop condition (GA, 2003).

2.3.3 Dry spells

Semi-arid regions (including Lesotho) are characterised by dry weather spells. Occasionally these reach exceptional proportions which seriously disadvantage farming activities and require special agricultural planning strategies and management decisions (De Jager et al., 1998). Although the definition of a dry spell may vary, depending on the aims and methodology used in each study, it generally refers to number of days without appreciable precipitation.A crucial aspect in this is the definition of a significant rainfall threshold in the typification of a dry day. Lazaro et al. (2001) employed a threshold of 1 mm, since rainfall less than this amount is usually evaporated off the surface.

2.3.4 Wet spells

The length of a wet spell is defined as the consecutive number of days with a significant Rainfall. The minimum length of a wet spell is taken as one day (Herath and Ratnayake, 2004). Sharma (1996) defined a wet day as a day with rainfall of more than zero and the Probability of occurrence of a wet day depends on the climatic system of a place or Region. Wet spells are an inherent property of climate, and depending upon their durations and the rainfall associated with the m, they can have distinct advantages as well as disadvantages (Mwangala, 2003).For instance, in agriculture, wet spells of relatively Short duration, typically not exceeding 3 days with light to moderate rainfall, can be very conducive to crop growth. However, if the spells are long, crop damage can easily occur as a result of water-logging in the soil or even flooding (Mwangala, 2003).

2.3.5 Water stress

Soil water stress will occur if there is not a balance between the atmospheric demands for Water and supply of water available in the soil (Shaw, 1977). Soil water availability is determined by the interaction of four factors: (1) amount of water present in the soil, (2) Characteristics of the soil profile, (3) Water requirements of the crop (4) Demand for Water by the atmosphere (Shaw and Newman, 1991; Hoogenboom, 2000). Atmospheric Demand is a function of the energy available (solar radiation), movement of water away from the evaporating surface (wind), dryness of the air (humidity), and air temperature or Sensible heat level (Shaw and Newman, 1991).

7/6/12

IIT Roorkee

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Thanking you sir

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LIST OF PUBLICATIONS:

1. **Mfwango, L.H.,** Tripathi, S.K., Pranuthi, G., Dubey, S.K. and Kumar, G.V. (2012).Simulation of Agronomic practices for Southern Highlands of Tanzania using DSSAT CERES-Maize model. Tanzania Journal of Science. (Communicated).

2. Tripathi, S.K., Pranuthi, G., Dubey, S.K., Kumar, G.V. and **Mfwango, L.H.,** (2012). Effect of Climate Variability on Irrigation Management in North West India. Paper accepted for presentation in the International Conference Sustainable Irrigation 2012 to be held from Dec. 11-13, 2012 at Adelaide, Australia.

For crop water to be adequate, the available soil water must be more than sufficient to meet the atmospheric evaporative demand. On windy, hot, sunny days with low humidity, for instance, evaporation demand on a crop is high; and thus, a high amount of available soil water must be present if the Crop is to avoid stress. Under cloudy skies, high humidity and cooler temperatures, on the other hand, atmospheric evaporative demand will be lower. Less water is needed to meet the demand, thus, plants can survive with lower amounts of available soil water (Shaw and Newman, 1991).

2.3.6 Growing degree days/Heat units

A degree day is the difference between the average temperature for a day and some base Temperature. Growing degree days (GDD) are used to match crop requirements for heat to the amount of heat available. The base temperature for calculating growing degree Days are the minimum threshold temperature at which plant growth starts (GA, 2003). Temperatures those are cooler than normal result in slower rate of development. If the Average daily temperature is below the base temperature, the growing degree day value equals zero. Negative values are not calculated because the crop is not set back by a temperature lower than the base temperature.

The calculation of growing degree days Assumes that plant growth is related directly to temperature when there are no other limitations. The growing degree days is calculated from the minimum and maximum Temperatures. The following formula is used for obtaining growing degree days for crops. (McMaster and Wilhelm, 1997):-

$$GDD = \frac{T_{max} + T_{min}}{2} - T_{base}$$

Where, TMAX and TMIN are daily maximum temperatures and minimum temperatures respectively. TBASE = 50°C (for Rice) is the base threshold temperature.

Table 2.1: Temperature requirements of crops (T_{base} for selected crops).

Crop	Base Temperature
Corn, sweet corn, sorghum. Rice, soybeans and tomato	50 °F
Cotton	60 °F
Peanuts	56 °F
Potato and sunflower	45 °F
Wheat , barley, rye, oats, flaxseed, lettuce and asparagus	40 °F

GDD are calculated by taking the average of the daily maximum and minimum temperatures compared to a base temperature, T_{base}, (usually 10 °C). As equation:

$$GDD = \frac{T_{max} + T_{min}}{2} - T_{base}.$$

GDDs are typically measured from the winter low. Any temperature below T_{base} is set to T_{base} before calculating the average. Likewise, the maximum temperature is usually capped at 30 °C because most plants and insects do not grow any faster above that temperature.However, some warm temperate and tropical plants do have significant requirements for days above 30 °C to mature fruit or seeds.

2.5 Geographic Information System (GIS):

Geographic Information Systems (GIS) is a discipline devoted to the acquisition, storage, Management, analysis, and visualization of spatial data in a computer environment (Longley et al., 2001). But according to Hall (2004), GIS is "a collection of information technology, data and procedures for collecting, storing, manipulating, analyzing, and presenting maps and descriptive information about features that can be represented on maps." The unique features that distinguish GIS from other types of information systems as (1) data of entities and relationships are managed within a spatial framework and (2) ability to perform spatial analyses (Hall, 2004).

2.5.1 Spatial interpolation

GIS applications often require spatio-temporal interpolation of an input data set. Spatiotemporal interpolation requires the estimation of the unknown values at unsampled Location-time pairs with a satisfying level of accuracy.

Using measured temperature or rainfall at the stations one could then use the spatio-temporal interpolation to estimate these parameters at unsampled locations and times (Longley et al., 2001; Li and Revesz, 2003). In many fields, spatial interpolation is used to evaluate physical data in a continuous domain (Chapman and Thorns, 2002; Taylor et al., 2004). It is most commonly applied as a precursor to isoline or contour mapping, the drawing of lines of equal value for generation of a realistic surface between observation points (Taylor et al., 2004).

A wide range of automated procedures have been developed, differing in their assumptions, local or global perspective and deterministic or stochastic nature (Collins and Bolstad, 1996; Taylor et. al., 2004).Spatial interpolation uses one principle, Tobler's law which states "all places are related but nearby places are more related than distant Places" (Dubois, 1997; Longley et al., 2001).There are a variety of interpolation methods which can generate continuous surfaces starting from irregularly distributed data, but the difficulty lies in the choice of the one that best reproduces the actual surface. each method has its own advantages and drawbacks, which depend strongly on the Characteristics of the set of point data: a method that fits well with some data can be Unsuited for a different set of data points, or if measured in different locations of the same surface (Collins and Bolstad, 1996; Caruso, 1997; Taylor et al., 2004).

The spatial interpolation of temperature and precipitation climate data is increasingly important in the development of agricultural, hydrological, and ecological models. Spatially explicit modelling of ecosystem structure, for example, requires estimates of climate variables at unsampled locations, usually on a regularly spaced grid (Skirvin *et al.*, 2003).

In addition to those involved in temperature modelling, temperature prediction at unsampled sites is of interest to individuals involved in fire management, resource management, and spraying or seeding operations.High resolution estimates of spatial variability in rainfall fields are important in solving problems for hydrologic analysis and designs especially for the identification of locally intense storms which could lead to floods or flash floods (Goovaerts, 2000).

According to Skirvin et al. (2003) in the Mountainous regions precipitation and temperature are strongly influenced by elevation through orographic effects and lapse rate; thus a digital elevation model (DEM) can supply both an independent variable for climate interpolation and a convenient regularly spaced grid.

Many researchers have evaluated various methods for interpolation of point climate data. In several studies, geostatistical methods have been rated superior over techniques such as Thiessen polygons, inverse distance weighting, least-squares polynomial regression, and spline surface fitting (Collins and Bolstad, 1996; Skirvin et al., 2003).

The choice of spatial interpolator is especially important in mountainous regions where data collections are sparse and variables may change over short spatial scales (Collins and Bolstad, 1996).One of the problems facing meteorologists and hydrologists studying spatial rainfall Patterns is the interpolation of data from irregularly spaced rain gauges in order to Determine mean areal rainfalls or to characterise rainfall variability within a region or catchment (Dirks et al., 1998).

Rainfall is intermittent and spatially discontinuous, frequently with zero accumulations; for this reason the reliable spatial interpolation of rainfall is inherently more difficult than for many other variables. Over short integration times, interpolation may be impossible so spatial interpolation of data has potential Problems that need to be taken into consideration when dealing with this type of data (Dirks et al., 1998).

There are two main groupings of interpolation techniques: deterministic and geostatistical. Deterministic interpolation techniques create surfaces from measured points, based on either the extent or similarity. Deterministic interpolation techniques can be divided into two groups, global and local. Global techniques calculate predictions using the entire dataset (Johnston *et al.*, 2001). Geostatistical interpolation techniques utilize the statistical and mathematical methods properties of the measured points.

Because geostatistics is based on statistics, these techniques produce not only prediction surfaces but also error or uncertainty surfaces, giving you an indication of accuracy of the predictions (Johnston et al., 2001).

CHAPTER 3

MATERIALS AND METHODS

3.1 Introduction

Our country has been blessed with abundant natural resources like sunlight, monsoonal rains, potential soils, perennial rivers for taking up systematic crop production. Andhra Pradesh is one of the ideal states blessed with all these natural resources for cultivation of a range of crops. The climatic conditions of a region affect the agricultural cropping pattern and different areas, thus, produce different crops. Amongst a host of climatic factors, rainfall, temperature, humidity, wind velocity and duration of sunshine etc. affect the cropping pattern in a significant way. Annual rainfall and its distribution over the entire year, and the regimes of diurnal and annual temperatures are, by far, the prominent factors affecting agriculture and the life style of the people. On the basis of climatic conditions and agricultural produce, Andhra Pradesh has been divided into nine agro-climatic zones, each one having special characteristics of its own.

3.2 Materials:

I have collected Andhra Pradesh (23 Districts) of Weather data from the new LocClim of FAO was used to develop the Moisture Adequacy Index of Andhra Pradesh Weather Parameters:

- Temperatures (T)
- Precipitation (P)
- Potential Evapo Transpiration (PET)
- Water Vapour Pressure (WVP)
- Wind Speed (WS)
- Sunshine(S)
- Climatic Net Primary Production Potential (NPP)

Water resources information collected from irrigation department government of Andhra Pradesh.

Major irrigation projects

Medium irrigation projects

Minor irrigation projects

Fig.3.1: New-LocClim Local climate weather data Estimator.

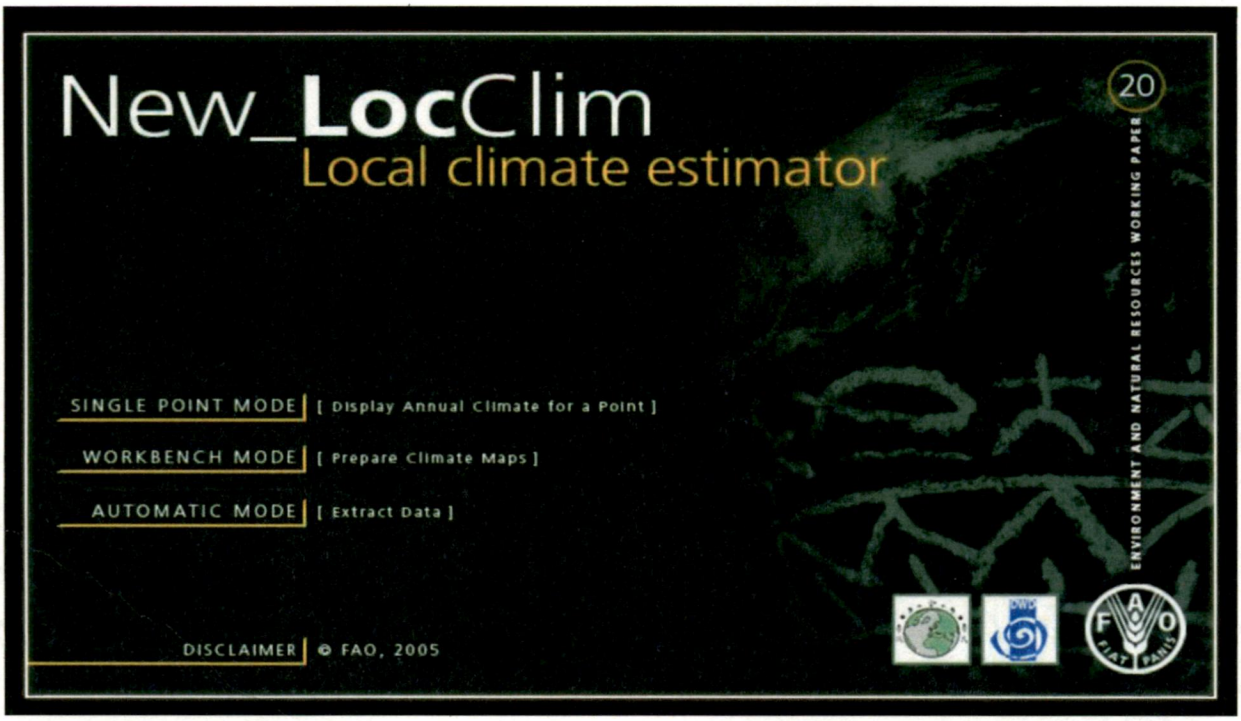


Fig.3.2: Harmonized World Soil Database (HWSD) viewer.

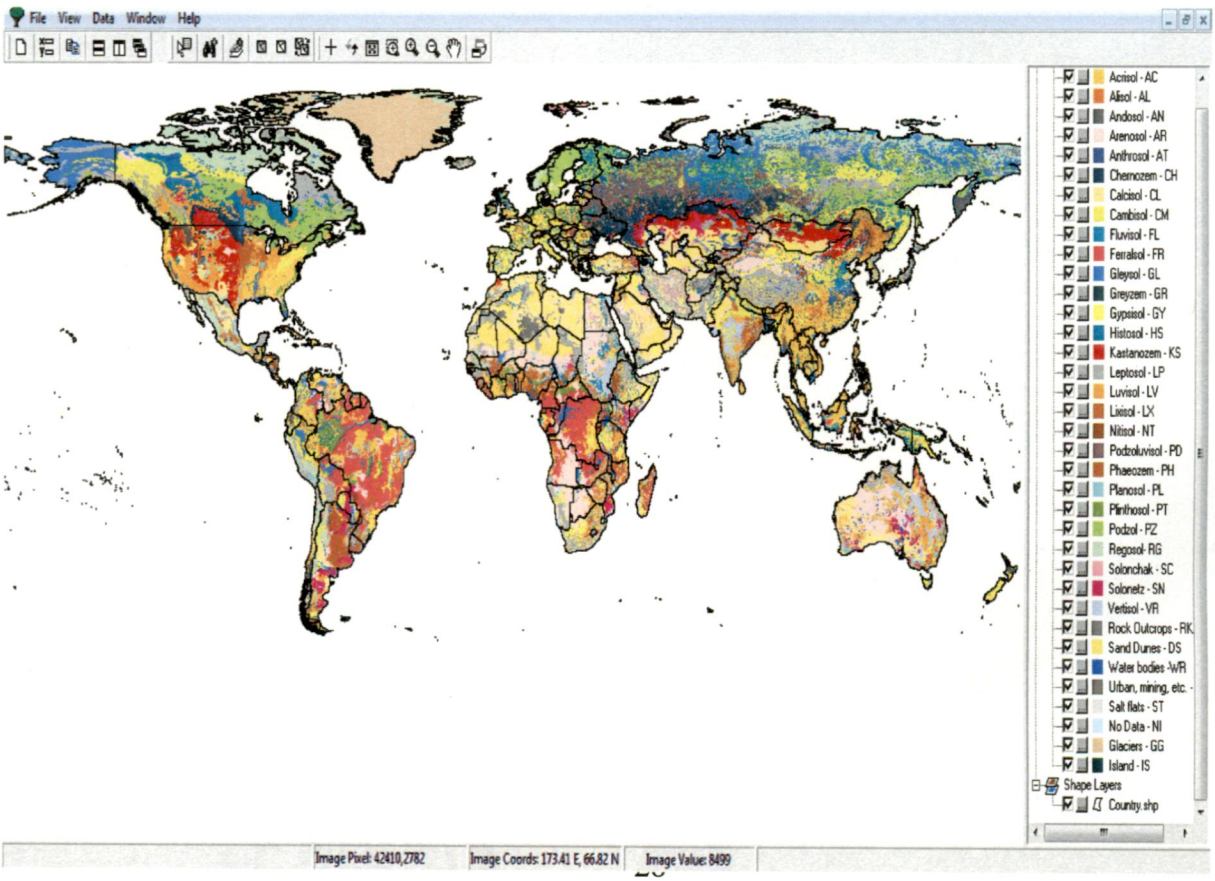
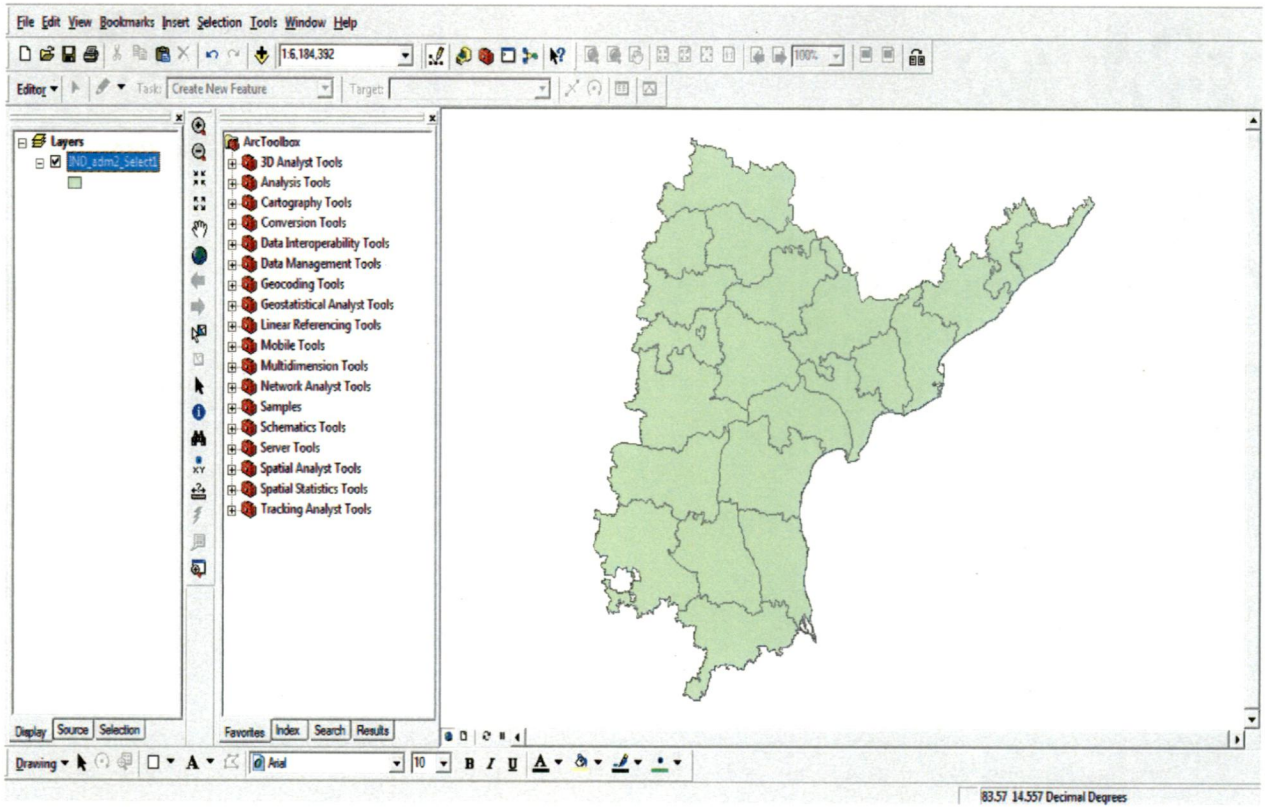


Fig.3.3: Arc-Gis Software map creator.



3.3 Zoning Definition:

Zoning divides the area into smaller units based on distribution of soil land surface and climate. Climate classification based on two approaches 1).Genetic approach 2). Generic approach o empirical approach, in the genetic approach classification is based on the controls such as general circulation, net radiation, and moisture fluxes .in the generic approach classification is based on the observed climatic elements or their effect on the phenomena. Usually vegetation or mankind because the controls of climate are far more difficult to measure than the climatic elements all the climatic classification schemes have therefore adopted the empirical approach.

3.4 Methods:

Koppen (1900), De Martonne (1928), Emberger (1955) Majundar (1964), demarcated climate types on the basis of empirical relationship between Rainfall and Temperature, Stenz (1946), Thornthwaite (1948), Troll (1965), Hargreave's (1971) introduced the rainfall and potential Evapotraspiration concept for delineating climate.

However, Koppen and thornthwaite classifications are universally accepted for delineating agro-climatic zones, but troll and Hargreaves climate classifications are mostly used to define Agro-Climate zones respectively.

There are some Indices used for moisture adequacy index's (MAI) are:

De Martonne Index	(P /T+10)
Thornthwaite & Mather's	((P-PET/PET))*100
Hargreaves	(P/PET)
Precipitation Factor	(PET-P)

3.5 Methodology:

Moisture Adequacy Index (MAI) as suggested by Hargreaves (1971) using Rainfall and Potential Evapo Transpiration (PET) was used to delineate the climatic variability over Andhra Pradesh. Weather data from the new LocClim of FAO was used to develop the Moisture Adequacy Index for 175 stations of Andhra Pradesh. Contours were plotted on the map of Andhra Pradesh using ArcGIS software.

The contours thus developed indicated that most of the stations were falling under the class/category of moderately deficit moisture (0.34 – 0.67). Pockets of high variability in the districts of Vizainagaram, west Godavari, Nizamabad, Srikakulam and Adilabad were observed. Sites of the pockets of very high MAI variability were identified through Google Earth and found that they were rich in water bodies and vegetation. Thus the pockets of intense MAI variability could be attributable to the presence of water bodies like minor irrigation tanks and reservoirs (small and large) in the context of Andhra Pradesh. The small irrigation tanks frequently distributed in the district affected the variability pattern in Moisture Adequacy Index of a given location.

3.5.1 Hargreave's Classification

Hargreave's (1971) introduced the rainfall and potential Evapotraspiration concept for delineating climate. He proposed a classification of climates on the basis of the degree of moisture adequacy. He used monthly probabilistic rainfall value at 75 % probability level (dependable rainfall) instead of normal rainfall and defined the moisture availability index (MAI) as:

$$MAI = \left(\frac{P}{PET}\right)$$

Where,

P = Annual precipitation in mm/year

PET = Annual evaptransiration in mm/year

The climatic classification adopted by Hargreaves is given in the following table:

S.No	MAI	CATEGORY
1	0.00 - 0.33	Very deficit (VD)
2	0.34 – 0.67	Moderately deficit (MD)
3	0.68 - 1.00	Somewhat deficit (SD)
4	1.00 - 1.33	Adequate (Ade)
5	>1.34	Excessive moisture (Exe)

The main objective of the study is to examine the moisture adequacy index in Andhra Pradesh; for this purpose data on precipitation & potential evaptransiration from the New LocClim of FAO were downloaded to calculate the Moisture Adequacy Index (MAI) for 175 stations of Andhra Pradesh. Hargreaves (1971) suggested:

MAI contours at 0.01 intervals were plotted over Andhra Pradesh using ArcGIS software. District wise water spread area of reservoirs and tanks as reported by FAO (1995) was used to calculate the percent area covered by reservoirs and tanks. The state of Andhra Pradesh has 23 districts. The mean MAI of the districts were calculated and value used for plotting the geopolitical boundaries.District wise record of water bodies and their distribution pattern was plotted on AP map using ArcGIS. Central Water Commission's National Register on Large Dams (2009) was collected to use ArcGIS for calculation of density of reservoirs & tanks as well as plot the same in different district.

3.5.2 Results

MAI calculated for different stations were falling under the moderately deficit class (0.34 - 0.67) with very less or negligible deviation (Tab.1). The highest MAI value was observed for the station Salur (1.07), located in Vizainagaram district and lowest MAI (0.29) was observed for the stations Tadipatri and Dharmavaram located in Anantapur district. District wise MAI was highest for the district of Vizainagaram (0.92) and least for Anantapur (0.34) district.

The highest rainfall was recorded as 1667.2 mm for the stations Bobbili and Salur located in Vizainagaram district and least rainfall of 533.9 mm was recorded for the stations Guntakal and Rayadurg located in Anantapur district. Rainfall was highest for the Vizainagaram (1438.3 mm) and least for Anantapur (593.8 mm) district.

The PET value was highest (2022.6 mm) for several places of Khammam and Warangal districts and least PET of 1376.4 mm for the station Jagityal located in Karimnagar district. The district wise PET calculated was maximum (2022.6 mm) for Warangal and khammam districts and minimum for Srikakulam (1549.6 mm) district. We estimated that the percentage of reservoir area covered highest in Nizamabad district (13.09%) and least in Krishna district (0.10%).MAI contour maps generated using ArcGIS showed MAI variability at several locations. The map with 0.01 contour intervals (Fig.3.4) generated many pockets of variability at several locations, but maximum variability observed towards Vizainagaram district. (Fig.3.6) by Medium irrigation tanks and reservoirs are plotted on the map.

Conclusion: The study conducted could be summarized with the fact that the water bodies of prominent nature could be easily indentified in the state of Andhra Pradesh by drawing contours of MAI at frequent intervals (0.01) because the state is agro climatically identified as a moderately deficit state.

Table 3.1: Hargreaves agro climatic zones based on (MAI) of Andhra Pradesh.

S.No.	Station	Location		Weather condition			Agroclimatic Class
		Lat (°)	Long (°)	RF (mm)	PET (mm)	MAI	
1	**Addanki**	15.8	79.97	858	1802.7	0.48	MD
2	**Adilabad**	19.67	78.53	1075.2	1682	0.64	MD
3	**Adoni**	15.62	77.27	761.3	1987.9	0.38	MD
4	**Akividu**	16.58	81.38	1178.1	1748.9	0.67	MD
5	**Alwal**	17.49	78.5	815.9	1572.3	0.52	MD
6	**Amadalavalasa**	18.41	83.91	1012.9	1575.3	0.64	MD
7	**Amalapuram**	16.58	82.01	1126.7	1561.6	0.72	SD
8	**Amaravathi**	16.57	80.36	864.8	1899.6	0.46	MD
9	**Anakapalle**	17.69	83.01	980.4	1565.4	0.63	MD
10	**Anantapur**	14.67	77.59	559.5	1750.7	0.32	VD
11	**Asifabad**	19.37	79.29	1339.1	1682	0.8	SD
12	**Atmakur**	14.61	79.63	709	1930.4	0.37	MD
13	**Badepally**	16.76	78.16	904.1	1572.3	0.58	MD
14	**Badrachalam**	17.67	80.89	1040.5	2022.6	0.51	MD

15	**Banaganapalli**	15.31	78.22	709	1930.4	0.37	MD
16	**Bandarulanka**	16.56	81.93	1126.7	1561.6	0.72	SD
17	**Banswada**	18.43	77.85	1098	1676.9	0.65	MD
18	**Bapatla**	15.9	80.47	845.3	1733.6	0.49	MD
19	**Bhattiprolu**	16.09	80.78	1020.1	1733.6	0.59	MD
20	**Bellampalle**	19.07	79.49	1105.1	1682	0.66	MD
21	**Betamcherla**	15.45	78.15	709	1930.4	0.37	MD
22	**Bhainsa**	19.11	77.96	1098	1676.9	0.65	MD
23	**Bhimavaram**	16.55	81.53	1126.7	1748.9	0.64	MD
24	**Bheemunipatnam**	17.89	83.45	980.4	1565.4	0.63	MD
25	**Bhongir**	17.52	78.89	815.9	1572.3	0.52	MD
26	**Bobbili**	18.57	83.35	1667.2	1575.3	1.06	AD
27	**Bodhan**	18.66	77.9	1098	1676.9	0.65	MD
28	**Badvel**	14.77	79.26	810.6	1919.3	0.42	MD
29	**Bugganipalle**	15.47	78.18	709	1930.4	0.37	MD
30	**Challapalle**	16.12	80.96	1020.1	1733.6	0.59	MD
31	**Chandur**	18.57	77.95	1339.1	1682	0.8	SD
32	**Chatakonda**	17.55	80.65	1040.5	2022.6	0.51	MD
33	**Chilakaluripet**	16.09	80.17	845.3	1802.7	0.47	MD
34	**Chirala**	15.82	80.35	845.3	1733.6	0.49	MD
35	**Chittoor**	13.21	79.09	1013.3	1776.7	0.57	MD
36	**Cuddapah**	14.47	78.82	810.6	1919.3	0.42	MD
37	**Devarakonda**	16.69	78.93	781	1802.7	0.43	MD
38	**Dharmavaram**	14.41	77.71	559.5	1919.3	0.29	VD
39	**Dhone**	15.39	77.87	706.6	1930.4	0.37	MD
40	**Eluru**	16.7	81.1	1086.7	1748.9	0.62	MD
41	**Gadwal**	16.23	77.8	761.3	1987.9	0.38	MD
42	**Chatkesar**	17.45	78.68	815.9	1572.3	0.52	MD
43	**Giddalur**	15.23	79.22	709	1919.3	0.37	MD
44	**Gooty**	15.12	77.63	559.5	1750.7	0.32	VD
45	**Gudivada**	16.43	80.99	1086.7	1748.9	0.62	MD
46	**Gudur**	14.15	79.85	1072.4	1763.5	0.61	MD
47	**Guntakal**	15.17	77.37	533.9	1750.7	0.3	VD
48	**Guntur**	16.3	80.43	1050.5	1733.6	0.61	MD
49	**Hindupur**	13.83	77.49	816.3	1623	0.5	MD
50	**Hyderabad**	17.39	78.49	810.1	1572.3	0.52	MD
51	**Ichchapuram**	19.1	84.71	1063	1446.4	0.73	SD
52	**Jaggaiahpet**	16.89	80.1	1040.5	1802.7	0.58	MD
53	**Jagityal**	18.8	78.92	1105.1	1676.9	0.66	MD
54	**Jammalamadugu**	14.84	78.38	810.6	1919.3	0.42	MD
55	**Jangaon**	17.72	79.16	947.9	2022.6	0.47	MD
56	**Kadiri**	14.11	78.16	696.4	1919.3	0.36	MD
57	**Kaghaznagar**	19.36	79.48	1105.1	1682	0.66	MD
58	**Kaikalur**	16.55	81.22	1009.8	1748.9	0.58	MD
59	**Kakinada**	16.95	82.24	1082.1	1561.6	0.69	MD
60	**Kalyandurg**	14.55	77.11	559.5	1750.7	0.32	VD

61	**Kamalapuram**	14.6	78.67	810.6	1919.3	0.42	MD
62	**Kamareddy**	18.32	78.35	1110.3	1676.9	0.66	MD
63	**Kandukur**	15.21	79.91	858	1763.5	0.49	MD
64	**Kanigiri**	15.4	79.51	858	1763.5	0.49	MD
65	**Kankipadu**	16.43	80.77	932.3	1733.6	0.54	MD
66	**Kapra**	17.49	78.58	810.1	1572.3	0.52	MD
67	**Karimnagar**	18.44	79.13	1105.1	2022.6	0.55	MD
68	**Kavali**	14.91	79.99	1072.4	1763.5	0.61	MD
69	**Kondapalle**	16.62	80.53	1050.5	1733.6	0.61	MD
70	**Koratla**	18.81	78.72	1098	1676.9	0.65	MD
71	**Kothagudem**	17.54	80.65	1040.5	2022.6	0.51	MD
72	**Kovurpalle**	14.78	80.02	1072.4	1763.5	0.61	MD
73	**Kovvur**	17.01	81.73	1178.1	1561.6	0.75	SD
74	**Kukatpalle**	17.48	78.42	815.9	1572.3	0.52	MD
75	**Kuppam**	12.75	78.34	910.8	1776.7	0.51	MD
76	**Kurnool**	15.82	78.04	706.6	1930.4	0.37	MD
77	**Kyatampalle**	17.95	79.38	1105.1	2022.6	0.55	MD
78	**Macherla**	16.48	79.44	687.7	1802.7	0.38	MD
79	**Machilipatnam**	16.18	81.13	1020.1	1733.6	0.59	MD
80	**Madanapalle**	13.55	78.5	696.4	1776.7	0.39	MD
81	**Mahabubnagar**	16.38	78.09	904.1	1987.9	0.45	MD
82	**Mancherial**	18.87	79.45	1105.1	2022.6	0.55	MD
83	**Mandamarri**	18.99	79.48	1105.1	2022.6	0.55	MD
84	**Mandapeta**	16.87	81.93	1082.1	1561.6	0.69	MD
85	**Mangalagiri**	16.43	80.57	1050.5	1733.6	0.61	MD
86	**Manugur**	17.94	80.81	1040.5	2022.6	0.51	MD
87	**Markapur**	15.74	79.27	858	1802.7	0.48	MD
88	**Medak**	18.05	78.26	1110.3	1572.3	0.71	SD
89	**Miryalaguda**	16.87	79.57	687.7	1802.7	0.38	MD
90	**Nagari**	13.32	79.59	1048	1776.7	0.59	MD
91	**Nagarkurnool**	16.49	78.31	904.1	1930.4	0.47	MD
92	**Naidupet**	13.91	79.89	942.9	1763.5	0.53	MD
93	**Nalgonda**	17.05	79.27	781	1802.7	0.43	MD
94	**Nandigama**	16.77	80.29	1050.5	1802.7	0.58	MD
95	**Nandikotkur**	15.86	78.27	706.6	1930.4	0.37	MD
96	**Nandyal**	15.48	78.48	709	1930.4	0.37	MD
97	**Narasaraopet**	16.24	80.05	845.3	1802.7	0.47	MD
98	**Narasannapet**	17.73	78.79	1012.9	1575.3	0.64	MD
99	**Narayanavaram**	13.42	79.59	942.9	1776.7	0.53	MD
100	**Narayanpet**	16.74	77.49	904.1	1987.9	0.45	MD
101	**Narsapur**	16.43	81.7	1098	1676.9	0.65	MD
102	**Narsingi**	18.04	78.42	1110.3	1572.3	0.71	SD
103	**Narsipatnam**	17.66	82.62	980.4	1565.4	0.63	MD
104	**Naspur**	18.86	79.5	1105.1	2022.6	0.55	MD
105	**Nellore**	14.46	79.98	1072.4	1763.5	0.61	MD
106	**Nidadavole**	16.92	81.67	1178.1	1561.6	0.75	SD

107	**Nirmal**	19.1	78.34	1098	1676.9	0.65	MD
108	**Nizamabad**	18.67	78.09	1098	1676.9	0.65	MD
109	**Nuzvid**	16.78	80.85	1086.7	1748.9	0.62	MD
110	**Ongole**	15.5	80.05	858	1763.5	0.49	MD
111	**Pakala**	13.45	79.12	942.9	1776.7	0.53	MD
112	**Palacole**	16.52	81.73	1126.7	1561.6	0.72	SD
113	**Palamner**	13.21	78.75	696.4	1776.7	0.39	MD
114	**Palwancha**	18.32	78.44	1040.5	2022.6	0.51	MD
115	**Patancheru**	17.53	78.27	815.9	1572.3	0.52	MD
116	**Pedana**	16.26	81.15	1009.8	1748.9	0.58	MD
117	**Peddapuram**	17.08	82.14	1082.1	1561.6	0.69	MD
118	**Pendurthi**	17.81	83.21	980.4	1565.4	0.63	MD
119	**Penugonda**	16.66	81.75	1126.7	1561.6	0.72	SD
120	**Penukonda**	14.08	77.6	559.5	1623	0.34	MD
121	**Pithapuram**	17.12	82.26	1082.1	1561.6	0.69	MD
122	**Ponnur**	16.07	80.55	845.3	1733.6	0.49	MD
123	**Proddutur**	14.75	78.55	810.6	1919.3	0.42	MD
124	**Pulivendula**	14.42	78.23	810.6	1919.3	0.42	MD
125	**Punganuru**	13.36	78.57	696.4	1776.7	0.39	MD
126	**Puttur**	13.44	79.56	942.9	1776.7	0.53	MD
127	**Quthbullapur**	17.5	78.46	810.1	1572.3	0.52	MD
128	**Rajam**	18.45	83.66	1012.9	1575.3	0.64	MD
129	**Rajampet**	14.2	79.16	810.6	1919.3	0.42	MD
130	**Rajahmundry**	17	81.8	1178.1	1561.6	0.75	SD
131	**Rajendranagar**	17.32	78.43	810.1	1572.3	0.52	MD
132	**Ramachandrapura**	16.84	82.03	810.1	1572.3	0.52	MD
133	**Ramagundam**	18.76	79.41	1105.1	2022.6	0.55	MD
134	**Rampachodavaram**	17.44	81.78	1178.1	1561.6	0.75	SD
135	**Rayachoty**	14.06	78.75	810.6	1919.3	0.42	MD
136	**Rayadurg**	14.7	76.87	533.9	1750.7	0.3	VD
137	**Renigunta**	13.63	79.5	942.9	1776.7	0.53	MD
138	**Repalle**	16.02	80.84	1020.1	1733.6	0.59	MD
139	**Sadasivpet**	17.62	77.95	963.5	1908.7	0.5	MD
140	**Salur**	18.52	83.21	1667.2	1565.4	1.07	AD
141	**Sangareddy**	17.62	78.09	815.9	1572.3	0.52	MD
142	**Sattenaplle**	16.4	80.15	1050.5	1802.7	0.58	MD
143	**Secunderabad**	17.48	78.55	815.9	1572.3	0.52	MD
144	**Shamsabad**	17.35	78.42	718	1367.4	0.53	MD
145	**Siddipet**	18.1	78.85	1110.3	2022.6	0.55	MD
146	**Singarayakonda**	15.25	80.02	858	1763.5	0.49	MD
147	**Sirsilla**	18.39	78.82	1110.3	1676.9	0.66	MD
148	**Srikakulam**	18.3	83.9	1012.9	1575.3	0.64	MD
149	**Srikalahasti**	13.75	79.7	942.9	1763.5	0.53	MD
150	**Sullurupeta**	13.7	80.02	942.9	1509.1	0.62	MD
151	**Suryapet**	17.14	79.62	781	1802.7	0.43	MD
152	**Tadepallegudem**	16.81	81.53	1178.1	1561.6	0.75	SD

153	**Tadipatri**	14.9	78	559.5	1930.4	0.29	VD
154	**Tandur**	17.25	77.58	904.1	1908.7	0.47	MD
155	**Tanuku**	16.75	81.7	1178.1	1561.6	0.75	SD
156	**Tenali**	16.24	80.65	1050.5	1733.6	0.61	MD
157	**Tirumala**	13.68	79.35	942.9	1776.7	0.53	MD
158	**Tirupati**	13.66	79.38	942.9	1776.7	0.53	MD
159	**Tuni**	17.35	82.55	1082.1	1561.6	0.69	MD
160	**Uppalkalan**	17.4	78.56	810.1	1572.3	0.52	MD
161	**Uravakonda**	14.95	77.26	559.5	1750.7	0.32	VD
162	**Venkatagiri**	13.96	79.59	942.9	1763.5	0.53	MD
163	**Vetapalem**	15.78	80.31	845.3	1733.6	0.49	MD
164	**Vikarabad**	17.33	77.9	810.2	1572	0.52	MD
165	**Vijayapuri**	17.32	78.58	687.7	1802.7	0.38	MD
166	**Vijayawada**	16.51	80.65	1050.5	1733.6	0.61	MD
167	**Vinukonda**	16.05	79.74	687.7	1802.7	0.38	MD
168	**Vishakhapatnam**	17.69	83.22	980.4	1565.4	0.63	MD
169	**Vizianagaram**	18.11	83.41	980.4	1565.4	0.63	MD
170	**Wanaparthy**	16.36	78.06	904.1	1930.4	0.47	MD
171	**Warangal**	18	79.59	947.9	2022.6	0.47	MD
172	**Yellandu**	17.59	80.32	1040.5	2022.6	0.51	MD
173	**Yemmiganur**	15.77	77.48	761.3	1987.9	0.38	MD
174	**Yerraguntla**	14.64	78.54	810.6	1919.3	0.42	MD
175	**Zaheerabad**	17.68	77.62	963.5	1908.7	0.5	MD
MEAN				**938.3**	**1751**	**0.5**	**MD**
MAXIMUM				**1667.2**	**2022.6**	**0.8**	
MINIMUM				**533.9**	**1367.4**	**0.3**	
STDEV				**185.6**	**153.5**		

Table 3.2:Distribution of tanks and reservoirs in Andhra Pradesh.

S.No.	Districts	Geographical Area (Sq. km.)	Rainfall (mm)	PET (mm)	Avg. MAI	Ayacut area of Medium irrigation projects (sq.km)	Area Medium irrigation projects (%)
1	**Adilabad**	16128	1126.1	1794.4	0.64	176	1.088
2	**Anantapur**	19130	593.8	1758.9	0.34	123	0.643
3	**Chittoor**	15152	897	1775.6	0.51	139	0.921
4	**Cuddappah**	15359	785.7	1920.5	0.41	111	0.723
5	**East Godavari**	10807	1083	1562.6	0.64	194	1.797
6	**Guntur**	12846	912.6	1773	0.52	109	0.849
7	**Karimnagar**	11391	1104.7	1815.2	0.61	65	0.567
8	**Khammam**	11823	1040.5	2022.6	0.51	279	2.356
9	**Krishna**	16029	1032.5	1751.7	0.59	86	0.538
10	**Kurnool**	8727	719.8	1917.1	0.4	118	1.352
11	**Mahaboobnaga**	9699	880.3	1899.4	0.48	65	0.674
12	**Medak**	17658	984.2	1732.7	0.58	38	0.217

13	**Nalgonda**	18432	769.3	1756.6	0.43	234	1.27
14	**Nellore**	14240	978.4	1752.6	0.5	41	0.291
15	**Nizamabad**	13076	1130.6	1735.4	0.66	87	0.666
16	**Prakasam**	7956	838.6	1782.9	0.47	41	0.521
17	**Rangareddy**	17626	809.6	1623.8	0.5	48	0.27
18	**Srikakulam**	5837	1022.9	1549.6	0.66	280	4.802
19	**Visakhapatna**	7493	980.4	1565.4	0.63	127	1.689
20	**Vizianagaram**	6539	1438.3	1568.7	0.92	525	1.531
21	**Warangal**	11161	1000.3	2022.6	0.49	171	8.028
22	**West Godavari**	7742	1145.5	1629.3	0.71	51	0.652
	Total/Mean	**274851**	**967**	**1759.5**	**0.55**	**3108.31**	**31.45**

Fig.3.4 Moisture Adequacy Index (MAI) at 0.01contour interval in Andhra Pradesh.

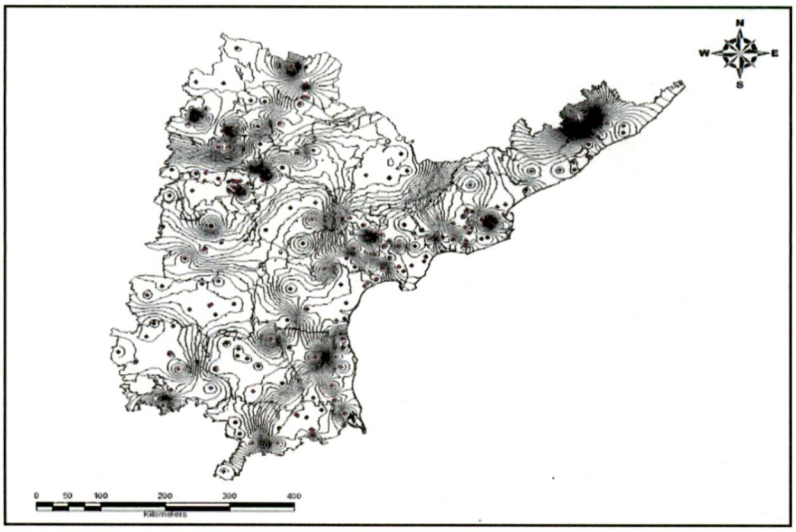


Fig. 3.5: District wise Moisture Adequacy Index of Andhra Pradesh.

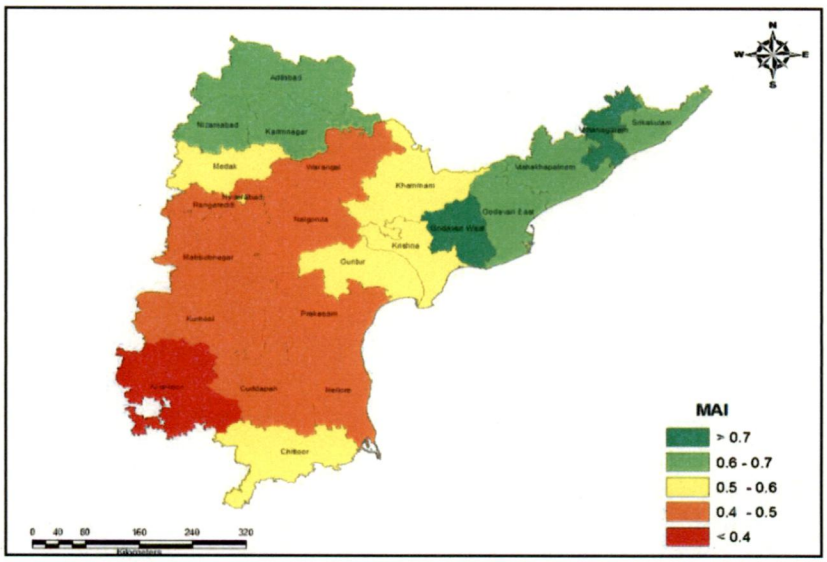


Fig. 3.6: Ayacut area of medium irrigation projects in Andhra Pradesh.

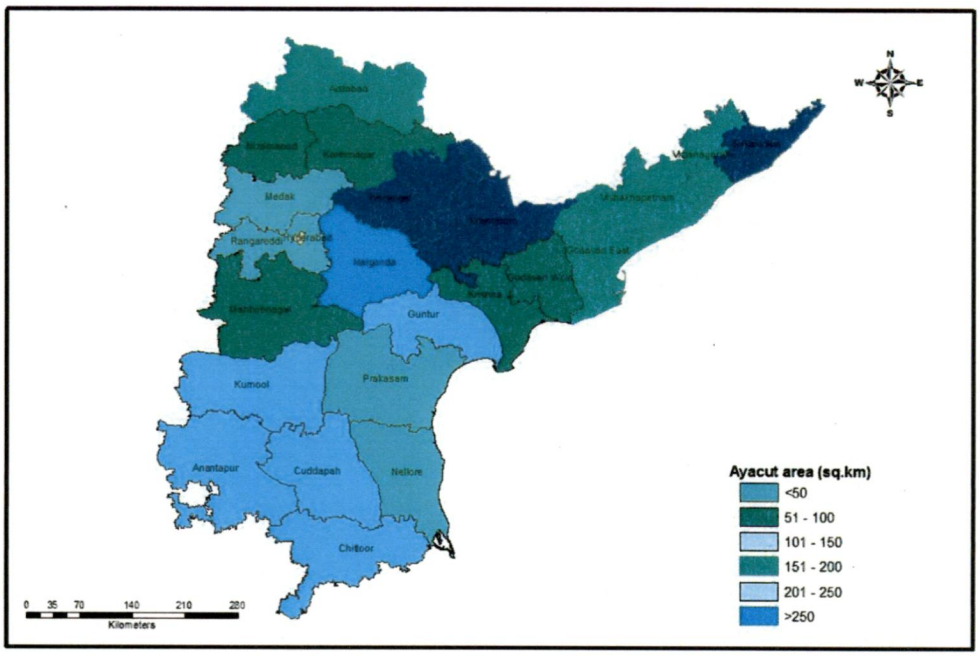
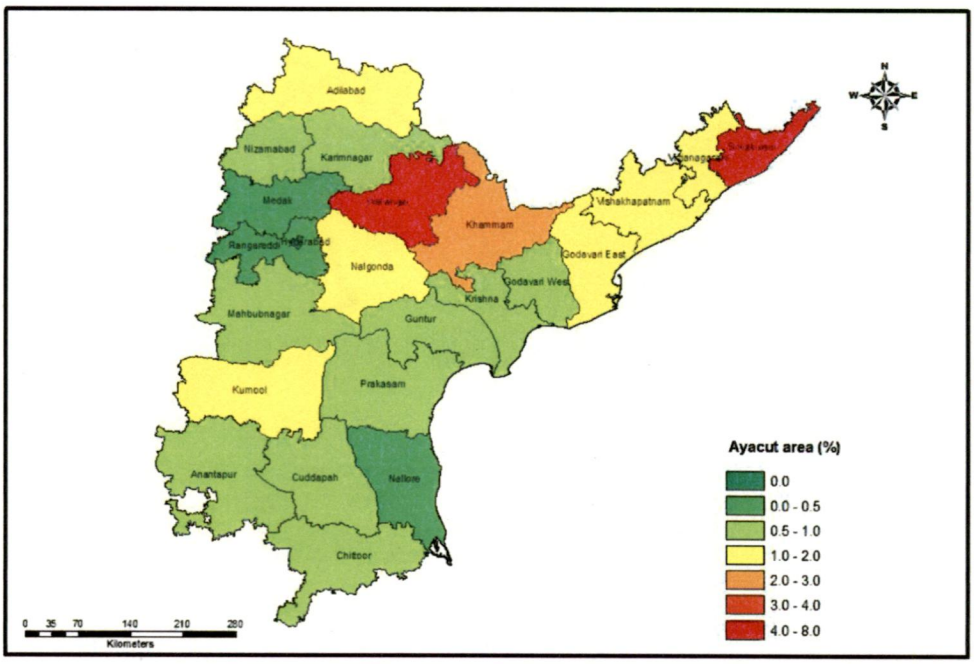


Fig.3.7: Percent area of medium irrigation projects in Andhra Pradesh.



CHAPTER 4

CROPPING PATTERN

4.1 Introduction:

Cropping pattern means the proportionate area under different crops during an Agricultural year. Rice, Wheat, millets and Pulses constitute food crops. In Andhra Pradesh, Rice is the major staple crop. Non-food crops constitute Fibres, Oilseeds, Tobacco, Dyes, fodder crops and green manure crops. The gross cropped area under all crops decreased to 125.6 lakhs hectares during 2009-2010 From 138.3 lakhs hectares in 2008-2009, showing a decrease of 9.2 percent. The area under different crops and their percentage to total cropped area during 2009-2010 and the average of preceding 5 years is given in table 4.1

4.2 Area under Food Crops:

Besides food grain crops, chillies, sugarcane, onions, fruits and Vegetables also constitute food crops. Out of 125.6 lakhs hectares of total cropped area, 83.02 lakhs hectares or 66.1 percent was under food crops. The area under food crops in the State during 2009-2010 is 83.02 lakhs hectares as against 91.23 lakhs hectares in 2008-2009 recording a decrease of 9.0 percent.

4.2.1 Area under Non-Food Crops

Non-food crops constitute Fibres, Oil seeds, Tobacco, Dyes, Fodder crops and Green Manure crops. The area under Non-food crops during 2009-2010 is 42.58 lakhs hectares constituting 33.9 percent of the total cropped area. The area under Non-Food crops decreased to 42.58 lakhs hectares as against 47.07 lakhs hectares in 2008-2009, a decrease being 9.5 percent.

4.2.2 Area under Food grain Crops

Out of 125.6 lakhs hectares of total cropped area during 2009-2010, 66.67 lakhs hects or 53.1 percent was accounted for food grain crops viz., Rice, Jowar, Maize and Pulses. Rice, Jowar and Maize together accounted for 36.6 percent of the total cropped area in the state during 2009-2010. The area Under Food-grains is estimated at 66.67 lakhs hectares during 2009-2010 as Against 74.42 lakhs hectares in 2008-2009. This decrease of 10.4 percent was attributed to decrease in area under food grains during 2009-2010.

4.2.3 Area under Kharif Food-grain Crops

Area under Food-grains during Kharif season 2009-2010 was 36.01 lakhs hectares as against 42.73 lakhs hectares in 2008-2009, showing a decrease by 15.7 percent. All the districts in the State (except Mahabubnagar, SPS Nellore, Kadapa, Anantapur and Chittoor districts) recorded a decrease in area under Food-grains during 2009-2010 over 2008-2009.

4.2.4 Area under Rabi Food-grain Crops

The area under Food-grains during Rabi season 2009-2010 was 30.65 lakhs hectares as against 31.69 lakhs hectares in 2008-2009, recording a decrease of 3.3 percent. All districts in the State (except Adilabad, Nizamabad, Karimnagar, Warangal, Visakhapatnam, East Godavari, West Godavari, and Chittoor) recorded an increase in area under Food-grains during 2009-2010 over2008-2009.

4.2.5 Food-grains Production

The total Food-grains production in the State is recorded at 155.99 lakhs Tonnes in 2009-2010 as against 204.21 lakhs tonnes in 2008-2009 showing a decrease of 23.6 percent due to Unfavourable seasonal conditions prevailing in the State.

Table 4.1: Cropping pattern in Andhra Pradesh (Area in Lakhs. hects).

S.No	Crop	Average of pre. 5 years	Share in total cropped area (%)	Area in 2009-10	Share in total cropped area (%)	Area in 2008-09	Share in total cropped area (%)	Variation over previous years (%)
1	Rice	38.83	29.4	34.41	27.4	43.87	31.7	-21.6
2	Wheat	0.11	0.1	0.1	0.1	0.14	0.1	-28.6
3	Jowar	3.95	3.0	3.85	3.0	2.79	2.0	38
4	Bajra	0.74	0.6	0.45	0.4	0.59	0.4	-23.7
5	Ragi	0.6	0.5	0.45	0.4	0.5	0.4	-10
6	Maize	7.56	5.7	7.83	6.2	8.52	6.2	-8.1
7	Major Millets	12.85	9.7	12.5	10	12.4	9	1.5
8	Korra	0.14	0.1	0.08	0.1	0.09	0.1	-11.1
9	Varagu	N	N	0.01	N	N	N	N
10	Samai	0.23	0.2	0.16	0.1	0.21	0.1	-23.8
11	Small Millets	0.01	N	N	N	N	N	N
12	Horsegram	0.55	0.4	0.59	0.5	0.38	0.3	55.3
13	Bengalgram	5.15	3.9	6.47	5.2	6.07	4.4	6.6
14	Redgram	4.56	3.4	4.63	3.7	4.43	3.2	4.5
15	Greengram	3.98	3	3.07	2.4	3.2	2.3	-4.1
16	Blackgram	4.37	3.3	4.29	3.4	3.38	2.4	26.9
17	Cowgram	0.21	0.2	0.23	0.2	0.2	0.2	15
18	Other Pulses	0.08	0.1	0.05	N	0.05	N	

19	Chillies	2.1	1.6	2.07	1.6	2.03	1.5	2
20	Onion	0.36	0.3	0.37	0.3	0.41	0.3	-9.8
21	Sugarcane	4.07	3.1	3.07	2.5	3.4	2.5	-9.7
22	Other Crops	10.21	7.7	10.84	8.6	10.97	7.9	-1.2
Total Food Crops		**87.81**	**66.4**	**83.02**	**66.1**	**91.23**	**66**	**-9**
23	Cotton	11.43	8.6	14.67	11.7	13.99	10.1	4.9
24	Groundnut	17.22	13	13.01	10.4	17.66	12.7	-26.3
25	Coconut	1.05	0.8	1.05	0.8	1.07	0.8	-1.9
26	Sesamum	1.27	1.0	0.9	0.7	0.8	0.6	-12.5
27	Sunflower	4.42	3.3	3.51	2.8	4.19	3.0	-16.2
28	Other Oil sees	3.93	3.0	3.77	3	3.56	2.6	5.9
Total Oil seeds		27.89	21.1	22.24	17.7	27.28	19.7	-18.5
29	Tobacco	1.36	1.0	1.99	1.6	1.71	1.3	16.4
30	Fodder Crops	1.74	1.3	0.85	0.7	1.0	0.7	-15
31	Other NF Crops	1.95	1.5	2.83	2.2	3.09	2.2	-8.4
Total NF Crops		**44.37**	**33.6**	**42.58**	**33.9**	**47.07**	**34**	**-9.5**
Total Cropped area		**132.18**	**100**	**125.6**	**100**	**138.3**	**100**	**-9.2**

4.2.6 Kharif Food-grain Production

The Production of food-grains during Kharif season 2009-2010 was 74.74 lakhs tonnes as against 105.62 lakhs tonnes in 2008-2009, registering a decrease of 29.2 percent. All the districts in the state except Kadapa, and Chittoor recorded a decrease in production of Kharif food-grains during 2009-2010 over 2008-2009.

4.2.7 Rabi Food-grain Production

The production of Rabi Food-grains with 81.25 lakhs tonnes in 2009-2010 as against the 98.59 lakhs tonnes in 2008-2009 recording a decrease of 17.6 percent. All the districts in the State (except Mahabubnagar, Nalgonda, Khammam, Srikakulam, Vizainagaram, Prakasam, Nellore, Kurnool and Anantapur) registered a decrease in production of Rabi Food-grains during 2009-2010 over 2008-2009. The area and estimated production of Food-grains in the state from 2005-2006 to 2009-2010 is given in Table 4.2

Table 4.2: Area and Production of food grains of Andhra Pradesh (Area in lakhs hectares).

S.No.	Year	Area (lakh/ hect.)			Production (lakhs ton)		
		Kharif	Rabi	Total	Kharif	Rabi	Total
Average of preceding 5 years		42.08	28.99	71.07	97.09	76.53	173.62
1	2005-2006	43.15	28.53	71.68	93.79	75.71	169.5
2	2006-2007	42.18	30.56	72.74	87.74	74.55	162.29
3	2007-2008	42.42	31.45	73.87	114.33	83.84	198.17
4	2008-2009	42.73	31.69	74.42	105.62	98.59	204.21
5	2009-2010	36.01	30.65	66.66	74.74	81.25	155.99
The crop wise production of food grains during 2009-2010 and 2008-2009 are given in table 4.3.							

Fig 4.1: Area and Production of food grains during (2005-2010) in Andhra Pradesh.

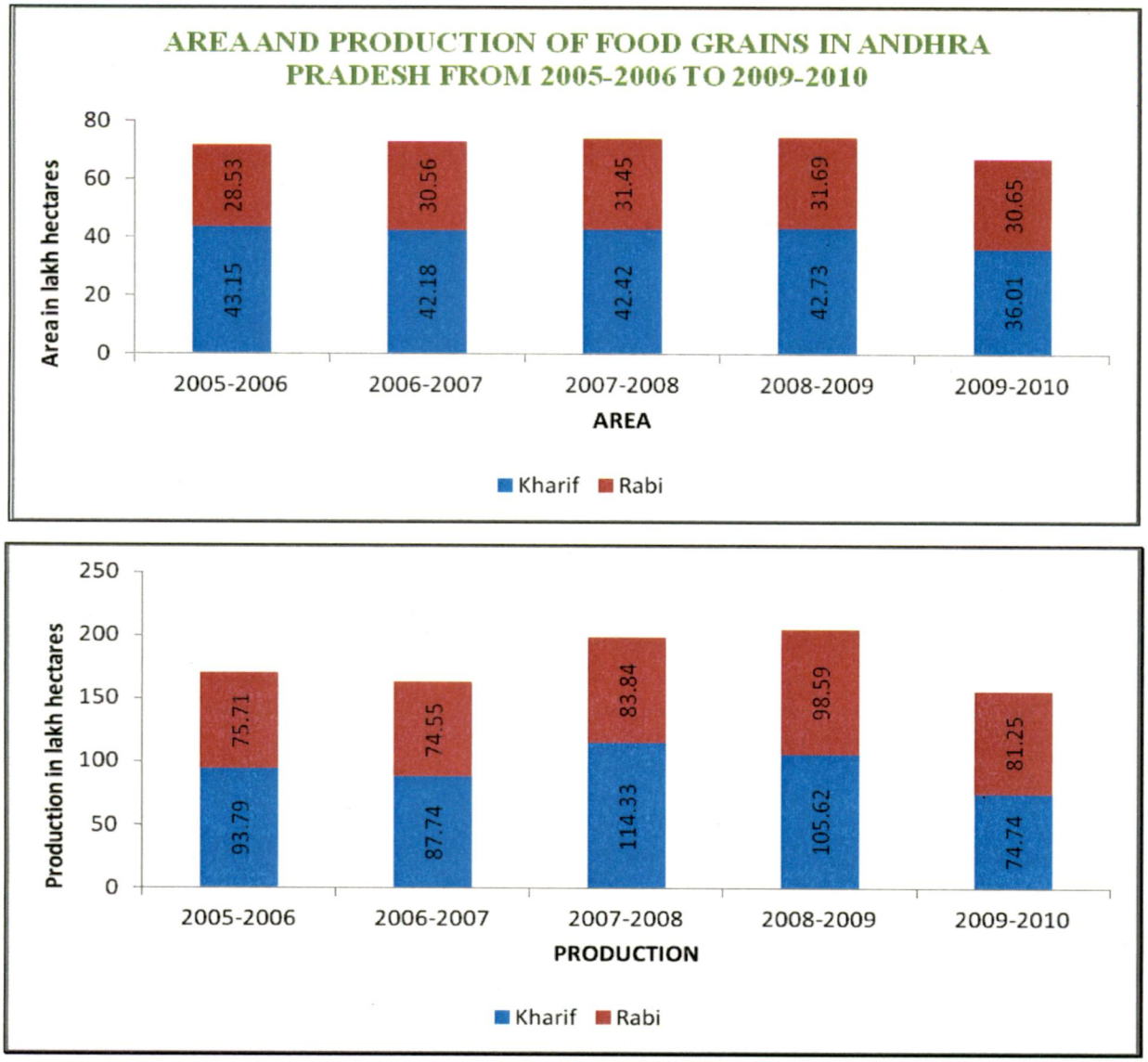


Table 4.3: Crop-Wise Production of Food-Grains in Andhra Pradesh:

S. No	Crop	Average of preceding 5 years	% to share Food grains production	2009-10	% to share Food grains production	2008-09	% to share Food grains production
1	Rice	121.48	70	108.38	69.5	142.1	69.7
2	Wheat	0.09	0.1	0.1	0.1	0.16	0.1
3	Jowar	4.84	2.8	4.37	2.8	4.36	2.4
4	Bajra	0.73	0.4	0.54	0.3	0.6	0.3
5	Maize	31.8	18.3	27.61	17.7	41.52	20.3
6	Ragi	0.7	0.4	0.54	0.4	0.52	0.3
Total Major Millets		38.07	21.9	33.06	21.2	47	23
7	Korra	0.11	0.1	0.05	N	0.07	N
8	Varagu	N	N	0.01	N	N	N
9	Samai	0.09	N	0.07	0.1	0.09	0.1

10	Small Millets	0.01	N	N	N	N	N
11	Total Millets	0.21	0.1	0.13	0.1	0.16	0.1
Total Major Small Millets		**38.28**	**22**	**33.19**	**23.1**	**47.16**	**23.1**
Total Cereals Millets		**159.85**	**92.1**	**141.67**	**90.8**	**189.73**	**92.9**
12	Redgrm	2.37	1.4	2.03	1.3	2.02	0.9
13	Bengalram	6.79	3.9	8.47	5.4	8.57	4.2
14	Greengram	1.59	0.9	0.63	0.4	1.36	0.7
15	Blackgram	2.66	1.5	2.69	1.7	2.2	1.1
16	Horsegram	0.24	0.1	0.36	0.3	0.16	0.1
17	Cowgram	0.09	0.1	0.1	0.1	0.12	0.1
18	Other pulses	0.03	N	0.04	N	0.05	N
Total Pulses		**13.77**	**7.9**	**14.32**	**9.2**	**14.48**	**7.1**
Total food grains		**173.62**	**100**	**155.99**	**100**	**204.21**	**100**
N: Negligible							

4.3 AREA, PRODUCTIVITY AND PRODUCTION:

4.3.1 Rice:

Rice is the principal crop extensively cultivated in all the districts of the State both in Kharif and Rabi seasons. It accounted for 27.4 percent of the total cropped area, 69.5 percent of the total Food-grains production during 2009-2010. The area under Rice during 2009-2010 was 34.41 lakhs hectares as against 43.87 lakhs hectares in 2008-2009, recording a decrease by 21.6 percent.

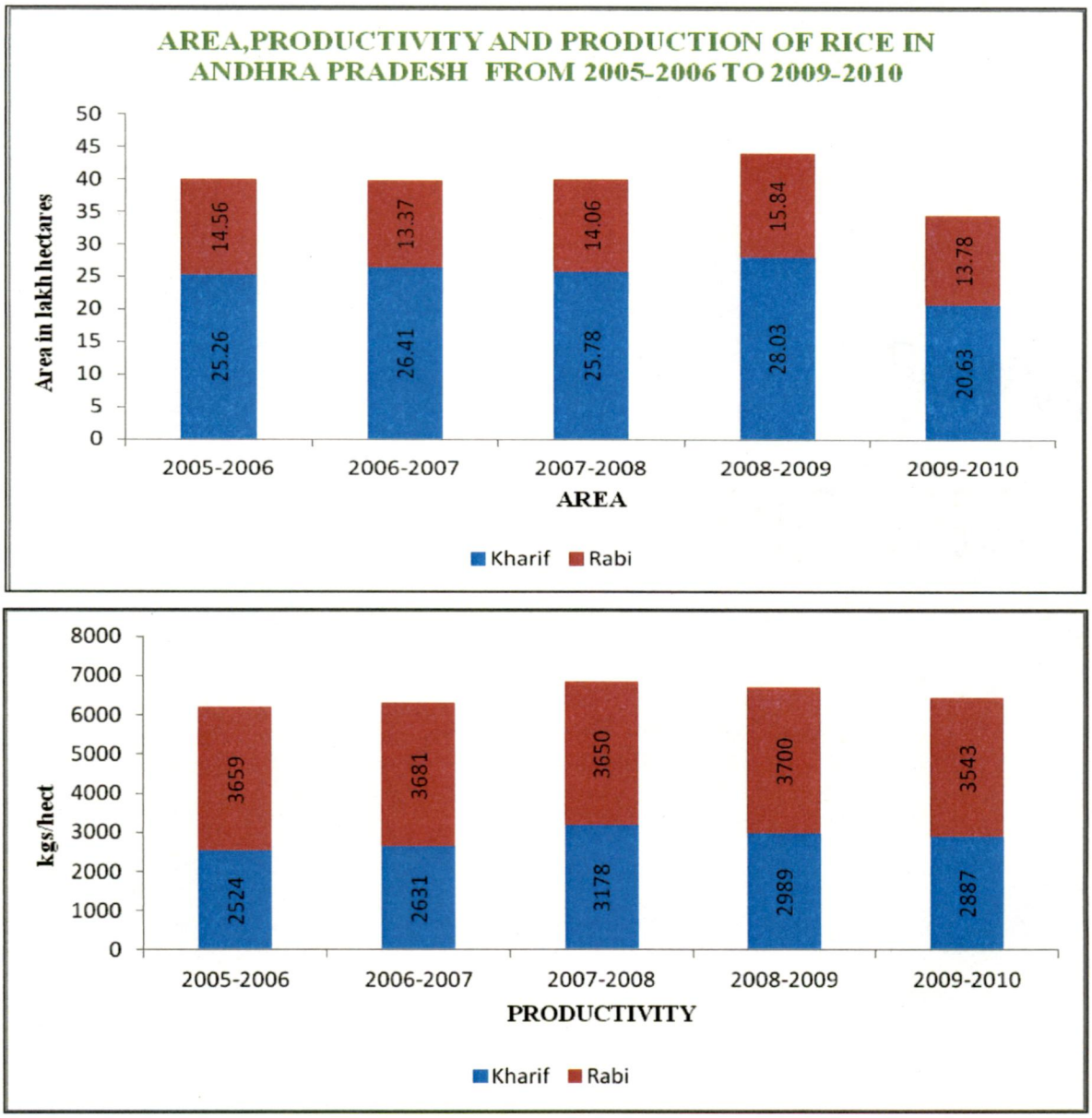
The area under Rice was decreased due to unfavourable seasonal conditions during the south-west monsoon period. Krishna district is at the top with the area of 3.37 lakhs hectares, followed by West Godavari (3.29 lakhs hectares), East Godavari (3.07 lakhs hectares), Guntur (3.03akh hectares), Nalgonda (2.73 lakhs hectares) and SPS Nellore (2.67 lakhs hectares) in 2009-2010.

The production of Rice during 2009-2010 was estimated at 108.38 lakhs tonnes as against 142.41 lakhs tonnes in 2008-2009, recording a decrease by 23.9 percent. The Productivity of Rice is 3150 Kgs/hect in 2009-2010 as against 3246 Kgs/ hect in 2008-2009. The area, productivity and production of Rice in the State for the last 5 years are presented in table 4.4.

Table 4.4:Area,Productivity and Production of rice in Andhra Pradesh.

S.No	Year	Area in lakh hects			Productivity in Kgs/hects.			Production in lakh tonnes		
		Kharif	Rabi	Total	Kharif	Rabi	Total	Kharif	Rabi	Total
Average of preceding 5 years		25.52	13.31	38.83	2842	3675	3125	72.58	48.9	121.48
1	2005-2006	25.26	14.56	39.82	2524	3659	2939	63.77	53.27	117.04
2	2006-2007	26.41	13.37	39.78	2631	3681	2984	69.49	49.23	118.72
3	2007-2008	25.78	14.06	39.84	3178	3650	3345	81.91	51.33	133.24
4	2008-2009	28.03	15.84	43.87	2989	3700	3246	83.8	58.61	142.41
5	2009-2010	20.63	13.78	34.41	2887	3543	3150	59.56	48.82	108.38

Fig 4.2: Area and Production of Rice during (2005-2010) in Andhra Pradesh.



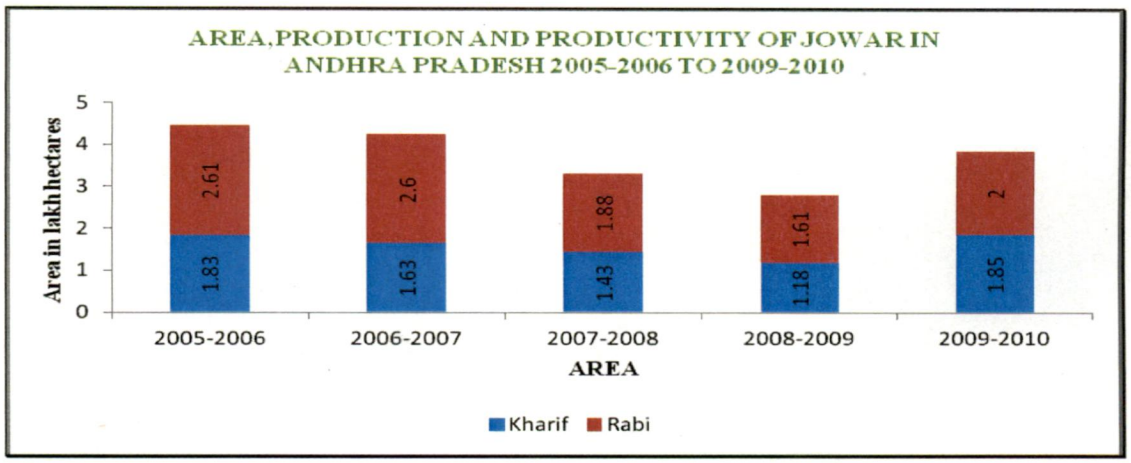
4.3.2 Jowar

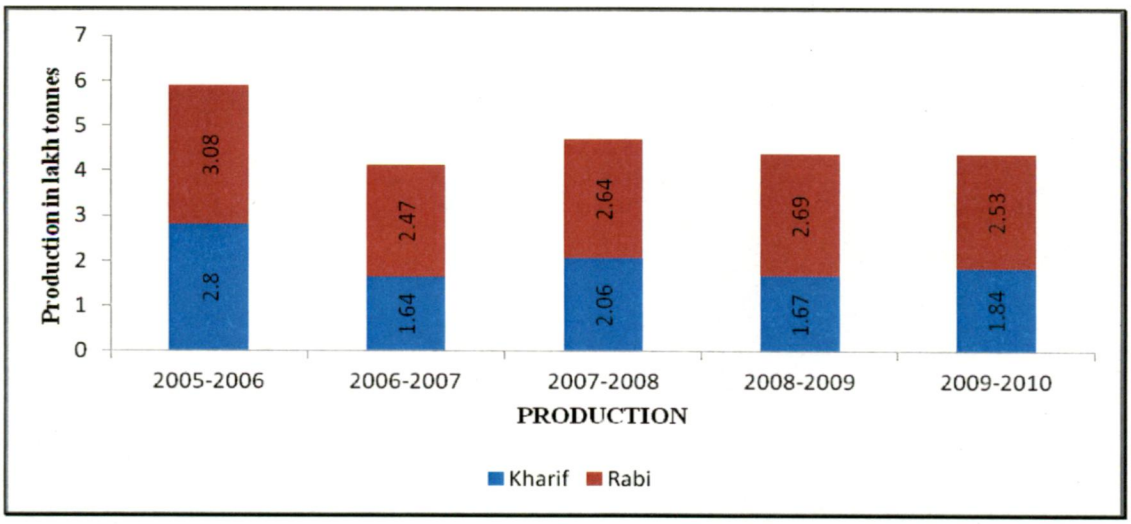
Next to Rice, Jowar is the principal Food-grain crop in the State. It is sown both in Kharif and Rabi seasons mostly under rain fed conditions. This crop accounted for 2.8 percent of the total cropped area in the State. Jowar is largely grown in the districts of Kurnool, Mahabubnagar, Anantapur, Adilabad, Medak, and Ranga Reddy .These districts together accounted for 81.0 percent of the total area under this crop during 2009-2010 in the State. The area sown under Jowar was 3.85 lakhs hectares during 2009-2010 as against 2.79 lakhs hectares in2008-2009, registering an increase of 38.0 percent.The production of Jowar was 4.37 lakhs Tonnes during 2009-2010 as against 4.36 lakhs Tonnes in 2008-2009, showing an increase of 0.2 percent.The increase of production is mainly due to increase in area during the year 2009-2010.The yield rate of Jowar was 1136 Kgs per hectare during 2009-2010, as against 1564 Kgs per hectare 2008-2009, recording a decrease of 27.4 percent. The area, productivity and production of Jowar crop from 2005-2006 to 2009- 2010 is given in Table – 4.5.

Table 4.5: Area, Productivity and Production of Jowar in Andhra Pradesh.

S.No	Year	Area in lakhs hects			Productivity in Kgs/hects.			Production in lakhs tonnes		
		Kharif	Rabi	Total	Kharif	Rabi	Total	Kharif	Rabi	Total
Average of preceding 5 years		1.61	2.34	3.95	1299	1236	1260	2.08	2.76	4.84
1	2005-2006	1.83	2.61	4.44	1532	1179	1324	2.8	3.08	5.88
2	2006-2007	1.63	2.6	4.23	989	952	966	1.64	2.47	4.11
3	2007-2008	1.43	1.88	3.31	1441	1400	1418	2.06	2.64	4.7
4	2008-2009	1.18	1.61	2.79	1411	1677	1564	1.67	2.69	4.36
5	2009-2010	1.85	2	3.85	996	1266	1136	1.84	2.53	4.37

Fig 4.3Area and Production of Jowar during (2005-2010) in Andhra Pradesh





4.3.3 Bajra

Bajra crop is generally sown under rain-fed conditions in the State mostly in Kharif season. Nizamabad, Kurnool, Prakasam, Mahabubnagar, and Visakhapatnam districts are important for the crop and these districts accounted for 65.8 percent of the total area under the crop in the state during 2009-2010. The area cultivated under this crop is 0.45 lakhs hectare in the year 2009-2010 as against 0.59 lakhs hectares in 2008-2009 representing a falloff 23.7 percent.

The production of Bajra was 0.54 lakhs tonnes in 2009-2010 as against 0.60 lakhs tonnes in 2008-2009,showing a decrease of 10.0 percent, due to decrease in the area during 2009-2010. The average yield rate of Bajra was 1177 Kgs. /hect in 2009-2010 as against 1019 Kgs/hect in 2008-2009, showing an increase of 15.5 percent. The area, productivity and production of Bajra crop from 2005-2006 to 2009-2010 are given in Table 4.6.

Table 4.6: Area, Productivity and Production of Bajra in Andhra Pradesh.

S.No	Year	Area in lakhs hects			Productivity in Kgs/hects.			Production in lakhs tonnes		
		Kharif	Rabi	Total	Kharif	Rabi	Total	Kharif	Rabi	Total
Average of preceding 5 years		0.63	0.11	0.74	1031	761	985	0.63	0.09	0.72
1	2005-2006	0.69	0.12	0.81	1051	806	1014	0.72	0.1	0.82
2	2006-2007	0.49	0.12	0.61	816	587	771	0.4	0.07	0.47
3	2007-2008	0.6	0.14	0.74	1363	791	1253	0.81	0.11	0.92
4	2008-2009	0.5	0.09	0.59	1030	957	1019	0.51	0.09	0.6
5	2009-2010	0.33	0.12	0.45	1301	828	1177	0.44	0.1	0.54

4.3.4 Ragi

Ragi crop is sown both under rain fed and irrigation conditions in both Kharif and Rabi seasons. Visakhapatnam, Chittoor, Ananthapur, Vizainagaram and Mahabubnagar districts together accounted for 85.3 percent of the total area under the crop during 2009-2010. The area sown under Ragi was 0.45 lakhs hectare during 2009-2010 as against 0.50 lakhs hectare in 2008-2009, registering a decrease of 10.0 percent during 2009-2010.

The production of Ragi was 0.54 lakhs tonnes in 2009-2010 as against 0.52 lakhs tonnes in 2008-2009, showing an increase of 3.8 percent, due to Increase in the area and average yield per hectare. The yield rate of Ragi was 1187Kgs/hect in 2009-2010 as against 1037Kgs/hect in 2008-2009, recording an increase by 150 Kgs per hectares. The area, productivity and production of Ragi crop from 2005-2006 to 2009-2010 are given in the table- 4.7.

Table 4.7: Area, Productivity and Production of Jowar in Andhra Pradesh.

S.No	Year	Area (lak/hect)			Productivity (kgs/hects.)			Production (lak/ton)		
		Kharif	Rabi	Total	Kharif	Rabi	Total	Kharif	Rabi	Total
Average of preceding 5 years		0.52	0.08	0.6	1097	1699	1171	0.58	0.12	0.7
1	2005-2006	0.57	0.09	0.66	1112	1816	1209	0.63	0.16	0.79
2	2006-2007	0.51	0.08	0.59	1004	1656	1095	0.51	0.13	0.64
3	2007-2008	0.48	0.07	0.55	1210	1515	1248	0.59	0.1	0.69
4	2008-2009	0.45	0.05	0.5	959	1708	1037	0.43	0.09	0.52
5	2009-2010	0.39	0.06	0.45	1078	1859	1187	0.42	0.12	0.54

4.3.5 Maize

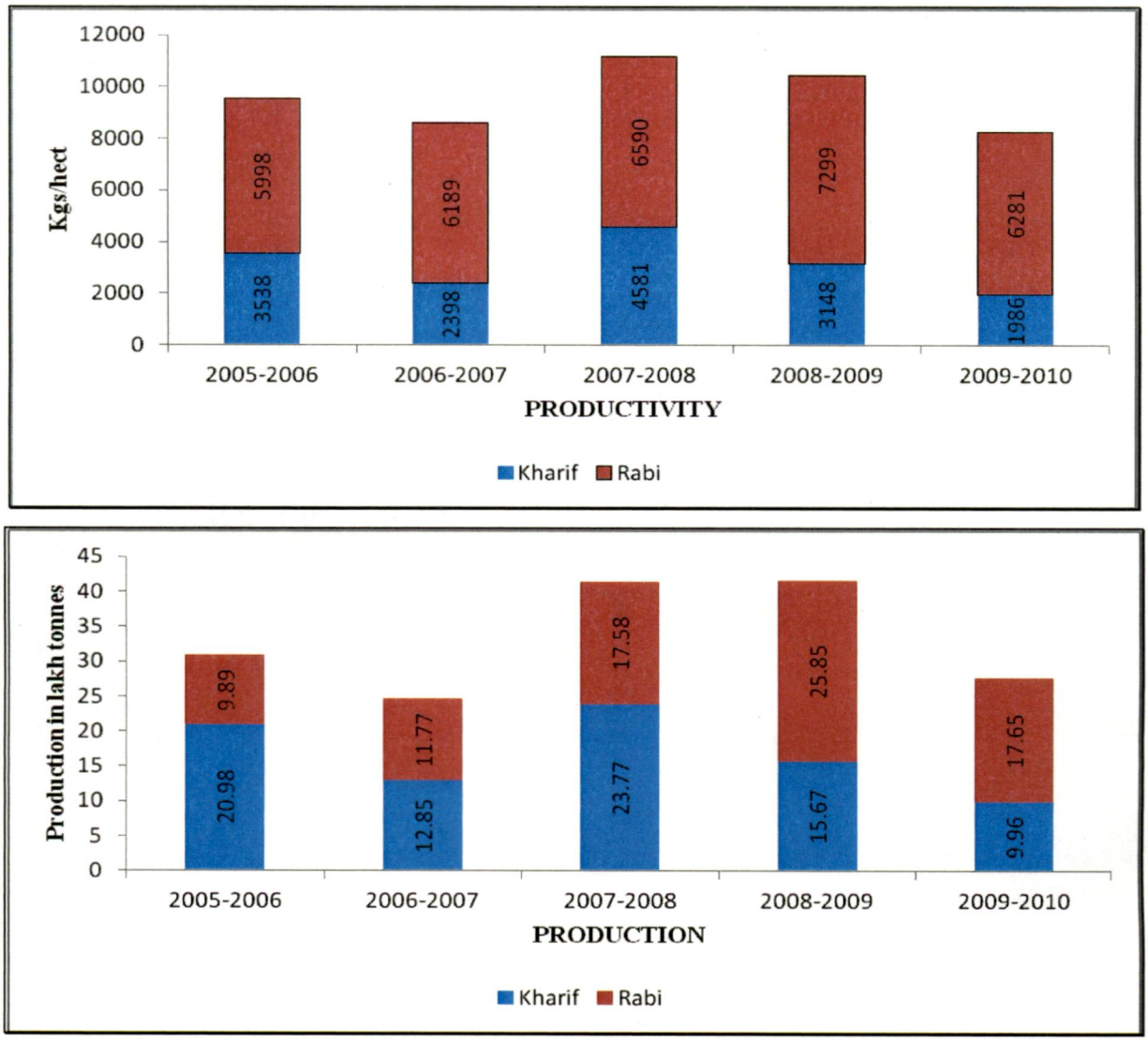
Maize crop is mostly grown in Telangana region. This crop accounted for 6.2 percent of the total cropped area in the State during 2009-2010. The Maize is largely grown in the districts of Mahabubnagar, Medak, Karimnagar, Nizamabad, Guntur, and Warangal districts and these districts together accounted for 70.9 percent of the total area under the crop in the State and Mahabubnagar district is accounted for above 16.6 percent of total area under this crop.The area under Maize was 7.83 lakhs hectares during 2009-2010 as against 8.52 lakhs hectares in 2008-9009, which shows a decrease 8.1 percent. The production of Maize was estimated at 27.61 lakhs tonnes during 2009-2010 as against 41.52 lakhs tonnes in 2008-2009, showing a decrease by 33.5 percent due to decrease in the area and average yield per hectare during 2009-2010.The average yield rate of Maize was 3528Kgs/hect in 2009-2010 as against 4874

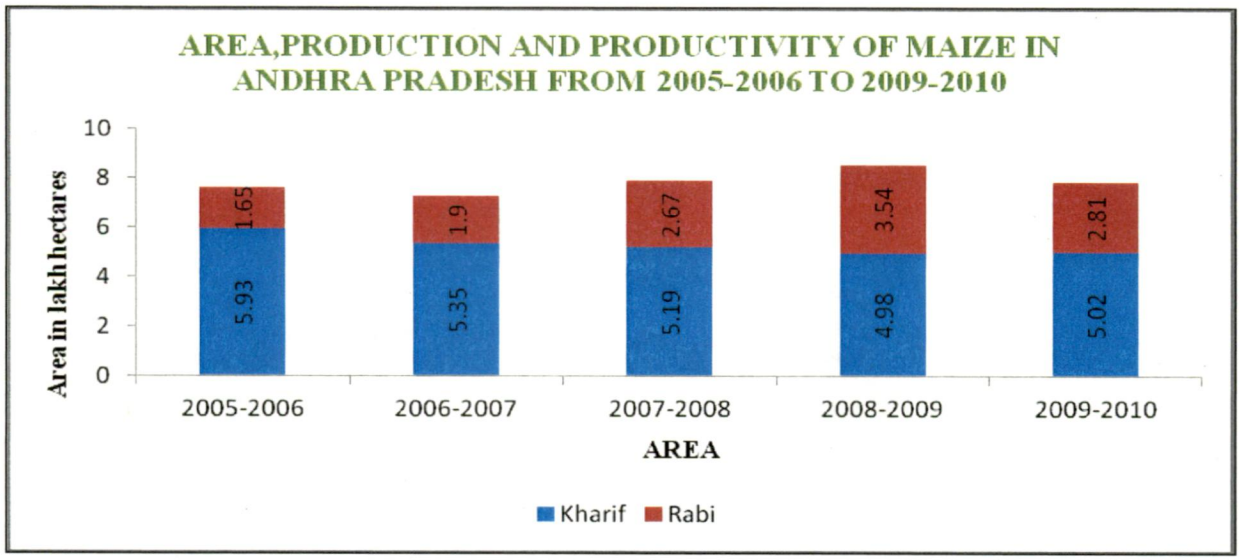
Kgs/hect in 2008-2009, showing a decrease of 27.6 percent. The area, productivity and production of Maize from 2005-2006 to 2009-2010 are given in the table 4.8.

Table 4.8: Area, Productivity and Production of Maize in Andhra Pradesh.

S.No	Year	Area in lakhs hects			Productivity in Kgs/hects.			Production in lakhs tonnes		
		Kharif	Rabi	Total	Kharif	Rabi	Total	Kharif	Rabi	Total
Average of preceding 5 years		5.3	2.26	7.56	3223	6304	4149	17.13	14.67	31.8
1	2005-2006	5.93	1.65	7.58	3538	5998	4073	20.98	9.89	30.87
2	2006-2007	5.35	1.9	7.25	2398	6189	3391	12.85	11.77	24.62
3	2007-2008	5.19	2.67	7.86	4581	6590	5263	23.77	17.58	41.35
4	2008-2009	4.98	3.54	8.52	3148	7299	4874	15.67	25.85	41.52
5	2009-2010	5.02	2.81	7.83	1986	6281	3528	9.96	17.65	27.61

Fig 4.4: Area and Production of Maize during (2005-2010) in Andhra Pradesh.





4.3.6 Minor Millets

6.6.1 Korra, Varagu, Samai and other Minor millets come under "minor millets" sparsely grown in the State. These crops are mainly sown under rained conditions and the area under these minor millets accounted for about 0.2 percent of the total cropped area in the State during 2009-2010. Visakhapatnam, Kurnool, and Vizainagaram districts are together accounted for 85.3 percent of the total area under minor millets in the state during 2009-2010. The area under minor Millets was 0.25 lakhs hect. in 2009-2010 as against 0.30 lakhs hect. in 2008-2009, showing decrease of 16.7 percent. 6.6.2 The production of Minor Millets (Korra, Varagu, Samai and Other Minor Millets) was 0.13 lakhs Tonnes in 2009-2010 as against 0.16 lakhs tonnes in 2008-2009, showing a decrease of 18.7, percent, due to decrease in area and average yield/hect. Rate in 2009-2010. Area and production of total Minor Millets from 2005-2006 to 2009-2010 are shown in the Table 4.9.

Table 4.9: Area, Productivity and Production of Minor Millets in Andhra Pradesh.

S.No	Year	Area in lakhs hects			Production in lakhs tonnes		
		Kharif	Rabi	Total	Kharif	Rabi	Total
Average of preceding 5 years		0.38	N	0.38	0.21	N	0.21
1	2005-2006	0.43	0.01	0.44	0.26	N	0.26
2	2006-2007	0.34	N	0.34	0.17	N	0.17
3	2007-2008	0.35	N	0.35	0.22	N	0.22
4	2008-2009	0.3	N	0.3	0.16	N	0.16
5	2009-2010	0.24	0.01	0.25	0.12	0.01	0.13

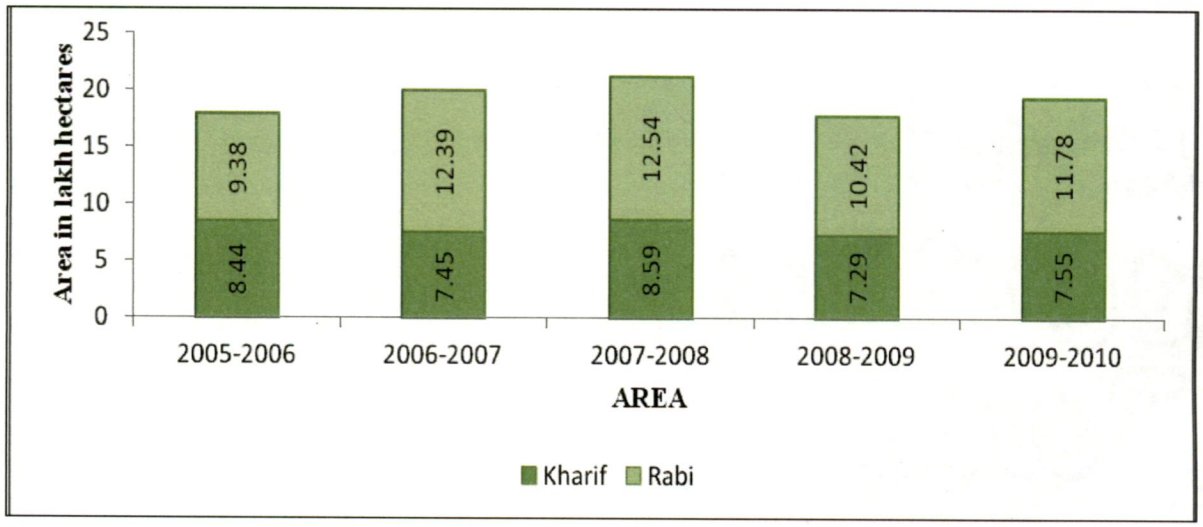
4.3.7 Pulses

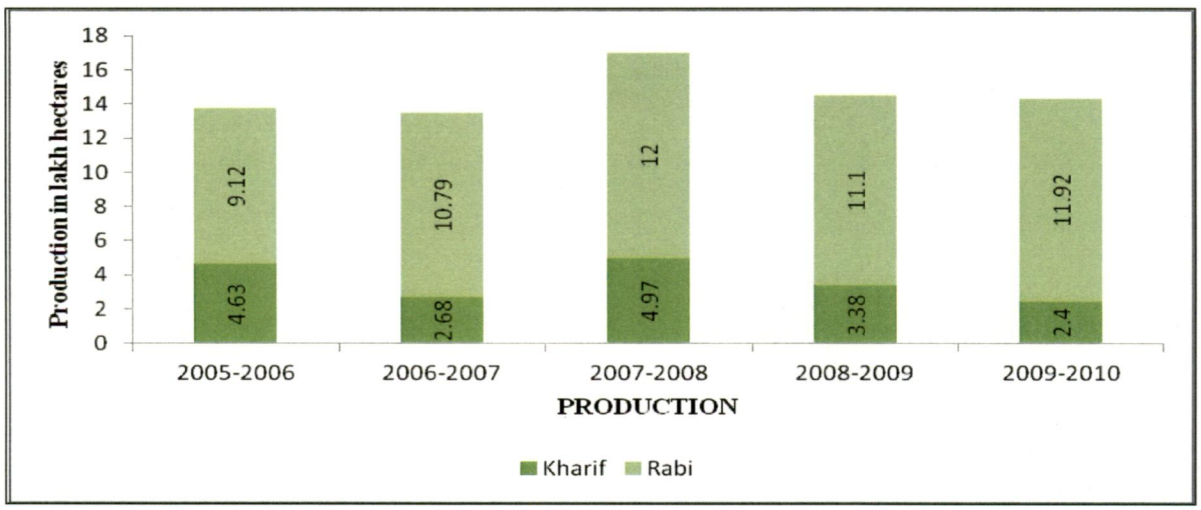
Pulses comprise of Red gram, Bengal gram, Green gram, Black gram, Horse gram Cow gram and other pulses. The area under these pulses accounted for about 15.4 percent of the total cropped area in the State during 2009-2010. The area under pulses was 19.33 lakhs hectares during 2009-2010 as against 17.71 lakhs hect. in 2008-2009, which shows an increase of 9.1 percent 6.7.2 Out of 14.32 lakhs tonnes of production of pulses in the State during 2009-2010, Redgram,Bengalgram, Green gram and Black gram accounted for 2.03, 8.47, 0.63and 2.69 lakhs tonnes respectively and they have contributed 96.5 per cent of the total pulses production.The production of pulses was 14.32 lakhs tonnes during 2009-2010 as against 14.48 lakhs tonnes in 2008-2009, showing a decrease of 1.1 percent. The decrease in production is due to decrease in the average yield per hectare. The area and production of pulses from 2005-2006 to 2009-2010 are shown in the table 4.10.

Table 4.10: Area, Productivity and Production of pulses in Andhra Pradesh.

S.No	Year	Area in lakhs hects			Production in lakhs tonnes		
		Kharif	Rabi	Total	Kharif	Rabi	Total
Average of preceding 5 years		8.11	10.8	18.91	3.87	9.9	13.77
1	2005-2006	8.44	9.38	17.82	4.63	9.12	13.75
2	2006-2007	7.45	12.39	19.84	2.68	10.79	13.47
3	2007-2008	8.59	12.54	21.13	4.97	12	16.97
4	2008-2009	7.29	10.42	17.71	3.38	11.1	14.48
5	2009-2010	7.55	11.78	19.33	2.4	11.92	14.32

Fig 4.5: Area and Production of Pulses during (2005-2010) in Andhra Pradesh.





4.3.8 Red gram

Red gram is sown predominantly under rain-fed conditions in Kharif season. The crop is sown in the months of June to August in the State. This crop is largely grown in Mahabubnagar, Prakasam, Adilabad Nalgonda, Ananthapur, Ranga Reddy, Kurnool, Guntur and Medak districts which accounted for 78.0 percent of the total area under this crop in the State during 2009-2010. Mahabubnagar district alone shared 19.9 percent of total area under this crop. The area under Red gram during 2009-2010 was 4.63 lakhs hectares as against 4.43 lakhs hectares in 2008-2009 and showing an increase of 4.5 percent.The production of Red gram during 2009-2010 was 2.03 lakhs tonnes as against 2.02 lakhs tonnes in 2008-2009, showing an increase of 0.5 percent slightly due to increase in area during 2009-2010.The yield rate of Red gram was 438 Kgs per hectare in 2009-2010 as against 455 Kgs per hectare in 2008-2009, showing a decrease of 3.7 percent. The area, productivity and production of Red gram from 2005-2006 to 2009-2010 are given in the table 4.11.

Table 4.11:Area, Productivity and Production of Red gram in Andhra Pradesh.

S.no	Year	Area in lakh hects			Productivity in Kgs/hects.			Production in lakh tonnes		
		Kharif	Rabi	Total	Kharif	Rabi	Total	Kharif	Rabi	Total
Average of preceding 5 years		4.51	0.05	4.6	514	560	514	2.34	0.03	2.37
1	2005-2006	4.88	0.06	4.9	608	624	608	2.97	0.04	3.01
2	2006-2007	3.96	0.05	4	399	566	401	1.58	0.03	1.61
3	2007-2008	4.59	0.04	4.6	651	647	651	2.99	0.03	3.02
4	2008-2009	4.39	0.04	4.4	454	516	455	2	0.02	2.02
5	2009-2010	4.38	0.25	4.6	433	533	438	1.9	0.13	2.03

4.3.9. Bengal gram

Bengal gram is mostly grown in Rabi season. The crop is sown in the month of October and November to a limited extent in the month of December also. The crop is grown externally under rain-fed conditions .The Crop is sown in Kurnool, Prakasam, Anantapur, Kadapa, and Medak districts which accounted for 70.5 percent of the total area under the crop in the state during 2009-2010 and Kurnool district alone shares 37.0 percent of the total area under this crop. The area under Bengal gram during 2009-2010 is at 6.47 lakhs hectares as against 6.07 lakhs hectares in 2008-2009, recording an increase of 6.6 percent.

The production of Bengal gram has decreased by 8.47 lakhs tonnes in 2009-2010 as against 8.57 lakhs tonnes in 2008-2009, showing a decrease of 1.2 percent. The average yield rate of Bengal gram was recorded at 1309 Kgs per hectares. in 2009-2010 as against 1413 Kgs per hectares in 2008-2009. The area, productivity and production of Bengal gram in the state from 2005-2006 to 2009- 2010 are shown in the table-4.12.

Table 4.12:Area, Productivity and Production of Bengal gram in Andhra Pradesh.

S.No	Year	Area (lakh/hect)			Productivity (kgs/hect)			Production (lakh/ton)		
		Kharif	Rabi	Total	Kharif	Rabi	Total	Kharif	Rabi	Total
Average of preceding 5 years		0	5.15	5.15	0	1310	1310	0	6.79	6.79
1	2005-2006	0	3.94	3.94	0	1590	1590	0	6.27	6.27
2	2006-2007	0	6.02	6.02	0	1087	1087	0	6.53	6.53
3	2007-2008	0	6.30	6.30	0	1448	1448	0	9.12	9.12
4	2008-2009	0	6.07	6.07	0	1413	1413	0	8.57	8.57
5	2009-2010	0	6.47	6.47	0	1309	1309	0	8.47	8.47

4.3.10 Green gram

Green gram crop is sown in both Kharif and Rabi seasons but it is more extensively in Kharif season. The crop is sown as an early Kharif crop in May and June and is harvested during August and September months. The area under Green gram during 2009-2010 was estimated as 3.07 lakhs hectares which constituted 2.4 percent of the cropped area in the State. The crop is extensively sown in Medak, Srikakulam, Mahabubnagar, Warangal, East Godavari Khammam and Nizamabad districts which together accounted for 69.1 percent of the total area under the crop in the State during 2009-2010. The area under Green gram during 2009-2010 was 3.07lakh hectares as against 3.20 lakhs hectares in 2008-2009 showing a decrease of 4.1 percent.

The production of Green gram during 2009-2010 was 0.63 lakhs tonnes as against 1.36 lakhs tonnes in 2008-2009, resulting a decrease of 53.7 percent and it was mainly due to decrease in the area and average yield rate per hectare during 2009-2010.The average yield of Green gram was 204 Kgs per hectares in 2009-2010 as against 426 Kgs per hectares showing a decrease of 222 Kgs per hectares. The area, productivity and production of Green gram from 2005-2006 to 2009-2010 are shown in the table – 4.13.

Table 4.13:Area, Productivity and Production of Green gram in Andhra Pradesh.

S.No	Year	Area (lakh/hect)			Productivity (kgs/hect)			Production (lakh/ton)		
		Kharif	Rabi	Total	Kharif	Rabi	Total	Kharif	Rabi	Total
Average of preceding 5 years		2.59	1.39	3.98	422	362	402	1.09	0.5	1.59
1	2005-2006	2.52	1.33	3.85	487	320	429	1.23	0.42	1.65
2	2006-2007	2.46	1.48	3.94	325	430	364	0.8	0.64	1.44
3	2007-2008	2.86	1.52	4.38	490	434	439	1.4	0.52	1.92
4	2008-2009	2.07	1.13	3.2	444	393	426	0.92	0.44	1.36
5	2009-2010	2.05	1.02	3.07	103	410	204	0.21	0.42	0.63

4.3.11. Black gram

Black gram is sown mostly in Rabi season. The crop is extensively Sown in Krishna, Guntur, Srikakulam, East Godavari, West Godavari SPS Nellore, Medak, Vizainagaram, Nizamabad and Adilabad, districts which Accounted for 88.9 percent of the total area under the crop in the State during 2009-2010, Krishna and Srikakulam districts alone show 51.9 percent of total area under this crop. The area sown under the Black gram was 4.29 lakhs hectares in 2009-2010 as against 3.38 lakhs hectares 2008-2009, showing an increase of26.9 percent.The production of Black gram was increased by 22.3 percent as Compared to the previous year. The increase in production is due to an increase in area of the crop. The yield rate of Black gram was increased to 626 Kgs/hect, in 2009-2010 from 653 Kgs/hect. in 2008-2009. The area, productivity and production of Black gram from 2005-2006 to 2009-2010 are shown in the Table 4.14.

Table 4.14:Area, Productivity and Production of Black gram in Andhra Pradesh.

S.No	Year	Area (lakh/hect)			Productivity (kgs/hect)			Production (lakh/ton)		
		Kharif	Rabi	Total	Kharif	Rabi	Total	Kharif	Rabi	Total
Average of preceding 5 years		0.8	3.57	4.37	451	644	610	0.36	2.3	2.61
1	2005-2006	0.79	3.42	4.21	427	632	593	0.34	2.16	2.5
2	2006-2007	0.82	4.16	4.98	275	788	703	0.22	3.28	3.5
3	2007-2008	0.96	4.07	5.03	508	493	496	0.49	2.01	2.5
4	2008-2009	0.69	2.69	3.38	586	670	653	0.4	1.8	2.2
5	2009-2010	0.83	3.46	4.29	154	739	626	0.13	2.56	2.69

4.3.12. Horse gram

Horse gram is raised in both Kharif and Rabi seasons. The area under Horse gram is 0.59 lakhs hectares or 0.5 percent of the total cropped area in the State. This crop is predominantly grown in Chittoor, Vizainagaram, Ananthapur, Srikakulam, Mahabubnagar, Visakhapatnam, and Nalgonda districts together accounted for 91.8 percent of the total area under the crop in the state during. 2009-2010. the area, productivity and production of Horse gram from2005-2006 to 2009-2010 are given in Table 4.15.

Table 4.15:Area, Productivity and Production of Horse gram in Andhra Pradesh.

S.No	Year	Area (lakh/hect)			Productivity (kgs/hect)			Production (lakh/ton)		
		Kharif	Rabi	Total	Kharif	Rabi	Total	Kharif	Rabi	Total
Average of preceding 5 years		0.08	0.47	0.55	488	416	427	0.04	0.2	0.24
1	2005-2006	0.1	0.47	0.57	496	345	371	0.05	0.16	0.21
2	2006-2007	0.1	0.54	0.64	441	475	470	0.05	0.25	0.3
3	2007-2008	0.07	0.43	0.5	562	482	493	0.04	0.21	0.25
4	2008-2009	0.04	0.34	0.38	488	409	419	0.02	0.14	0.16
5	2009-2010	0.2	0.39	0.59	653	598	617	0.13	0.23	0.36

4.3.13. Cow gram

Cow gram crop is mostly grown in Karimnagar, Khammam, Warangal, Nalgonda and Medak, districts which together accounted for 70.5 percent of the total area under the crop in the State. The area, productivity and production of Cow gram from 2005-2006 to 2009-2010 are given in the table – 4.16.

Table 4.16:Area, Productivity and Production of Cow gram in Andhra Pradesh.

S.no	Year	Area in lakh hects			Productivity in Kgs/hects.			Production in lakh tonnes		
		Kharif	Rabi	Total	Kharif	Rabi	Total	Kharif	Rabi	Total
Average of preceding 5 years		0.07	0.14	0.21	340	459	419	0.02	0.07	0.09
1	20052006	0.08	0.14	0.22	299	472	409	0.02	0.07	0.09
2	20062007	0.06	0.13	0.19	315	379	361	0.02	0.05	0.07
3	20072008	0.05	0.15	0.2	414	488	469	0.02	0.07	0.09
4	20082009	0.07	0.13	0.2	425	662	582	0.03	0.09	0.12
5	20092010	0.06	0.17	0.23	265	552	479	0.01	0.09	0.1

4.3.14 Other Pulses

Other Pulses are raised in both Kharif and Rabi seasons, Visakhapatnam, Chittoor and Nizamabad districts together accounted for 85.1 percent of the total area under the crop in the

State. The area, productivity and production of other pulses from 2005-2006 to 2009-2010 are given in the Table – 4.17.

Table 4.17:Area, Productivity and Production of Other pulses in Andhra Pradesh.

S.No	Year	Area (lakh/hect)			Productivity (kgs/hect)			Production (lakh/ton)		
		Kharif	Rabi	Total	Kharif	Rabi	Total	Kharif	Rabi	Total
Average of preceding 5 years		0.06	0.02	0.08	331	798	510	0.02	0.02	0.04
1	2005-2006	0.07	0.02	0.09	218	98	189	0.02	N	0.02
2	2006-2007	0.05	0.01	0.06	267	518	324	0.01	0.01	0.02
3	2007-2008	0.06	0.03	0.09	407	1685	809	0.03	0.04	0.07
4	2008-2009	0.03	0.02	0.05	490	1532	989	0.01	0.04	0.05
5	2009-2010	0.03	0.02	0.05	490	1532	989	0.02	0.02	0.04

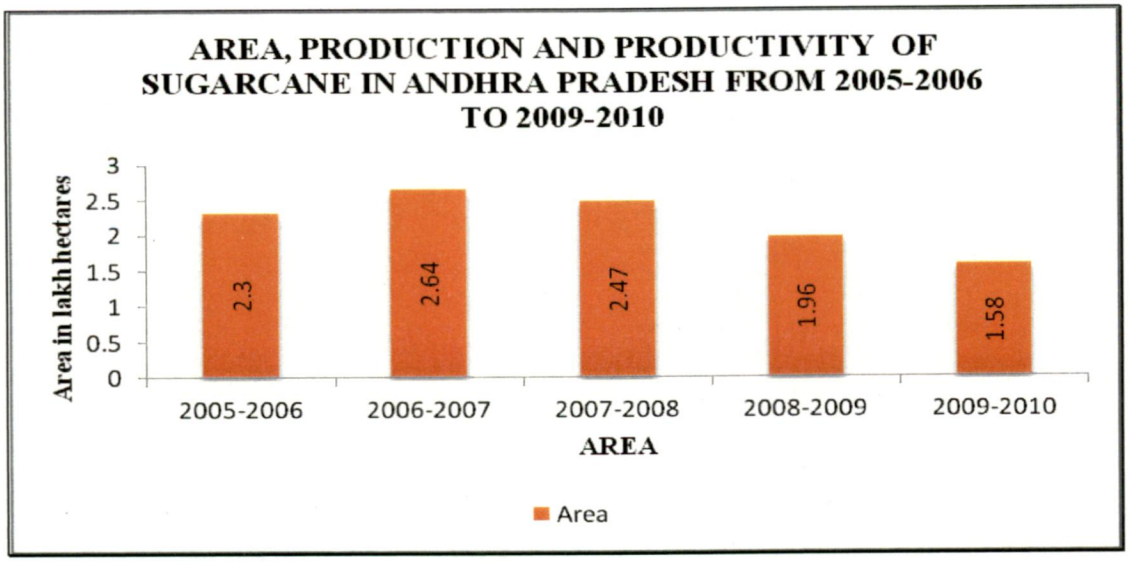
4.3.15 Sugarcane

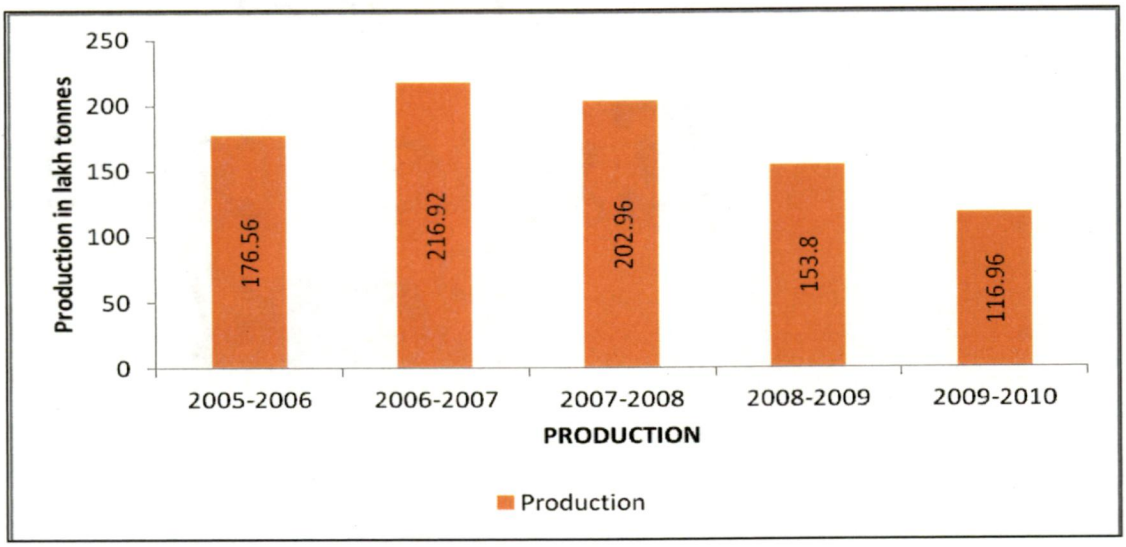
Sugarcane is an important commercial crop in the state. It is mainly an irrigated crop. Adsali variety crop which is grown only in Nizamabad district and it is a long duration crop of more than one year sown in the month of December/January and harvested in February/March of the succeeding year. Visakhapatnam, Chittoor, West Godavari, Medak, Vizainagaram, west Godavari, Krishna and Nizamabad districts together accounted for 90.6 percent of the total area under the crop in the state during 2009-2010. The area under Sugarcane was 1.58 lakhs hectares in 2009-2010 as against 1.96 lakhs hect. in 2008-2009, showing a decrease by 19.4 percent during 2009-2010.The production of Sugarcane was estimated at 116.96 lakhs tonnes during 2009-2010 as against 153.80 lakhs tonnes in 2008-2009 recording a decrease of 23.9 percent. It was due to a decrease in area of the crop and average yield per hectare in 2008-2009.The yield rate of Sugarcane was 74102 Kgs/hect. in 2009-2010 as against 78434 Kgs/hect. in 2008-2009 decreased by 5.5 percent. The area, productivity and production of Sugarcane from 2005-2006 to 2009-2010 are shown in table 4.18.

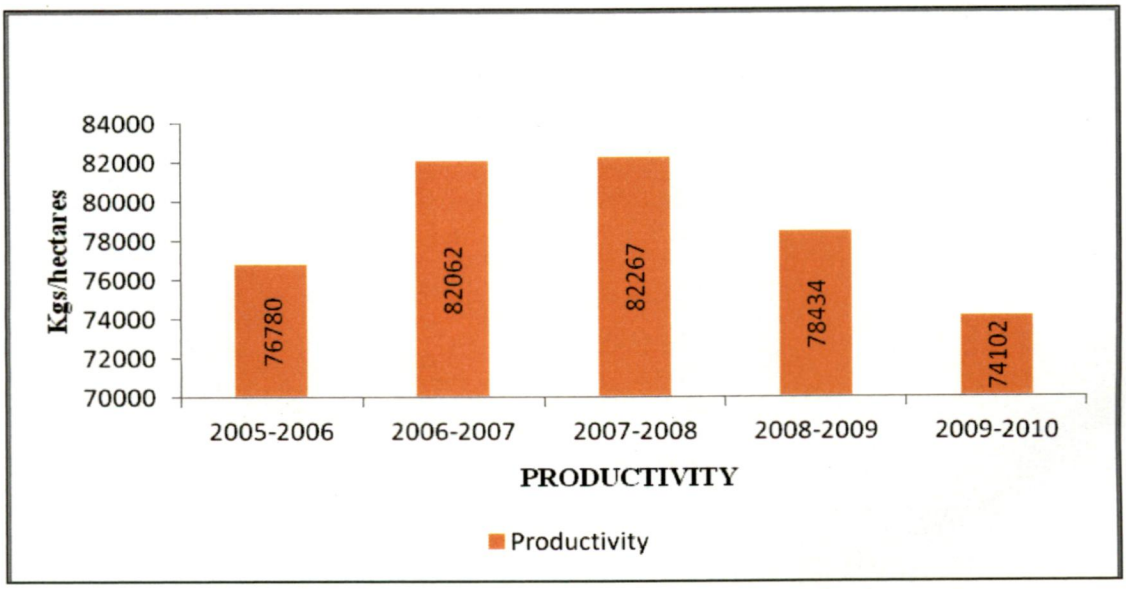
Table 4.18: Area, Productivity and Production of Sugarcane in Andhra Pradesh.

S.No	Year	Area (lakh/hect) (coming for harvest)	Productivity (kgs/hect)		Production (lakh/ton)	
			Cane	Gur	Cane	Gur
Average of preceding 5 years		2.29	78931	8258	181.53	19.05
1	2005-2006	2.3	76780	8110	176.56	18.65
2	2006-2007	2.64	82062	8957	216.92	23.67
3	2007-2008	2.47	82267	8682	202.96	21.42
4	2008-2009	1.96	78434	8035	153.8	15.76
5	2009-2010	1.58	74102	7507	116.96	11.85

Fig 4.6: Area and Production of Sugarcane during (2005-2010) in Andhra Pradesh.







4.3.16 Chillies

Chillies are one of the important crops in condiments and Spices group. Andhra Pradesh State stands first in the country in terms of area and production of Chillies crop during 2009-2010. The crop is grown both under irrigated and unirrigated conditions in both Kharif and Rabi seasons. The area under chillies during the year 2009-2010 was 2.07 lakhs hectares and occupied 2.0 percent in gross cropped area.The crop is extensively grown in Guntur, Khammam Warangal, Prakasam, and Kurnool, districts. These districts together accounted 74.3 percent of the total area under the crop in the state and Guntur district alone accounts for 32.4 percent of total area under the crop. The area sown under chillies was 2.07 lakhs hectares during 2009-2010 as against 2.03 lakhs hectares in 2008-2009 and showing an increase of 2.0 percent. The production of chillies was 8.31 lakhs tonnes in2009-2010 as against 7.73 lakhs tonnes in 2008-2009, registering an increase of 7.5 percent, due to increase in the area and average yield per hectare during 2009-2010. The average productivity of Chillies has registered as 4023 Kgs per hectares. in 2009-2010 from 3803 Kgs/hect. in 2008-2009. The area, productivity and production of Chillies from 2005-2006 to 2009-2010 is given in Table 4.19

Table 4.19: Area, Productivity and Production of Chillies in Andhra Pradesh.

S.No	Year	Area (lakh/hect)			Productivity (kgs/hect)			Production (lakh/ton)		
		Kharif	Rabi	Total	Kharif	Rabi	Total	Kharif	Rabi	Total
Average of preceding 5 years		1.63	0.47	2.10	3540	3052	3429	5.76	1.43	7.19
1	2005-2006	1.28	0.44	1.72	3268	2753	3136	4.17	1.21	5.38
2	2006-2007	1.65	0.49	2.14	3698	3179	3579	6.10	1.56	7.66
3	2007-2008	1.74	0.49	2.23	3669	2731	3463	6.38	1.34	7.72
4	2008-2009	1.60	0.43	2.03	3846	3644	3803	6.15	1.58	7.73
5	2009-2010	1.57	0.5	2.07	4090	3815	4023	6.40	1.91	8.31

4.3.17 Onions

Onion crop is one of the important vegetable crops in the state. It is grown in both Kharif and Rabi seasons in the State mainly under irrigated conditions. An area of 0.37 lakhs hectares or 0.3 percent of the total cropped area in the State is under Onions crop during 2009-2010. It is extensively cultivated in Kurnool, Medak and Mahabubnagar districts. These districts together accounted for 59.0 percent of the total area under the crop in the State. During 2009-2010 the area cultivated under this crop 0.37 lakhs hectare as against 0.41 lakhs hectare in 2008-2009 and showing a decrease of 9.8 percent.The production of Onion crop is estimated at 7.08 lakhs tonnes by 2009-2010 as against 7.29 lakhs tonnes by 2008-09 and showing a

decrease of 2.9 percent. The productivity of Onions was estimated at 19367 Kgs per hectares in 2009-2010 as against 18009 Kgs/hect. in 2008-2009, showing an increase of 7.5 percent. The area, productivity and production of Onions from 2005-2006 to 2009-2010 are presented in the table 4.20.

Table 4.20: Area, Productivity and Production of Onions in Andhra Pradesh.

S.No	Year	Area (lakh/hect)			Productivity (kgs/hect)			Production (lakh/ton)		
		Kharif	Rabi	Total	Kharif	Rabi	Total	Kharif	Rabi	Total
Average of preceding 5 years		0.22	0.14	0.36	16701	21382	18475	3.69	2.92	6.61
1	2005-2006	0.20	0.16	0.36	17823	20818	19136	3.64	3.32	6.96
2	2006-2007	0.19	0.12	0.31	16496	21915	18668	3.07	2.72	5.79
3	2007-2008	0.23	0.14	0.37	17007	22000	18894	3.90	3.10	7.00
4	2008-2009	0.27	0.14	0.41	16452	21038	18009	4.40	2.89	7.29
5	2009-2010	0.23	0.14	0.37	16328	24492	19367	3.75	3.33	7.08

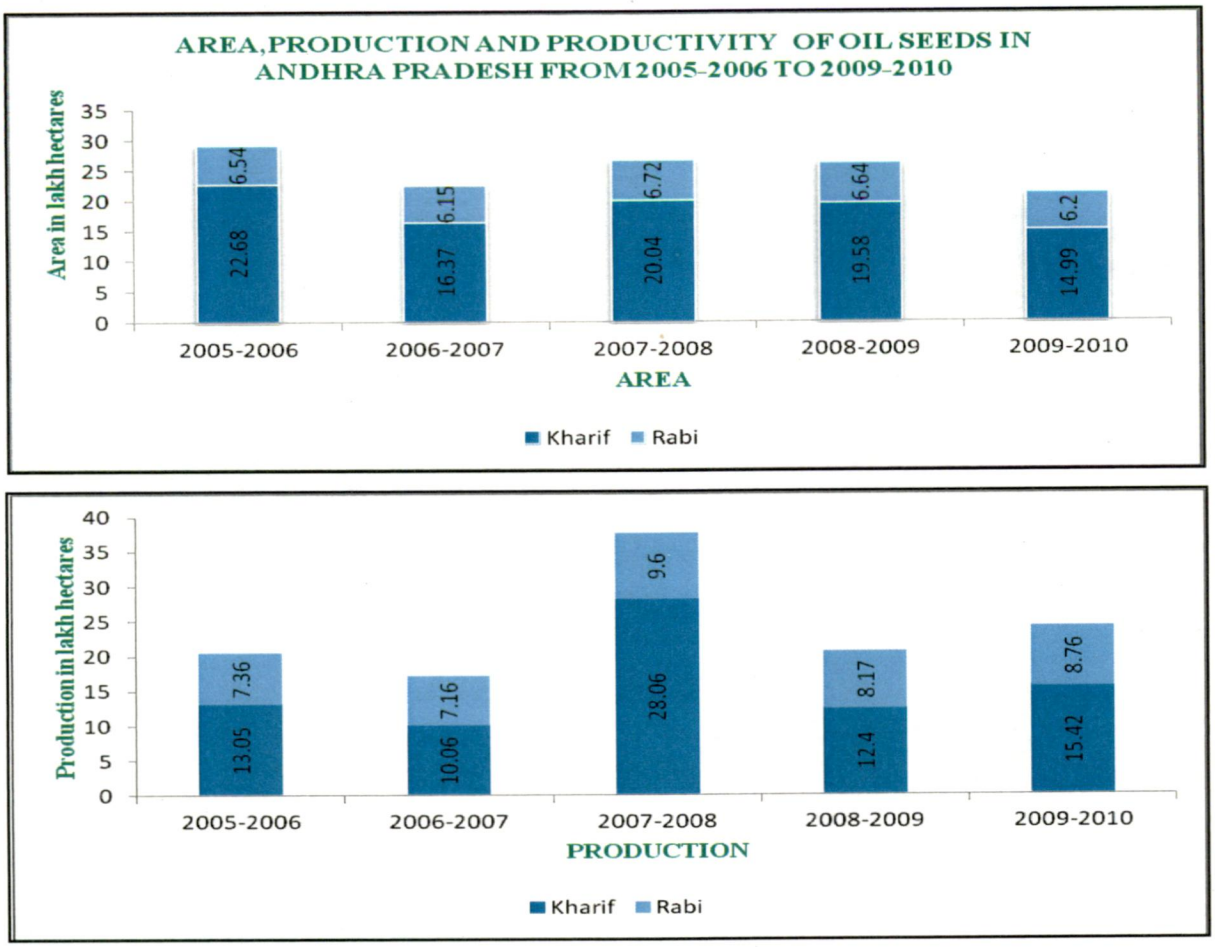
4.3.18 Oil Seeds

Andhra Pradesh is one of the important States in the country growing Oil seed crops like Groundnut, Sunflower and Castor. The area under Oil seeds during 2009-2010 was 21.19 lakhs hectares which constituted 16.9 percent of the total cropped area in the State. The area under oil seeds was 21.19 lakhs hectares during 2009-2010 as against 26.22 lakhs hectares in 2008-2009, recording a decrease of 19.2 percent.Out of 24.18 lakhs tonnes of production of oil seeds, Groundnut, Sunflower and Castor accounted for 10.07, 2.69 and 0.64 lakhs tones respectively .Which together accounted for 55.4 percent of the total oil seeds production in the State. The production of oil seeds was 24.18 lakhs tonnes during 2009-2010 as against 20.57 lakhs tonnes in 2008-2009, showing an increase of 17.5 percent .The area and production of Oil seeds from 2005-2006 to 2009-2010 are shown in table –4.21

Table 4.21:Area, Productivity and Production of Oil seeds in Andhra Pradesh.

S.No	Year	Area (lakh/hect)			Production (lakh/ton)		
		Kharif	Rabi	Total	Kharif	Rabi	Total
Average of preceding 5 years		20.27	6.51	26.78	15.86	7.72	23.58
1	2005-2006	22.68	6.54	29.22	13.05	7.36	20.41
2	2006-2007	16.37	6.15	22.52	10.06	7.16	17.22
3	2007-2008	20.04	6.72	26.76	28.06	9.6	37.66
4	2008-2009	19.58	6.64	26.22	12.4	8.17	20.57
5	2009-2010	14.99	6.2	21.19	15.42	8.76	24.18

Fig 4.7: Area and Production of Oil seeds during (2005-2010) in Andhra Pradesh.



4.3.19. Groundnut

Groundnut is one of the important Oilseed crops mostly cultivated under rained fed conditions and is cultivated in almost all districts. The area under Oilseeds during 2009-2010 was 22.23 lakhs hectares which constituted 17.7 percent of the total cropped area in the State.Out of which, Groundnut alone accounted for 58.52 percent of the total area under Oilseeds. The area is recorded in Ananthapur, Kurnool, Chittoor, and Kadapa, districts and Ananthapur district accounted for 49.3 percent of the total area of the state under Groundnut crop in the State during 2009-2010.

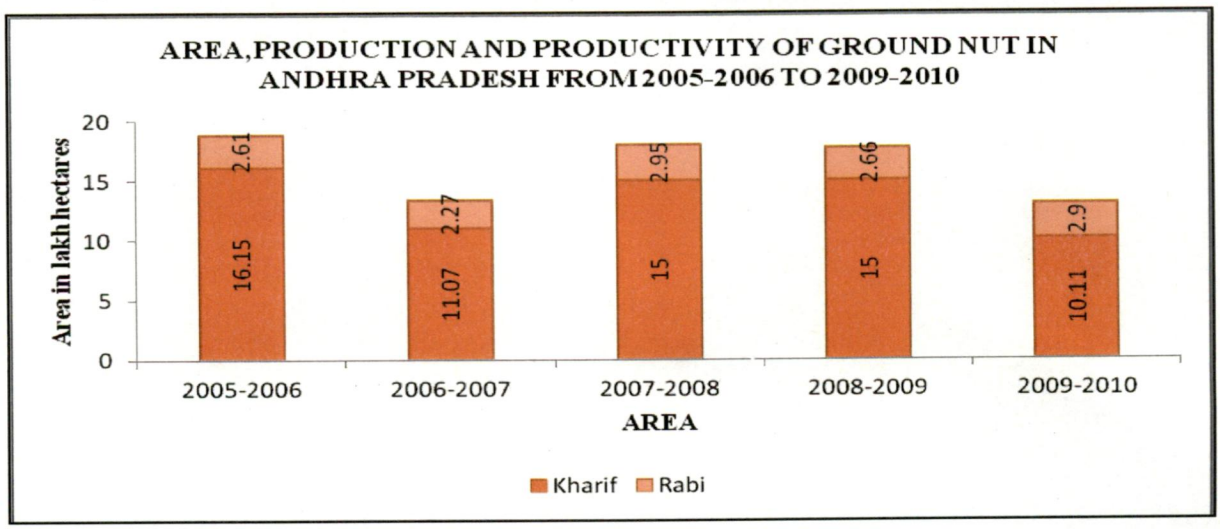
The area sown under Groundnut was 13.01 lakhs hectares during in 2008-2009 as against 17.66 lakhs hectares in 2008-2009 and showing decrease of 26.3 percent.In terms of production, during the year 2009-2010 Groundnut recorded at 10.07 lakhs tonnes which is 41.6 percent of the total Oil Seeds production in the state. The production of Groundnut during 2009-2010 was 10.07 lakhs tonnes as against 9.73 lakhs tonnes in 2008-2009 and

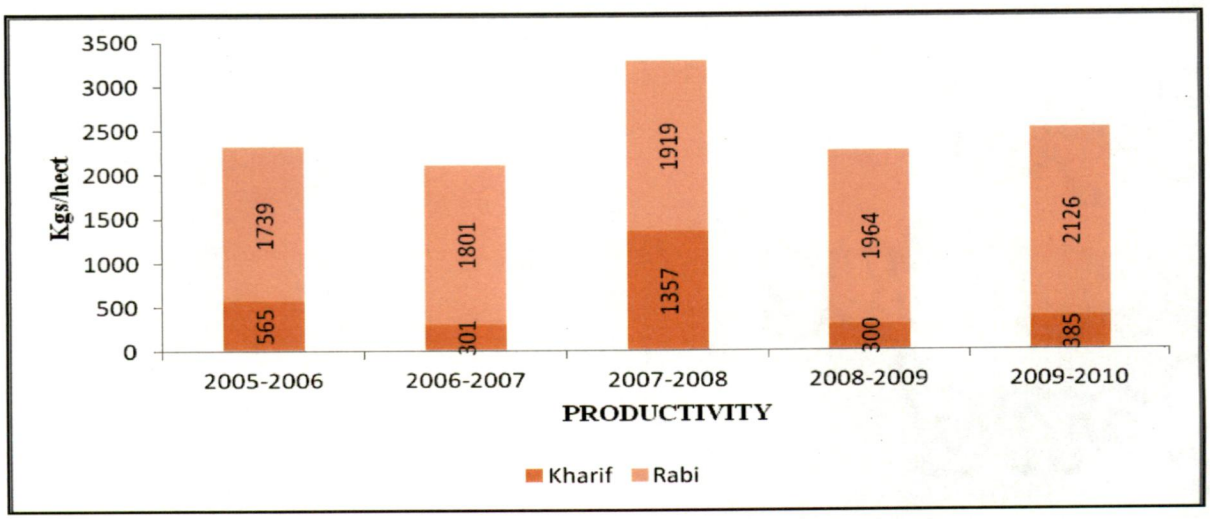
showing an increase of 3.5 percent due to increase in an average yield per hectare during 2009-2010.The yield rate of Groundnut was increased to 774 Kgs/hect.In 2009-2010 as against 551 Kgs/hect.In 2008-2009 recording an increase of 40.5 percent. The area, productivity and production of Groundnut from 2005-2006 to 2009-2010 are presented in table-4.22

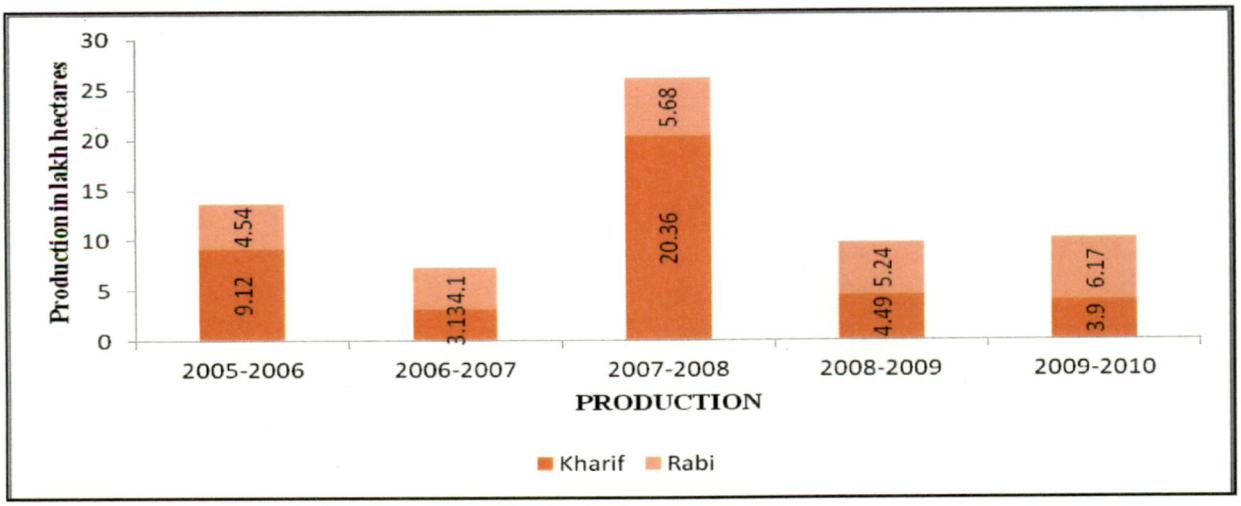
Table 4.22: Area, Productivity and Production of Ground nut in Andhra Pradesh.

S.No	Year	Area (lakh/hect)			Productivity (kgs/hect)			Production (lakh/ton)		
		Kharif	Rabi	Total	Kharif	Rabi	Total	Kharif	Rabi	Total
Average of preceding 5 years		14.65	2.57	17.22	660	1816	835	9.96	4.69	14.65
1	2005-2006	16.15	2.61	18.76	565	1739	728	9.12	4.54	13.66
2	2006-2007	11.07	2.27	13.34	301	1801	557	3.13	4.10	7.43
3	2007-2008	15.00	2.95	17.95	1357	1919	1449	20.36	5.68	26.04
4	2008-2009	15.00	2.66	17.66	300	1964	551	4.49	5.24	9.73
5	2009-2010	10.11	2.90	13.01	385	2126	774	3.90	6.17	10.07

Fig 4.8: Area and Production of Groundnut during (2005-2010) in Andhra Pradesh.







4.3.20 Sesamum

The crop is cultivated both in Kharif and Rabi seasons in the state. Kharif crop is sown in the months of June and July and Rabi crop is sown in October. Vizainagaram, Prakasam, Warangal, Srikakulam, Kadapa, Adilabad Karimnagar, and Visakhapatnam, districts together accounted for 76.8 percent of the total area under this crop in the state during 2009-2010. The area sown under Sesamum was 0.90 lakhs hectares in 2009-2010 as against 0.80 lakhs hectares in 2008-2009, showing an increase of 12.5 percent.The production of Sesamum was 0.20 lakhs tonnes in 2009-2010 as against 0.19 lakhs tonnes in 2008-2009, showing an increase of 5.3 percent due to an increase in the area during 2008-09.The yield rate of Sesamum was 229 Kgs/hects in 2009-2010 as against 234 Kgs/hects., in 2008-2009 showing a decrease of 2.1 percent. The area, Productivity and production of Sesamum from 2005-2006 to 2009-2010 are given in table-4.23.

Table 4.23: Area, Productivity and Production of Sesamum in Andhra Pradesh.

S.No	Year	Area (lakh/hect)			Productivity (kgs/hect)			Production (lakh/ton)		
		Kharif	Rabi	Total	Kharif	Rabi	Total	Kharif	Rabi	Total
Average of preceding 5 years		0.92	0.35	1.27	203	302	230	0.17	0.11	0.28
1	2005-2006	0.79	0.37	1.16	205	343	249	0.16	0.13	0.29
2	2006-2007	0.80	0.34	1.14	230	308	253	0.18	0.11	0.29
3	2007-2008	0.82	0.31	1.13	231	245	235	0.19	0.08	0.27
4	2008-2009	0.46	0.34	0.80	209	267	234	0.10	0.09	0.19
5	2009-2010	0.47	0.43	0.90	198	263	229	0.09	0.11	0.20

4.3.21 Sunflower

Sunflower is an important oil seed crop in the State. It is cultivated both in Kharif and Rabi seasons. It is extensively cultivated in Kurnool, Ananthapur, Kadapa, Mahabubnagar, Prakasam, Nizamabad and Medak districts and these districts together accounted for 93.8 percent of the total area under this crop in the state during 2009-2010. The area sown under Sunflower was 3.51 lakhs hectare in 2009-2010 as against 4.19 lakhs hectares in 2008-2009 showing a marginal decrease of 16.2 percent. The production of Sunflower was 2.69 lakhs tonnes in 2009-2010 as against 3.26 lakhs tonnes in 2008-2009 and showing a decrease of 17.5 percent, due to decrease in the area and average yield per hectare. The yield rate of sunflower was 771 Kgs. /hects in 2009-2010 as against 780 Kgs/hects. in 2008-2009, showing a decrease of 1.2 percent. The area, productivity and production of Sunflower from 2005-2006 to 2009-2010 are presented in table 4.24.

Table 4.24: Area, Productivity and Production of Sunflower in Andhra Pradesh.

S.No	Year	Area (lakh/hect)			Productivity (kgs/hect)			Production (lakh/ton)		
		Kharif	Rabi	Total	Kharif	Rabi	Total	Kharif	Rabi	Total
Average of preceding 5 years		1.21	3.21	4.42	516	861	765	0.61	2.75	3.36
1	2005-2006	1.31	3.13	4.44	349	802	669	0.46	2.52	2.98
2	2006-2007	1.28	3.18	4.46	405	874	739	0.52	2.77	3.29
3	2007-2008	1.16	3.10	4.26	632	1176	1028	0.73	3.64	4.37
4	2008-2009	0.89	3.3	4.19	641	817	780	0.57	2.69	3.26
5	2009-2010	0.93	2.58	3.51	375	912	771	0.34	2.35	2.69

4.3.22. Castor

The castor is cultivated in Kharif season in the State. It is extensively cultivated in; Mahabubnagar, Kurnool, Nalgonda, Prakasam and Ranga Reddy districts and these districts together account for 96.4 percent of the total area in the State during 2009-2010 and Mahabubnagar district alone shared 57.0 percent of total area under this crop. The area sown under Castor was 1.48 lakhs hectares in 2009-2010 as against 1.59 lakhs hectares 2008-2009, recording a decrease of 6.9 percent.The production of castor during 2009-2010 was 0.64 lakhs tonnes as against 0.81 lakhs tonnes in 2008-2009, recording a decrease of 21.0 percent, and due to decrease in area and yield per hectare during 2009-2010.The yield rate of Castor was 432 Kgs/hects in 2009-2010 as against 511 Kgs. /hect. in 2008-2009, showing a decrease of 15.5 percent. The area, productivity and production of Castor from 2005-2006 to 2009-2010 are presented in table – 4.25.

Table 4.25: Area, Productivity and Production of Castor in Andhra Pradesh.

S.No	Year	Area (lakh/hect)			Productivity (kgs/hect)			Production (lakh/ton)		
		Kharif	Rabi	Total	Kharif	Rabi	Total	Kharif	Rabi	Total
Average of preceding 5 years		2.35	N	2.35	478	0	478	1.08	0	1.08
1	2005-2006	3.45	0	3.45	407	0	407	1.4	0	1.40
2	2006-2007	2.02	0	2.02	430	0	430	0.87	0	0.87
3	2007-2008	1.99	0	1.99	654	0	654	1.29	0	1.29
4	2008-2009	1.57	0.02	1.59	511	0	511	0.81	0	0.81
5	2009-2010	1.46	0.02	1.48	431	829	432	0.63	0.01	0.64

4.3.23 Cotton

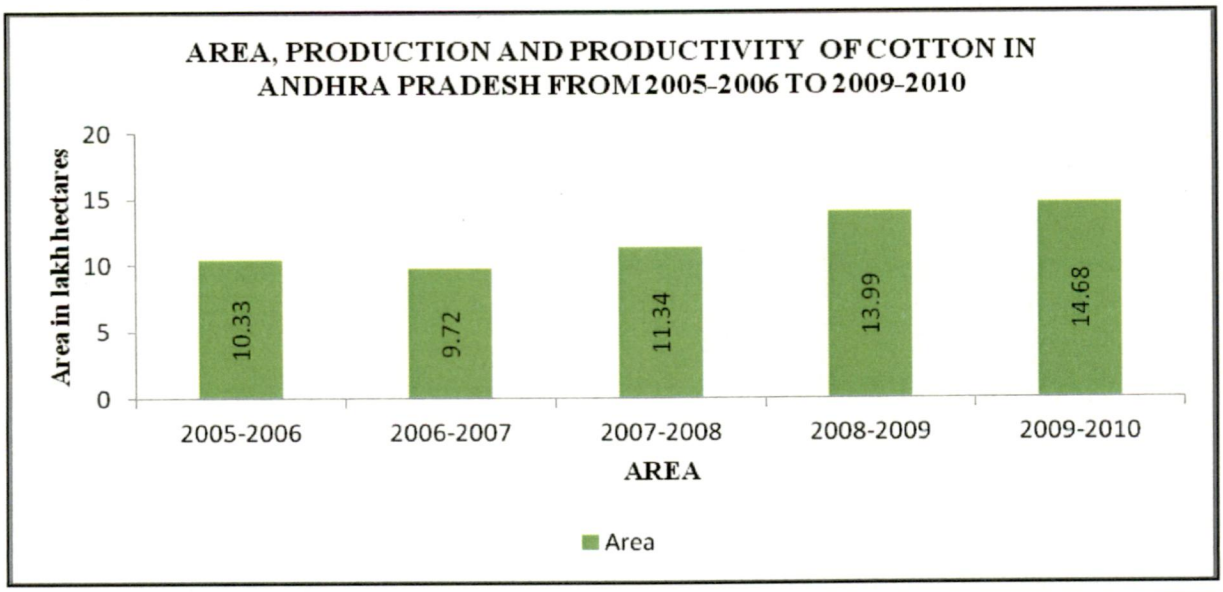
Cotton is an important Fibre crop grown in Kharif season in the state, mainly as un-irrigated crop. Andhra Pradesh is one of the first three states along with Gujarat, Maharashtra in India in respect of area and production of cotton. During Kharif season, the crop is mainly raised as a rain-fed crop in the traditional areas of Adilabad, Karimnagar, Warangal, Guntur Nalgonda and Khammam districts and in few other pockets of Mahabubnagar, Medak, Krishna, Kurnool, Prakasam, Rangareddy and Nizamabad. Area under Cotton during the year 2009-2010 was 14.68 lakhs hectares which is accounted for 11.7 percent of gross cropped area in the state. Adilabad, Karimnagar, Warangal, Guntur, Nalgonda and Khammam districts together accounted for 74.0 percent total area under the crop in the State during 2009-2010. The area under crop was 14.68 lakhs hect.During 2009-2010 as against 13.99 lakhs hect in 2008-2009, recording an increase by 4.9 percent.

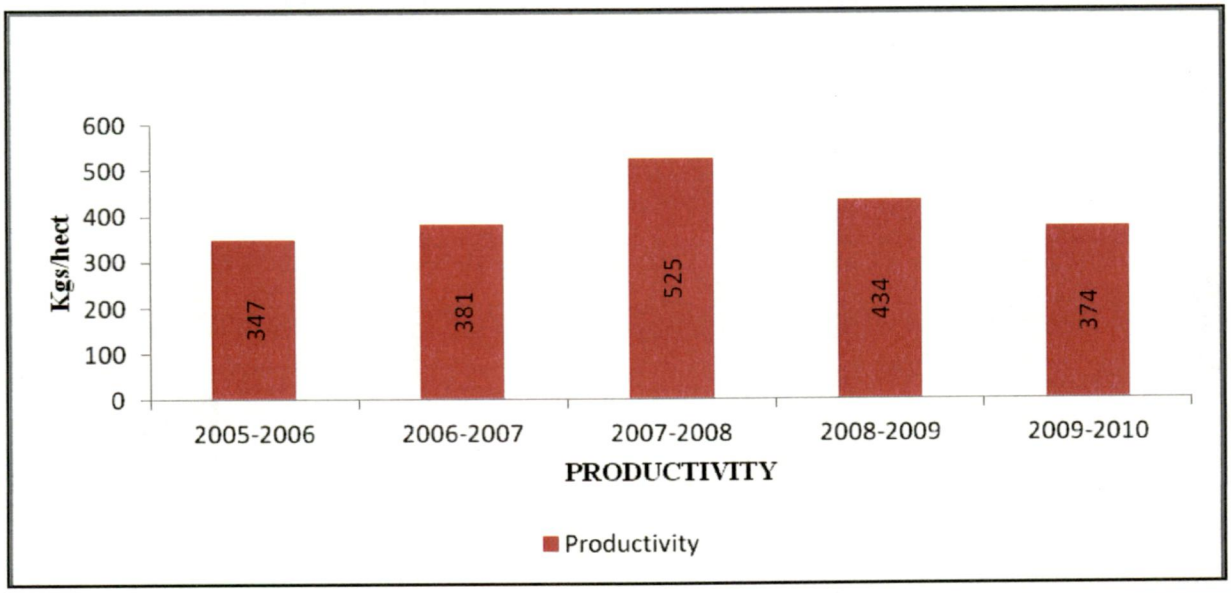
The production of Cotton in the State was 32.32 lakhs bales of 170 Kgs in 2009-2010 (lint) as compared to 35.69 lakhs bales in 2008-2009 recording a decrease of 9.4 percent and due to increase in area during 2009-2010. The area, productivity and production of Cotton from 2005-2006 to 2009-2010 are presented in the table – 4.26.

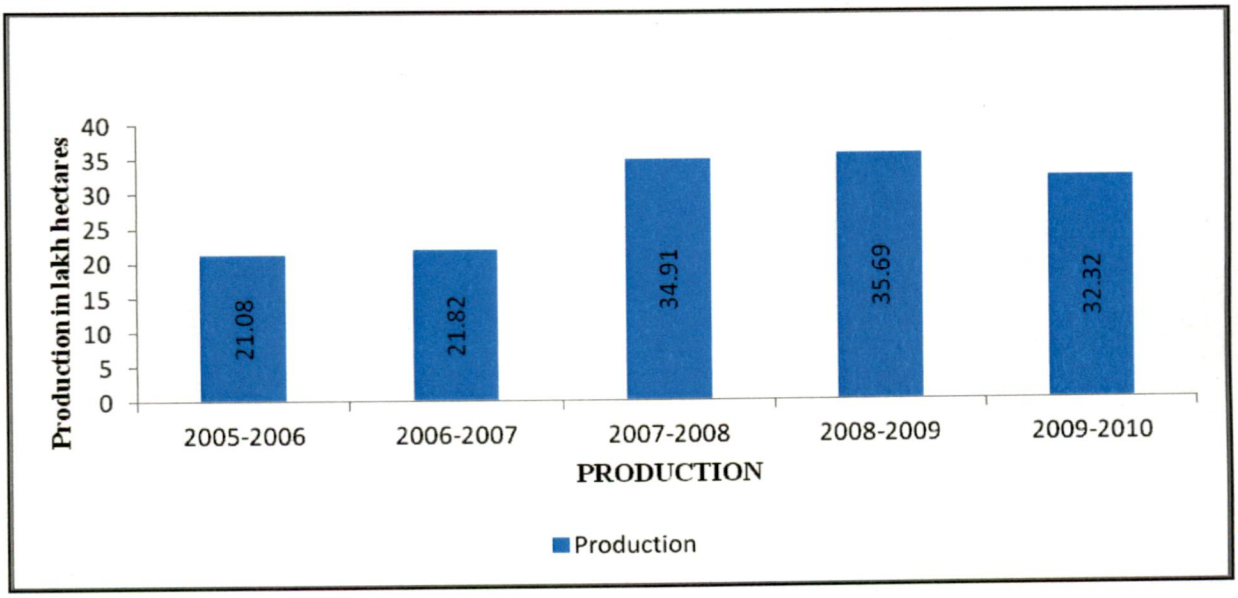
Table 4.26: Area, Productivity and Production of Cotton in Andhra Pradesh.

S.No	Year	Area (lakh/hect)	Productivity (kgs/hect)	Production (lakh/ton)
Average of preceding 5 years		11.43	401	27.08
1	2005-2006	10.33	347	21.08
2	2006-2007	9.72	381	21.82
3	2007-2008	11.34	525	34.91
4	2008-2009	13.99	434	35.69
5	2009-2010	14.68	374	32.32

Fig 4.9: Area and Production of Cotton during (2005-2010) in Andhra Pradesh.







4.3.24 Mesta

Mesta crop is mostly confined to Vizainagaram and Srikakulam districts which together account for 98.8 percent of the total area under the crop in the state during 2009-2010. The area sown under Mesta was 0.23 lakhs hectares in 2009-2010 as against 0.37 lakhs hectares in 2008-2009 showing a decrease of 37.8 percent.

The production of Mesta was 1.91 lakhs bales of 180 Kgs each bale during 2009-2010 as against 2.95 lakhs bales in 2008-2009 and showing a decrease of 35.3 percent due to a decrease in area during 2009-2010. The area, productivity and production of Mesta crop from 2005-2006 to 2009-2010 are presented in table 4.27.

Table 4.27: Area, Productivity and Production of Mesta in Andhra Pradesh.

S.No	Year	Area (lakh/hect)	Productivity (kgs/hect)	Production (lakh/ton)
Average of preceding 5 years		0.52	1559	4.51
1	2005-2006	0.5	1645	4.55
2	2006-2007	0.62	1581	5.44
3	2007-2008	0.57	1601	5.01
4	2008-2009	0.37	1431	2.95
5	2009-2010	0.23	1495	1.91

4.3.25 Tobacco

Tobacco is the major export crop in the state. Andhra Pradesh is ranked first in area and second in Production of Tobacco among the states in the country. The crop is mainly sown during Rabi season. There are two varieties of Tobacco viz: Virginia and natu.Prakasam, West Godavari, Kurnool and SPS Nellore districts together account for 78.5 percent of the total area in the State during 2009-2010. Area under crop was 1.99 lakhs hects.

During 2009-2010 as against 1.71 lakhs hects.In 2008-2009 showing an increase of 16.4 percent.The production of Tobacco during 2009-2010 was 3.60 lakhs tonnes as Against 3.14 lakhs tonnes in 2008-2009, recording an increase of 14.6 percent, due to an increase in area during 2009-2010. The area, productivity and Production of Tobacco from 2005-2006 to 2009-2010 are given in the table 4.28.

Table 4.28: Area, Productivity and Production of Tobacco in Andhra Pradesh.

S.No	Year	Area (lakh/hect)	Productivity (kgs/hect)	Production (lakh/ton)
Average of preceding 5 years				
1	Virginia	1.04	1325	1.38
	Natu	0.32	2161	0.69
	Total	1.36	1498	2.07
2	2005-2006			
	Virginia	0.98	1272	1.25
	Natu	0.36	2022	0.73
	Total	1.34	1474	1.98
3	2006-2007			
	Virginia	0.99	1225	1.22
	Natu	0.28	2155	0.6
	Total	1.27	1429	1.82
4	2007-2008			
	Virginia	0.92	1308	1.15
	Natu	0.28	2490	0.6
	Total	1.2	1458	1.75
5	2008-2009			
	Virginia	1.3	1613	2.11
	Natu	0.41	2541	1.03
	Total	1.71	1834	3.14
6	2009-2010			
	Virginia	1.51	1691	2.55
	Natu	0.48	2185	1.05
	Total	1.99	1810	3.6
District-wise /crop-wise, area, productivity and production are given in summary table/Detailed tables.				

CHAPTER 5

AGROO-CLIMATIC ZONING OF AP

5.1 Introduction:

Agro-climatological zoning is defined as the division of a certain area into several zones, according to the degree of favourability for growing a given crop using climate factors (Todorov, 1981). According to Bishnoi (1989), agro-climatological zoning is a useful tool for agricultural planning of new lands that need to be brought under cultivation and also for using old land resources more judiciously. Agro-climatic classifications have proved to be of great utility for planning and management of various agricultural and Forestry activities (Yazdanpanah *et al.*, 2001). Agro-climatic zoning for specialised purposes like epidemic and spread of diseases, and agro-climatic zoning of particular crops, natural pastures etc are becoming important these days. This is because of the need for quantification of agro-climatic resources suitable for potential productivity in specific areas having optimum agro-climatic conditions (Bishnoi, 1989).

Comprehensive agro-climatic analyses may help to select the proper form of land exploitation, thus avoiding costly failures (Bishnoi, 1989). During the first half of 20th century, climatologists and agro climatologists tried to use well-known climatological classifications for agro-climatic zoning (Todorov, 1981). It was expected that a crop can be introduced into a new area if the climate of this area is the same or similar as the climate of the area of origin of the crop. Many of these attempts failed because the climatic comparisons between a location where the crop has been successfully grown and the proposed location cannot be based on means of climate parameters even if these refer to fairly short intervals of time like ten days (dekads) (Primault, 1977).

The mean is never representative, in actual fact it may be composed of widely diverging values but calculations of the frequencies of occurrence of specific meteorological phenomenon's should be used as a basis in determining suitable areas (Primault, 1977).In order to obtain the desired result more quickly, it is preferable to make use of the crop itself in determining suitability rather than to undertake rigorous comparison of climatological data using the annual precipitation or mean monthly temperatures (Todorov, 1981).

To avoid a failure, before a crop (or a variety of a crop) is introduced into an area, the agro-climatic suitability of the area for growing the crop has to be known (Todorov, 1981). Primault (1977) emphasized the fact that introduction of a new crop or of a new variety is meaningful from an economic point of view if the crop can be grown fairly quickly, thus the farmer should be convinced that the crop in question will reach maturity in time to be harvested. Agro-climatological zoning of a crop is done separately for each crop because different crops have different agro-climatic requirements and different responses to climate.

When varieties or cultivars of a given crop have different agro climatic requirements or lengths of growing season, the zoning should be done separately for each variety (Todorov, 1981). In addition, suitable areas for agricultural use are determined by an evaluation of environment components (climate, soil, and relief), and the understanding of local biophysical restraints. In this kind of evaluation, many variables are involved and each one should be weighting according to their relative importance on the optimal growth conditions for the specific crops (Ceballos-Silva and Lopez-Blanco, 2003). The accurate identification and the characterization of current production areas and potential production areas are essential to successful agricultural research and development (Ceballos-Silva and Lopez-Blanco, 2003).Applications of agro-climatic zoning techniques are so wide and varied, thus it is difficult to evolve a rational universal method for agro-climatic zoning (Bishnoi, 1989).

Geographic information systems (GIS) have been used for the drawing Arc Gis maps of Andhra Pradesh. The objective of this chapter is to use GIS, Precipitation (P) and Potential Evapotraspiration (PET) presented in the previous chapters to classify different regions of Andhra Pradesh according to Hargreaves (1971) proposed a classification based on Moisture adequacy index values (Hargreaves (1971).

5.2 Data and Methods:

5.2.1 Data

For this purpose, Kharif and Rabi season 29 growing crops of all districts of Andhra Pradesh were collected from Directorate of economics and statistics Government of Andhra Pradesh. The input data for determining suitable areas for different variety of crop production are the best agro climatic zones of Andhra Pradesh.

5.2.2 Methodology

The different crops indices were computed using Microsoft Excel sheet, different statistical parameters (total, mean, and percentile) of seasonal wise crops values were done using the Microsoft Excel. Arc Gis maps drawn to show percentage of crop productivity area in each crop season (Kharif & Rabi) in every district of Andhra Pradesh. Finally we showed the suitability map for growing crops in every district of Andhra Pradesh.

5.3 Results and Discussion:

The study has brought out following observations and results pertaining to agro-climatic zones for different crops in different seasons in Andhra Pradesh. **Rice** is the principal crop extensively cultivated in all the districts of the State both in Kharif and Rabi seasons. It accounted for 27.4 percent of the total cropped area, 69.5 percent of the total Food-grains production during 2009-2010. In **Kharif season** the area, productivity and production of Rice in the State for the last 5 years (2005-2010) are presented and the rice crop production estimated in West Godavari district is at the top with the (11.5%), followed by East Godavari (9.9%), Krishna (9.3%), Guntur (8.3%), Nalgonda (8.1%) and Karimnagar (6.9%),Nellore (5.4%) and Warangal (4.9%).These districts together accounted for 64.3 percent of the total area under this crop in the state during 2009-2010.

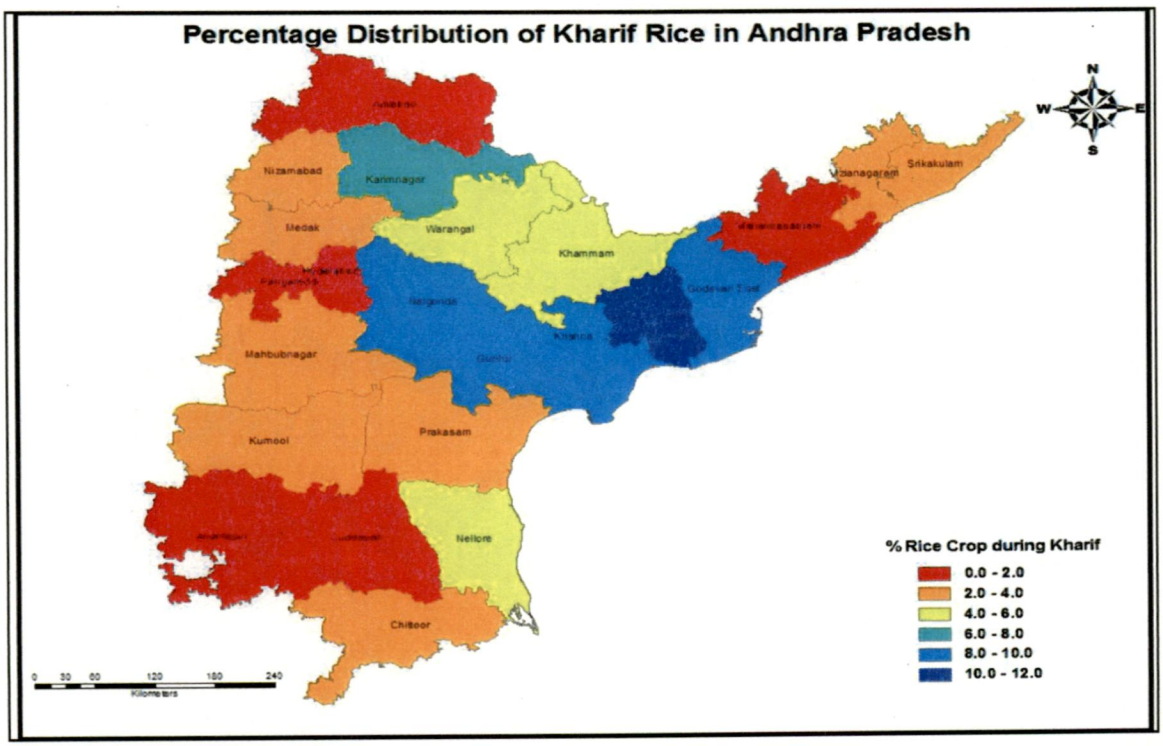
In **Rabi season** the area, productivity and production of Rice in the State for the last 5 years (2005-2010) are presented and the rice crop production estimated in West Godavari district is at the top with the (12.6%), followed by East Godavari (11.4%), Krishna (9.1%), Guntur (7.8%), Nalgonda (8.1%) and Karimnagar (6.0%),Nellore (5.9%) and Nalgonda (5.8%).These districts together accounted for 66.7 percent of the total area under this crop in the state during 2009-2010.

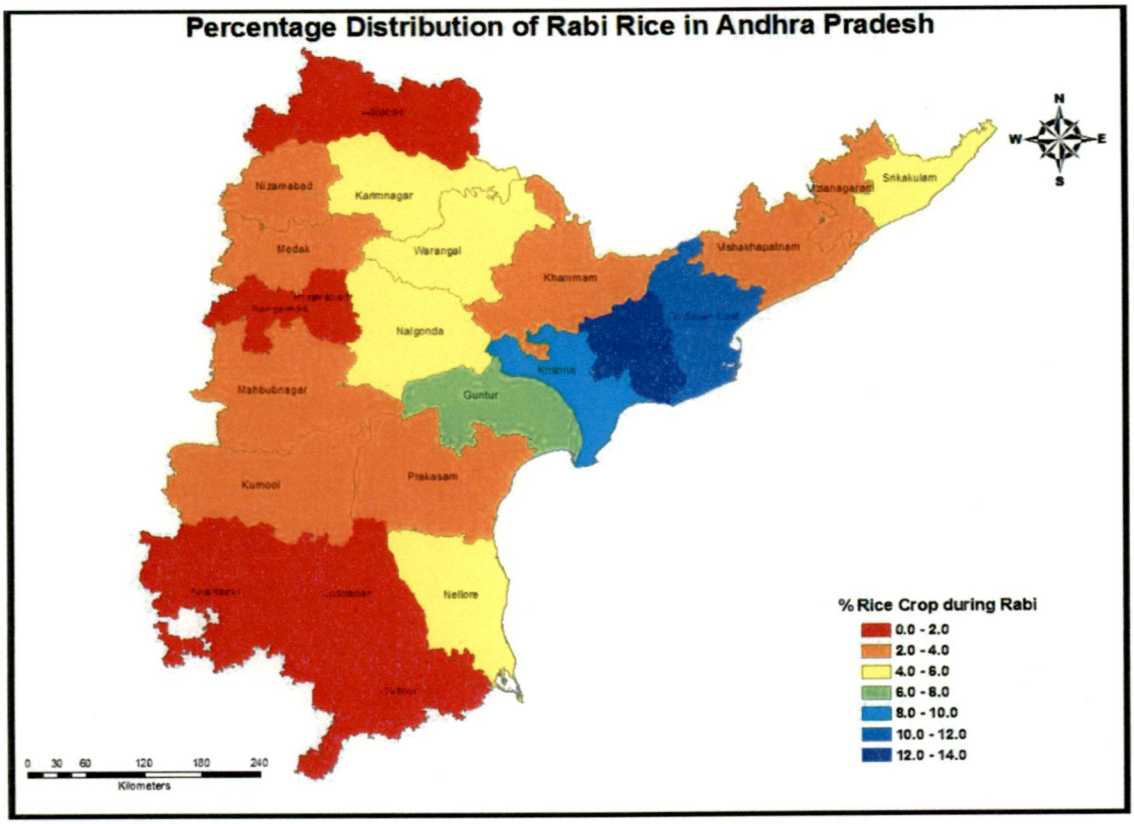
Table 5.1:District wise percentage of rice Crop area during (2005-2010) in Andhra Pradesh.

S.No.	District	Area (ha)	Rice			
			Kharif (ha)	Kharif (%)	Rabi (ha)	Rabi (%)
1	Srikakulam	583700	141932	3.7	160213	5.0
2	Vizainagaram	653900	89055	2.3	104100	3.2
3	Visakhapatnam	749300	62136	1.6	65816	2.0
4	East Godavari	1080700	380398	9.9	366727	11.4
5	West Godavari	774200	443031	11.5	406213	12.6

6	Krishna	1602900	358920	9.3	292994	9.1
7	Guntur	1284600	319847	8.3	251284	7.8
8	Prakasam	795600	148721	3.9	97777	3.0
9	Nellore	1424000	206099	5.4	189026	5.9
10	Chittoor	1515200	81027	2.1	58156	1.8
11	Kadapa	1535900	66753	1.7	53325	1.7
12	Ananthapur	1913000	48057	1.2	46900	1.5
13	Kurnool	872700	106876	2.8	69355	2.1
14	Mahabubnagar	969900	123930	3.2	114163	3.5
15	Rangareddy	1762600	40170	1.0	39598	1.2
16	Hyderabad	65000	0	0.0	3	0.0
17	Medak	1765800	83872	2.2	88930	2.8
18	Nizamabad	1307600	148858	3.9	120589	3.7
19	Adilabad	1612800	63051	1.6	52137	1.6
20	Karimnagar	1139100	266396	6.9	192202	6.0
21	Warangal	1116100	190237	4.9	158271	4.9
22	Khammam	1182300	164522	4.3	113211	3.5
23	Nalgonda	1843200	310697	8.1	185851	5.8
	Total	**27550100**	**3844585**	**100.0**	**3226841**	**100.0**

Fig 5.1: Percentage Distribution of Kharif and Rabi Rice in Andhra Pradesh.





Wheat

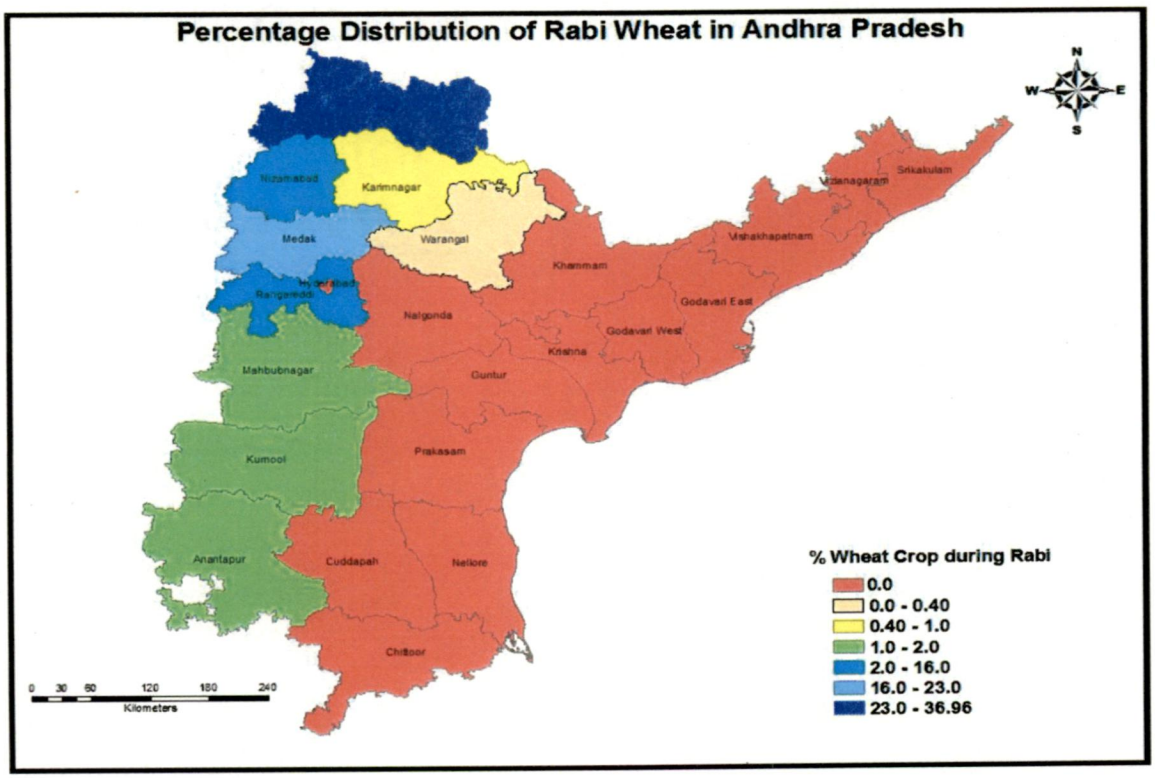
Wheat crop is sown mostly Rabi season under rain fed conditions in the State.In **Rabi season** the area, productivity and production of wheat in the State for the last 5 years (2005-2010) are presented and the wheat crop largely grown in the districts of Adilabad district is at the top with the (37.0%), followed by Medak (23.1%), Rangareddy (16.4%), nizamabad (15.5%) and Anantapur is the bottom with the (2.6%) in 2009-2010. These districts together accounted for 94.6 percent of the total area under this crop during 2009-2010 in the State.

Table 5.2: District wise percentage of Wheat Crop area during (2005-2010) in Andhra Pradesh

S.No.	District	Area in (ha)	Wheat in Rabi (ha)	Wheat in Rabi (%)
1	Srikakulam	583700	0	0.0
2	Vizainagaram	653900	0	0.0
3	Visakhapatnam	749300	0	0.0
4	East Godavari	1080700	0	0.0
5	West Godavari	774200	0	0.0
6	Krishna	1602900	0	0.0
7	Guntur	1284600	0	0.0
8	Prakasam	795600	0	0.0
9	Nellore	1424000	0	0.0

10	Chittoor	1515200	0	0.0
11	Kadapa	1535900	0	0.0
12	Ananthapur	1913000	221	2.6
13	Kurnool	872700	165	1.9
14	Mahabubnagar	969900	172	2.0
15	Rangareddy	1762600	1408	16.4
16	Hyderabad	65000	0	0.0
17	Medak	1765800	1977	23.1
18	Nizamabad	1307600	1325	15.5
19	Adilabad	1612800	3170	37.0
20	Karimnagar	1139100	101	1.2
21	Warangal	1116100	36	0.4
22	Khammam	1182300	0	0.0
23	Nalgonda	1843200	0	0.0
	Total	**27550100**	**8575**	**100.0**

Fig 5.2 Percentage Distribution of Rabi Wheat in Andhra Pradesh



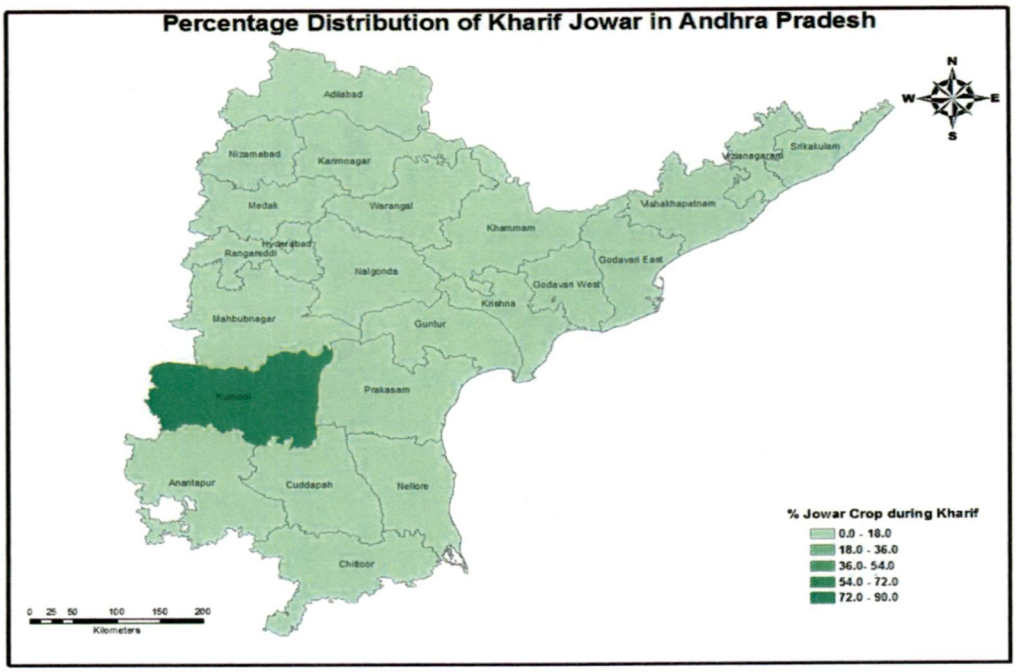
Jowar Next to Rice, Jowar is the principal Food-grain crop in the State. It is sown both in Kharif and Rabi seasons mostly under rain fed conditions.ThisCrop accounted for 2.8 percent of the total cropped area in the State. In **Kharif season** the area, productivity and production of Jowar in the State for the last 5 years (2005-2010) are presented and the Jowar crop largely grown in the districts of Kurnool district is at the top with the (90.4%), followed by

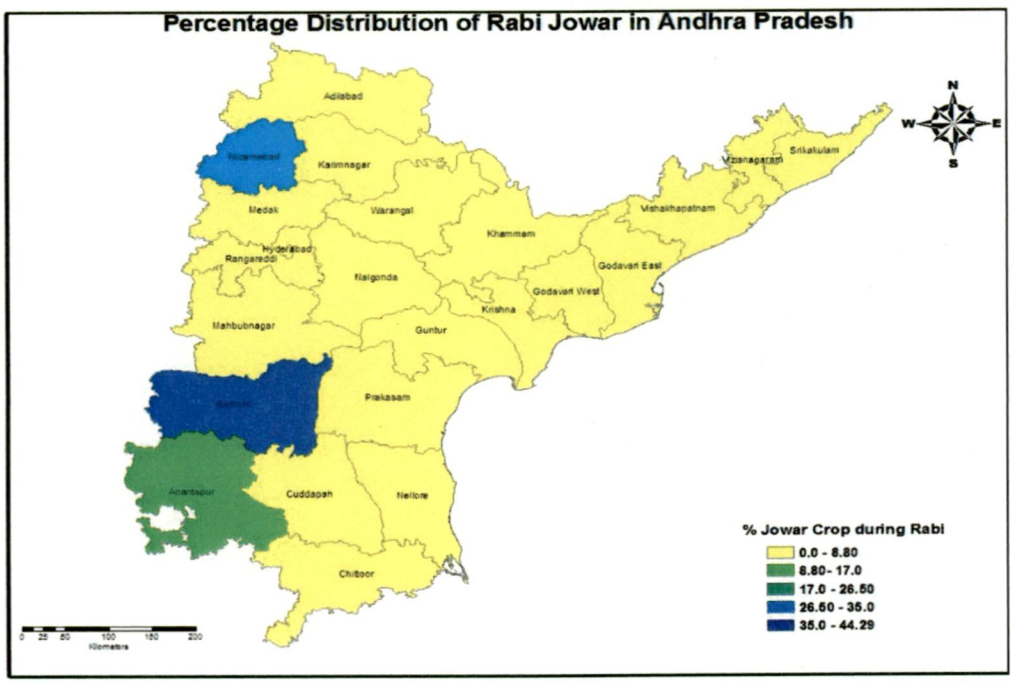
Anantapur (9.1%), and Kadapa (0.4%). These districts together accounted for 94.6 percent of the total area under this crop during 2009-2010 in the State. In **Rabi season** the area, productivity and production of Jowar in the State for the last 5 years (2005-2010) are presented and the Jowar crop largely grown in the districts of Kurnool district is at the top with the (44.3%), followed by Nizamabad (26.9%), Anantapur (11.9%), Guntur(6.8%),Adilabad(5.0%) and Kadapa (2.2%) in 2009-2010.These districts together accounted for 97.1 percent of the total area under this crop during 2009-2010 in the State.

Table 5.3: District wise percentage of Jowar Crop area during (2005-2010) in Andhra Pradesh

S.No.	District	Area (ha)	Jowar			
			Kharif (ha)	Kharif (%)	Rabi (ha)	Rabi (%)
1	Srikakulam	583700	0	0.0	0	0.0
2	Vizainagaram	653900	0	0.0	0	0.0
3	Visakhapatnam	749300	0	0.0	0	0.0
4	East Godavari	1080700	0	0.0	0	0.0
5	West Godavari	774200	0	0.0	0	0.0
6	Krishna	1602900	0	0.0	8	0.0
7	Guntur	1284600	0	0.0	1824	6.8
8	Prakasam	795600	0	0.0	59	0.2
9	Nellore	1424000	5	0.1	1	0.0
10	Chittoor	1515200	4	0.0	33	0.1
11	Kadapa	1535900	30	0.4	585	2.2
12	Ananthapur	1913000	730	9.1	3205	11.9
13	Kurnool	872700	7283	90.4	11969	44.3
14	Mahabubnagar	969900	0	0.0	367	1.4
15	Rangareddy	1762600	0	0.0	25	0.1
16	Hyderabad	65000	0	0.0	0	0.0
17	Medak	1765800	0	0.0	103	0.4
18	Nizamabad	1307600	0	0.0	7263	26.9
19	Adilabad	1612800	0	0.0	1358	5.0
20	Karimnagar	1139100	0	0.0	146	0.5
21	Warangal	1116100	0	0.0	0	0.0
22	Khammam	1182300	0	0.0	9	0.0
23	Nalgonda	1843200	0	0.0	66	0.2
	Total	**27550100**	**8052**	**100.0**	**27021**	**100.0**

Fig 5.3: Percentage Distribution of Kharif and Rabi Jowar in Andhra Pradesh.





Bajra crop is sown both in Kharif and Rabi seasons mostly under rain fed conditions in the State. The area cultivated under this crop is 0.45 lakh hectares in the year 2009-2010 as against 0.59 lakh hectares in 2008-2009 representing a fall off 23.7 percent.

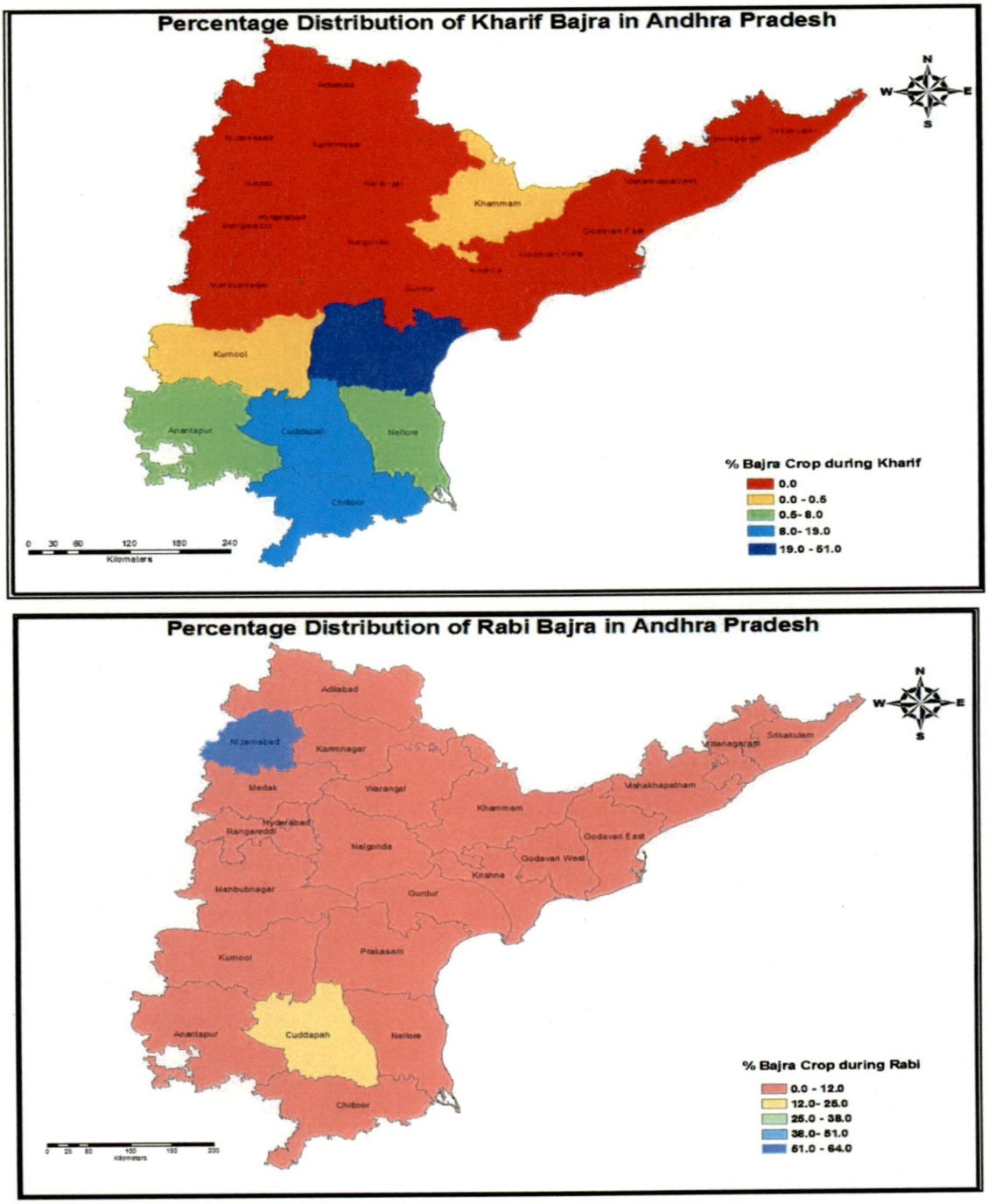
In **Kharif season** the area, productivity and production of Bajra in the State for the last 5 years (2005-2010) are presented and the Bajra crop production estimated in Prakasam district is at the top with the (51.3%), followed by Kadapa (19.1%), Chittoor (13.9%), Nellore

(8.9%), and Anantapur (5.8%) in 2009-2010.These districts together accounted for 99 percent of the total area under this crop during 2009-2010 in the State. In **Rabi season** the area, productivity and production of Bajra in the State for the last 5 years (2005-2010) are presented and the Bajra crop production estimated in Nizamabad district is at the top with the (64.1%), followed by Kadapa (21.6%), Adilabad (6.7%), and Kurnool (5.1%) in 2009-2010.These districts together accounted for 97.5 percent of the total area under this crop during 2009-2010 in the State.

Table 5.4:District wise percentage of Bajra Crop area during (2005-2010) in Andhra Pradesh.

S.No.	District	Area (ha)	Bajra			
			Kharif (ha)	Kharif (%)	Rabi (ha)	Rabi (%)
1	Srikakulam	583700	0	0.0	0	0.0
2	Vizainagaram	653900	0	0.0	0	0.0
3	Visakhapatnam	749300	0	0.0	0	0.0
4	East Godavari	1080700	0	0.0	0	0.0
5	West Godavari	774200	0	0.0	0	0.0
6	Krishna	1602900	0	0.0	0	0.0
7	Guntur	1284600	0	0.0	0	0.0
8	Prakasam	795600	3327	51.3	159	1.4
9	Nellore	1424000	575	8.9	0	0.0
10	Chittoor	1515200	900	13.9	58	0.5
11	Kadapa	1535900	1239	19.1	2466	21.6
12	Ananthapur	1913000	379	5.8	66	0.6
13	Kurnool	872700	32	0.5	578	5.1
14	Mahabubnagar	969900	0	0.0	0	0.0
15	Rangareddy	1762600	0	0.0	0	0.0
16	Hyderabad	65000	0	0.0	0	0.0
17	Medak	1765800	0	0.0	0	0.0
18	Nizamabad	1307600	0	0.0	7313	64.1
19	Adilabad	1612800	0	0.0	769	6.7
20	Karimnagar	1139100	0	0.0	2	0.0
21	Warangal	1116100	0	0.0	0	0.0
22	Khammam	1182300	35	0.5	1	0.0
23	Nalgonda	1843200	0	0.0	0	0.0
	Total	**27550100**	**6487**	**100.0**	**11412**	**100.0**

Fig 5.4 Percentage Distribution of Kharif and Rabi Bajra in Andhra Pradesh



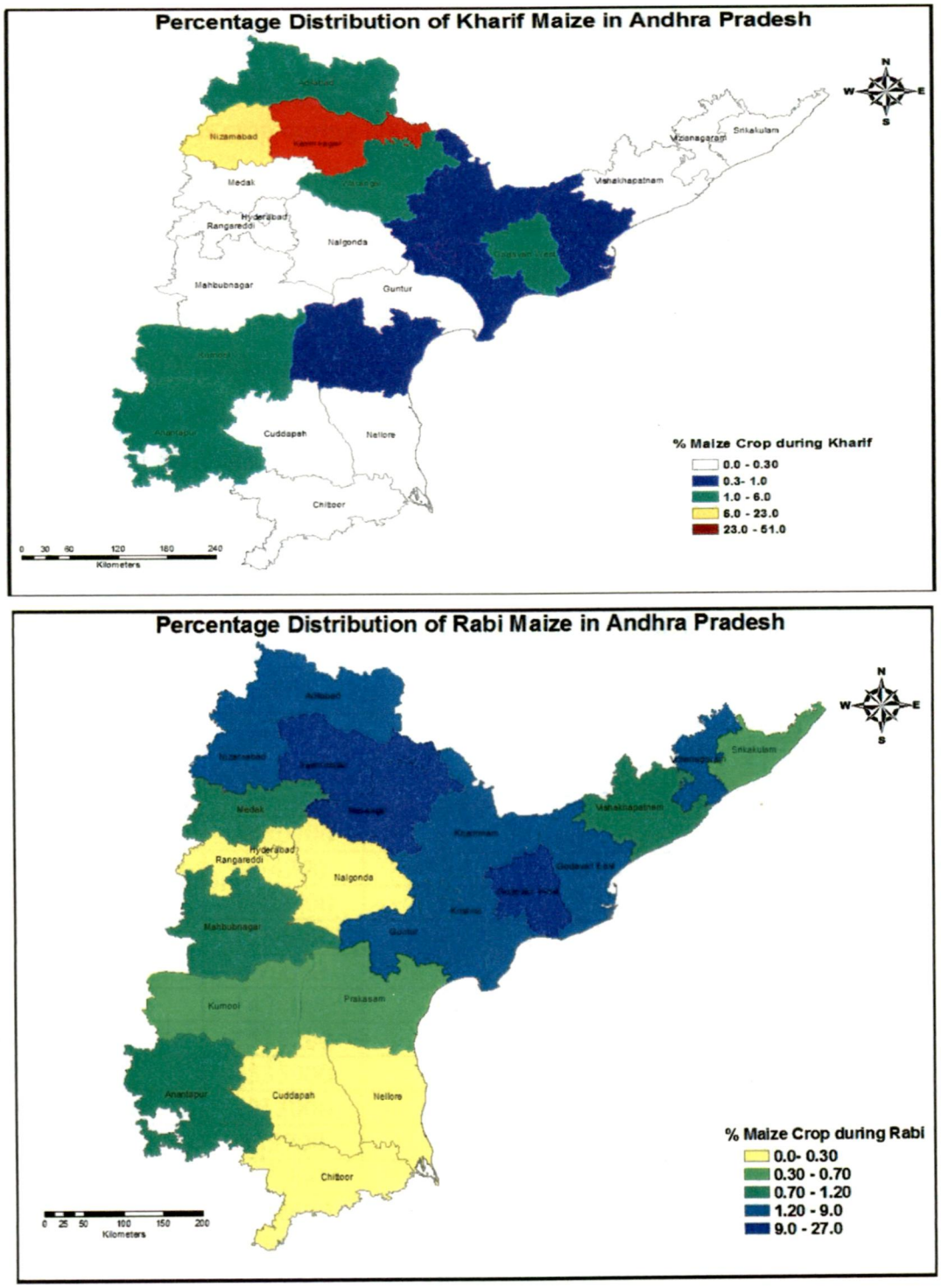
Maize crop is mostly grown in Telangana region. This crop accounted for 6.2 percent of the total cropped area in the State during 2009-2010. **The Kharif Maize** is largely grown in the districts of Karimnagar (51.5%), Nizamabad (23.2%), Warangal (6.1%), Adilabad (6.0%), some part of Anantapur (3.4%) and Kurnool (2.9%) districts and west Godavari (2.7%) district. These districts together accounted for 95.7 percent of the total area under the crop in the State and Karimnagar district is accounted for above 51.5 percent of total area under this crop.

In **Rabi season** the area, productivity and production of Maize in the State for the last 5 years (2005-2010) are presented and the Maize crop production estimated in Karimnagar district is at the top with the (27.6%), followed by West Godavari (16.2%), Warangal (13.8%), Guntur (9.4%), Khammam (5.8%) and nizamabad are the bottom with the (5.1%) in 2009-2010. These districts are important for the crop accounted for 77.9 percent of the total area under the crop in the state during 2009-2010.

Table 5.5:District wise percentage of Maize Crop area during (2005-2010) in Andhra Pradesh.

S.No.	District	Area in (ha)	Maize			
			Kharif (ha)	Kharif (%)	Rabi (ha)	Rabi (%)
1	Srikakulam	583700	105	0.1	1058	0.7
2	Vizainagaram	653900	0	0.0	5692	3.8
3	Visakhapatnam	749300	241	0.2	1336	0.9
4	East Godavari	1080700	724	0.6	6247	4.2
5	West Godavari	774200	3033	2.7	24034	16.2
6	Krishna	1602900	1202	1.1	5916	4.0
7	Guntur	1284600	341	0.3	13958	9.4
8	Prakasam	795600	1071	1.0	597	0.4
9	Nellore	1424000	56	0.0	20	0.0
10	Chittoor	1515200	194	0.2	356	0.2
11	Kadapa	1535900	37	0.0	1	0.0
12	Ananthapur	1913000	3803	3.4	1354	0.9
13	Kurnool	872700	3273	2.9	811	0.5
14	Mahabubnagar	969900	4	0.0	1668	1.1
15	Rangareddy	1762600	3	0.0	466	0.3
16	Hyderabad	65000	0	0.0	0	0.0
17	Medak	1765800	0	0.0	1880	1.3
18	Nizamabad	1307600	26020	23.2	7616	5.1
19	Adilabad	1612800	6456	5.8	4847	3.3
20	Karimnagar	1139100	57767	51.5	40868	27.6
21	Warangal	1116100	6794	6.1	20449	13.8
22	Khammam	1182300	1031	0.9	8515	5.8
23	Nalgonda	1843200	72	0.1	292	0.2
	Total	**27550100**	**112227**	**100.0**	**147981**	**00.0**

Fig 5.5: Percentage Distribution of Kharif and Rabi Maize in Andhra Pradesh.



Ragi crop is sown both under rain fed and irrigation conditions in both Kharif and Rabi seasons. Anantapur, Chittoor, Vishakhapatnam, Nellore, Kadapa and Srikakakulam districts together accounted for 85.3 percent of the total area under the crop during 2009-2010. In **Kharif season** the area, productivity and production of Ragi in the State for the last 5 years

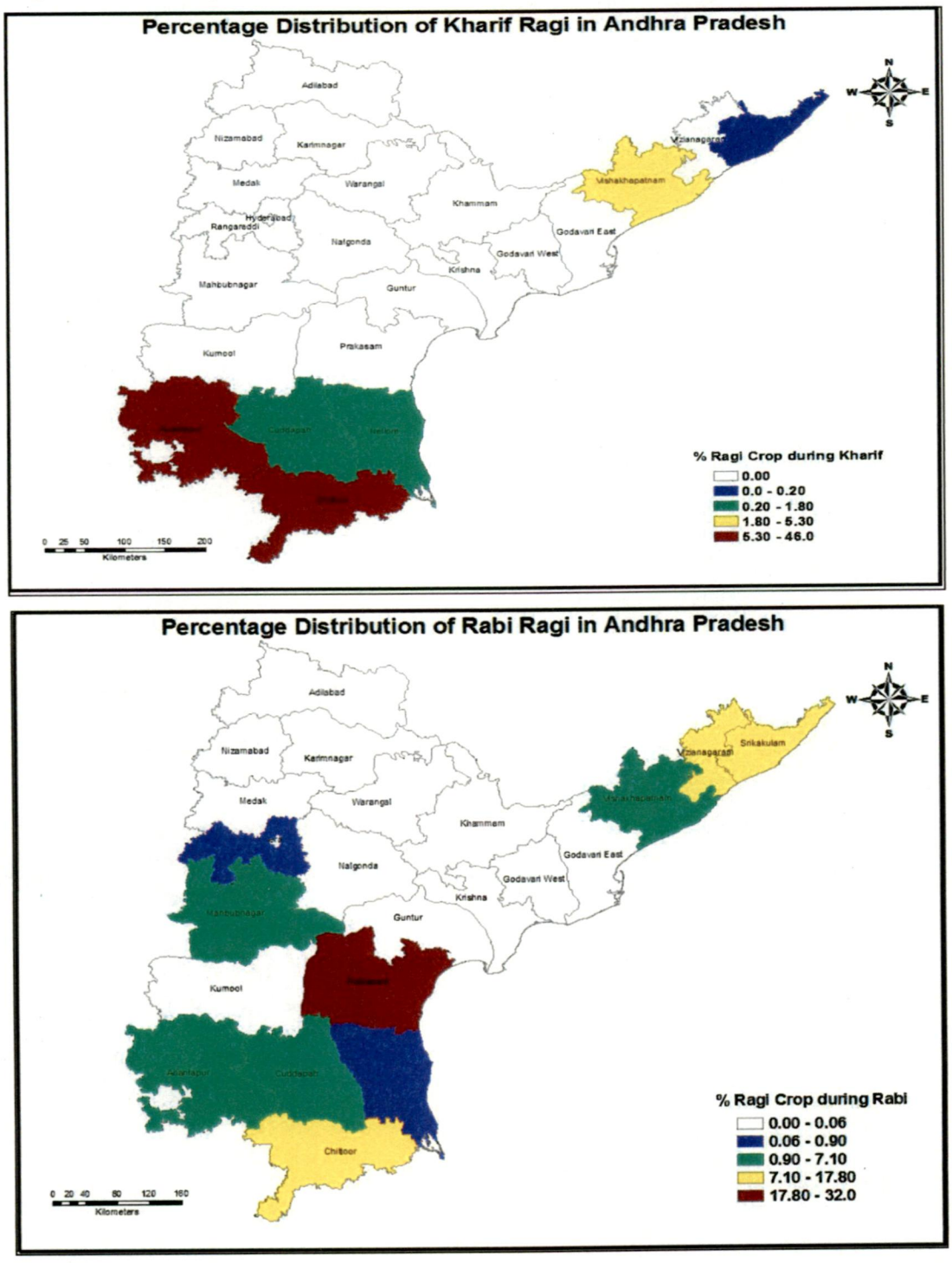
(2005-2010) are presented and the Ragi crop production estimated in Anantapur district is at the top with the (46.3%), followed by Chittoor (45.1%), Vishakhapatnam (5.3%), Nellore (1.8%), and Kadapa (1.3%), in 2009-2010.These districts together accounted for 99.8 percent of the total area under this crop during 2009-2010 in the State.

In **Rabi season** the area, productivity and production of Ragi in the State for the last 5 years (2005-2010) are presented and the Ragi crop production estimated in Prakasam district is at the top with the (32.0%), followed by Srikakakulam (17.8%), Vizainagaram (13.3%), Chittoor (12.4%), and Vishakhapatnam (7.2%),Kadapa(5.7%),and Anantapur (5.3%) in 2009-2010.These districts together accounted for 93.7 percent of the total area under this crop during 2009-2010 in the State.

Table 5.6:District wise percentage of Ragi Crop area during (2005-2010) in Andhra Pradesh.

S.No.	District	Area in (ha)	Ragi			
			Kharif (ha)	Kharif (%)	Rabi (ha)	Rabi (%)
1	Srikakulam	583700	8	0.3	1580	17.8
2	Vizainagaram	653900	0	0.0	1184	13.3
3	Visakhapatnam	749300	168	5.3	635	7.2
4	East Godavari	1080700	0	0.0	0	0.0
5	West Godavari	774200	0	0.0	0	0.0
6	Krishna	1602900	0	0.0	0	0.0
7	Guntur	1284600	0	0.0	0	0.0
8	Prakasam	795600	0	0.0	2839	32.0
9	Nellore	1424000	58	1.8	87	1.0
10	Chittoor	1515200	1426	45.1	1097	12.4
11	Kadapa	1535900	40	1.3	502	5.7
12	Ananthapur	1913000	1465	46.3	472	5.3
13	Kurnool	872700	0	0.0	6	0.1
14	Mahabubnagar	969900	0	0.0	399	4.5
15	Rangareddy	1762600	0	0.0	69	0.8
16	Hyderabad	65000	0	0.0	0	0.0
17	Medak	1765800	0	0.0	0	0.0
18	Nizamabad	1307600	0	0.0	0	0.0
19	Adilabad	1612800	0	0.0	0	0.0
20	Karimnagar	1139100	0	0.0	0	0.0
21	Warangal	1116100	0	0.0	0	0.0
22	Khammam	1182300	0	0.0	0	0.0
23	Nalgonda	1843200	0	0.0	0	0.0
	Total	**27550100**	**3165**	**100.0**	**8870**	**100.0**

Fig 5.6 Percentage Distribution of Kharif and Rabi Ragi in Andhra Pradesh



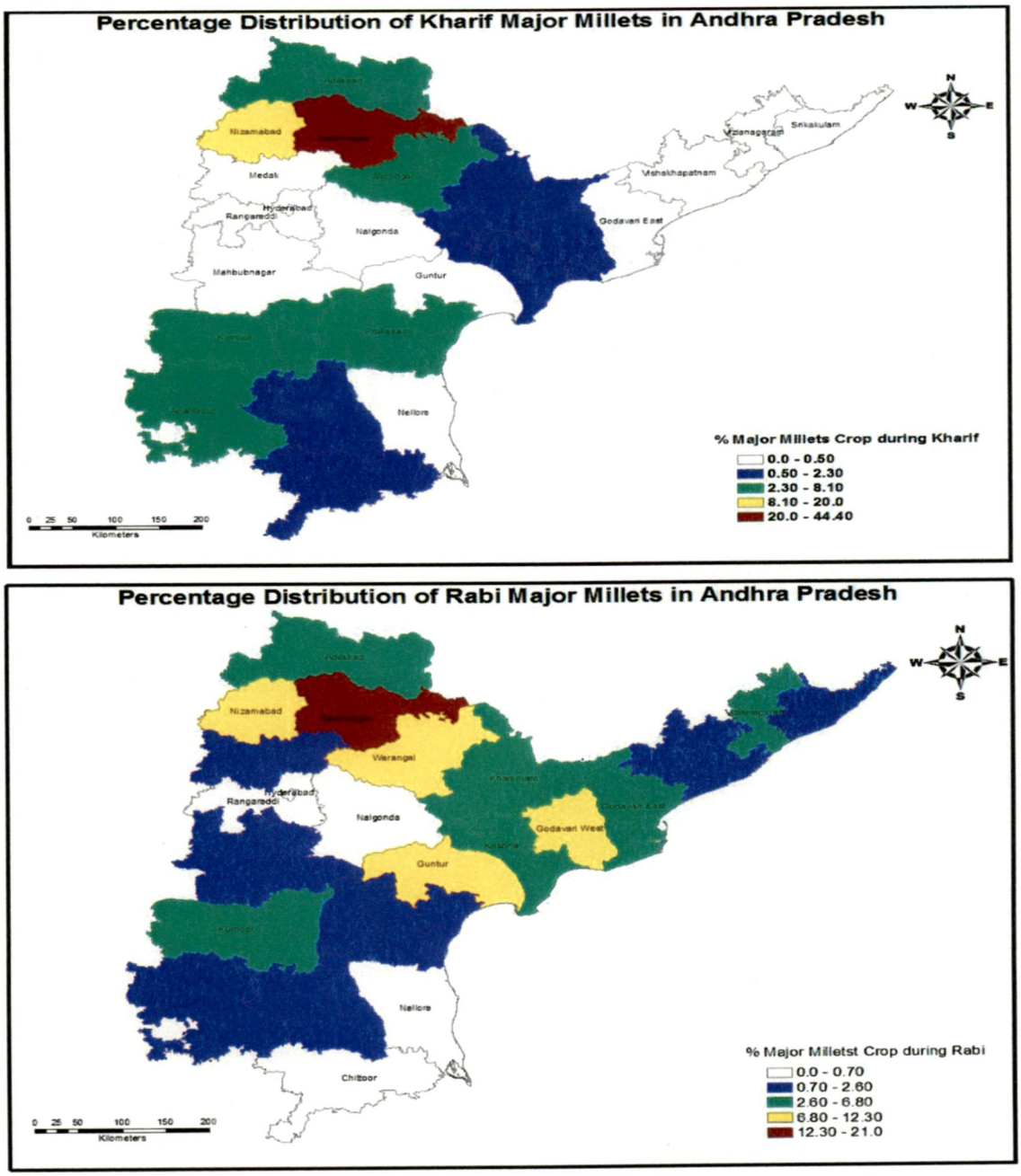
Major Millets Korra, Varagu, Samai and other Minor millets come under "major millets" sparsely grown in the State. These crops are mainly sown under rain fed conditions and the area under these minor millets accounted for about 0.2 percent of the total cropped area in the State during 2009-2010.In **Kharif season** the area, productivity and production of Major

Millets in the State for the last 5 years (2005-2010) are presented and the Minor Millets production estimated in Karimnagar district is at the top with the (44.5%), followed by Nizamabad (20.0%), Kurnool (8.1%), Warangal (5.2%), Adilabad (5.0%) and Anantapur are the bottom with the (4.9%) in 2009-2010. These districts are important for the crop accounted for 87.7 percent of the total area under the crop in the state during 2009-2010. In **Rabi season** the area, productivity and production of Major Millets in the State for the last 5 years (2005-2010) are presented and the Minor Millets production estimated in Karimnagar district is at the top with the (21.0%), followed by west Godavari (12.3%), nizamabad (11.4%), Warangal (10.5%), Guntur (8.1%) and Kurnool are the bottom with the (6.8%) in 2009-2010. These districts are important for the crop accounted for 70.1 percent of the total area under the crop in the state during 2009-2010.

Table 5.7: District wise percentage of Major Millet's area during (2005-2010) in Andhra Pradesh

S.No.	District	Area in (ha)	Total Major Millets			
			Kharif (ha)	Kharif (%)	Rabi (ha)	Rabi (%)
1	Srikakulam	583700	113	0.1	2638	1.4
2	Vizainagaram	653900	0	0.0	6876	3.5
3	Visakhapatnam	749300	409	0.3	1971	1.0
4	East Godavari	1080700	724	0.6	6247	3.2
5	West Godavari	774200	3033	2.3	24034	12.3
6	Krishna	1602900	1202	0.9	5924	3.0
7	Guntur	1284600	341	0.3	15782	8.1
8	Prakasam	795600	4398	3.4	3654	1.9
9	Nellore	1424000	694	0.5	108	0.1
10	Chittoor	1515200	2524	1.9	1544	0.8
11	Kadapa	1535900	1346	1.0	3554	1.8
12	Ananthapur	1913000	6377	4.9	5097	2.6
13	Kurnool	872700	10588	8.1	13364	6.8
14	Mahabubnagar	969900	4	0.0	2434	1.2
15	Rangareddy	1762600	3	0.0	560	0.3
16	Hyderabad	65000	0	0.0	0	0.0
17	Medak	1765800	0	0.0	1983	1.0
18	Nizamabad	1307600	26020	20.0	22192	11.4
19	Adilabad	1612800	6456	5.0	6974	3.6
20	Karimnagar	1139100	57767	44.5	41016	21.0
21	Warangal	1116100	6794	5.2	20449	10.5
22	Khammam	1182300	1066	0.8	8525	4.4
23	Nalgonda	1843200	72	0.1	358	0.2
	Total	**27550100**	**129931**	**100.0**	**195284**	**100.0**

Fig 5.7: Percentage Distribution of Kharif and Rabi Major millets in Andhra Pradesh.

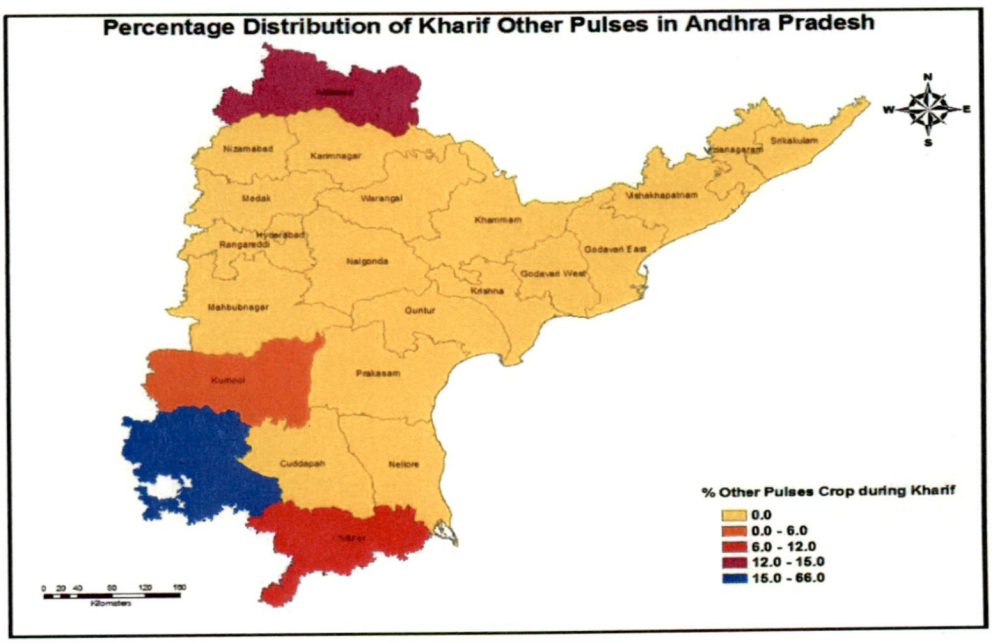


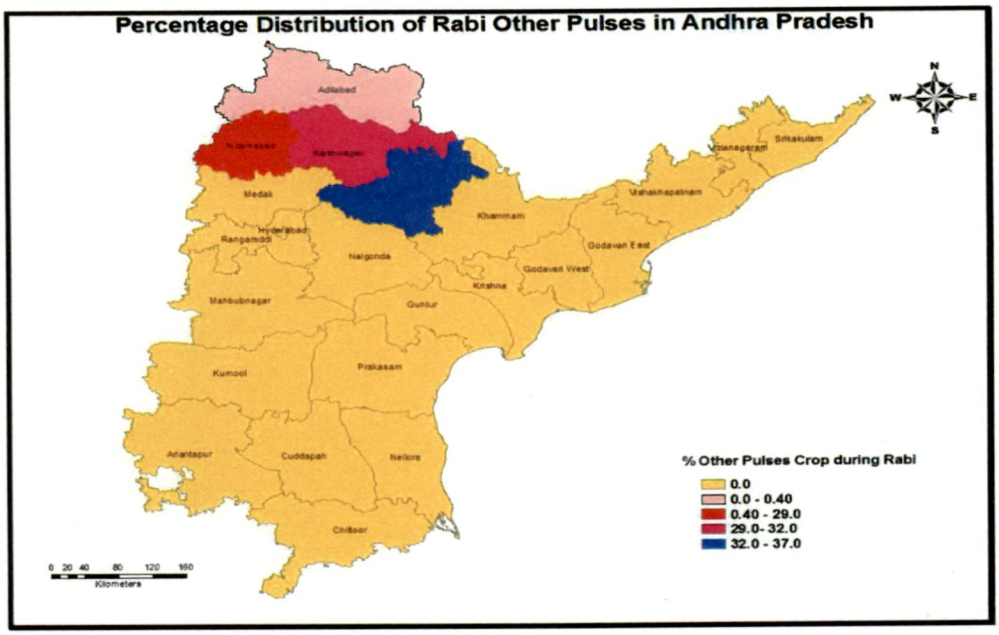
Other Pulses are raised in both Kharif and Rabi seasons in Andhra Pradesh.In **Kharif season** Anantapur district (66.7%), Adilabad (15.2%), Chittoor (12.1%) and Kurnool (6.1) .These districts together account for 100 percent of the total area under the crop in the State. In **Rabi season** Warangal (37.6%), Karimnagar (32.5%) and Nizamabad (29.5%). These districts together account for 99.5 percent of the total area under the crop in the State

Table 5.8:District wise percentage of Other Pulses area during (2005-2010) in Andhra Pradesh.

S.No.	District	Area in (ha)	Other Pulses			
			Kharif (ha)	Kharif (%)	Rabi (ha)	Rabi (%)
1	Srikakulam	583700	0	0.0	0	0.0
2	Vizainagaram	653900	0	0.0	0	0.0
3	Visakhapatnam	749300	0	0.0	0	0.0
4	East Godavari	1080700	0	0.0	0	0.0
5	West Godavari	774200	0	0.0	0	0.0
6	Krishna	1602900	0	0.0	0	0.0
7	Guntur	1284600	0	0.0	0	0.0
8	Prakasam	795600	0	0.0	0	0.0
9	Nellore	1424000	0	0.0	0	0.0
10	Chittoor	1515200	4	12.1	0	0.0
11	Kadapa	1535900	0	0.0	0	0.0
12	Ananthapur	1913000	22	66.7	0	0.0
13	Kurnool	872700	2	6.1	0	0.0
14	Mahabubnagar	969900	0	0.0	0	0.0
15	Rangareddy	1762600	0	0.0	0	0.0
16	Hyderabad	65000	0	0.0	0	0.0
17	Medak	1765800	0	0.0	0	0.0
18	Nizamabad	1307600	0	0.0	253	29.5
19	Adilabad	1612800	5	15.2	4	0.5
20	Karimnagar	1139100	0	0.0	279	32.5
21	Warangal	1116100	0	0.0	323	37.6
22	Khammam	1182300	0	0.0	0	0.0
23	Nalgonda	1843200	0	0.0	0	0.0
	Total	**27550100**	**33**	**100.0**	**859**	**100.0**

Fig 5.8 Percentage Distribution of Kharif and Rabi Other pulses in Andhra Pradesh





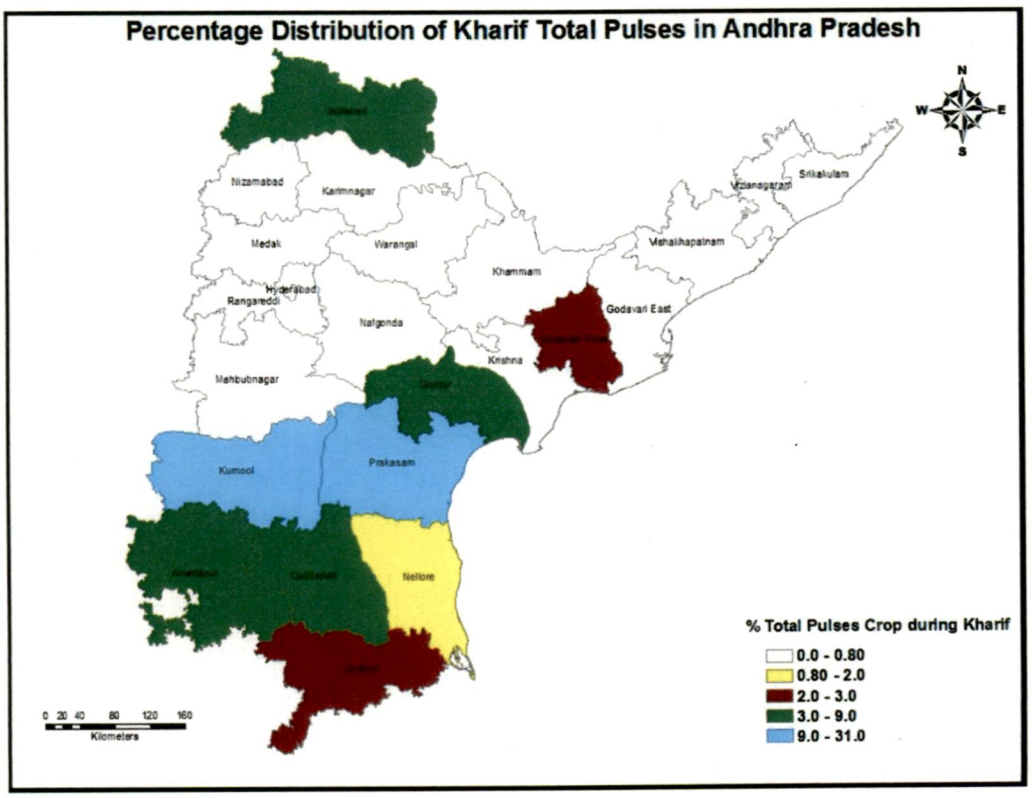
Total Pulses comprise of Redgram, Bengal gram, Green gram, Black gram, Horse gram Cow gram and other pulses. The area under these pulses accounted for about 15.4 percent of the total cropped area in the State during 2009-2010. In **Kharif season** the area, productivity and production of pulses in the State for the last 5 years (2005-2010) are presented and the pulses production estimated in Kurnool district is at the top with the (31.4%), followed by Prakasam(23.4%), Adilabad (9.3%), Anantapur (8.8%), Kadapa (8.1%) and Guntur (7.7%) in 2009-2010. These districts are important for the crop accounted for 88.7 percent of the total area under the crop in the state during 2009-2011 in **Rabi season** the area, productivity and production of pulses in the State for the last 5 years (2005-2010) are presented and the pulses production estimated in Karimnagar district is at the top with the (41.8%), followed by Anantapur (17.1%),Warangal(11.7%), Nalgonda(7.1%), Kurnool (5.3%) and Medak (4.1%) in 2009-2010. These districts are important for the crop accounted for 87.1percent of the total area under the crop in the state during 2009-2010.

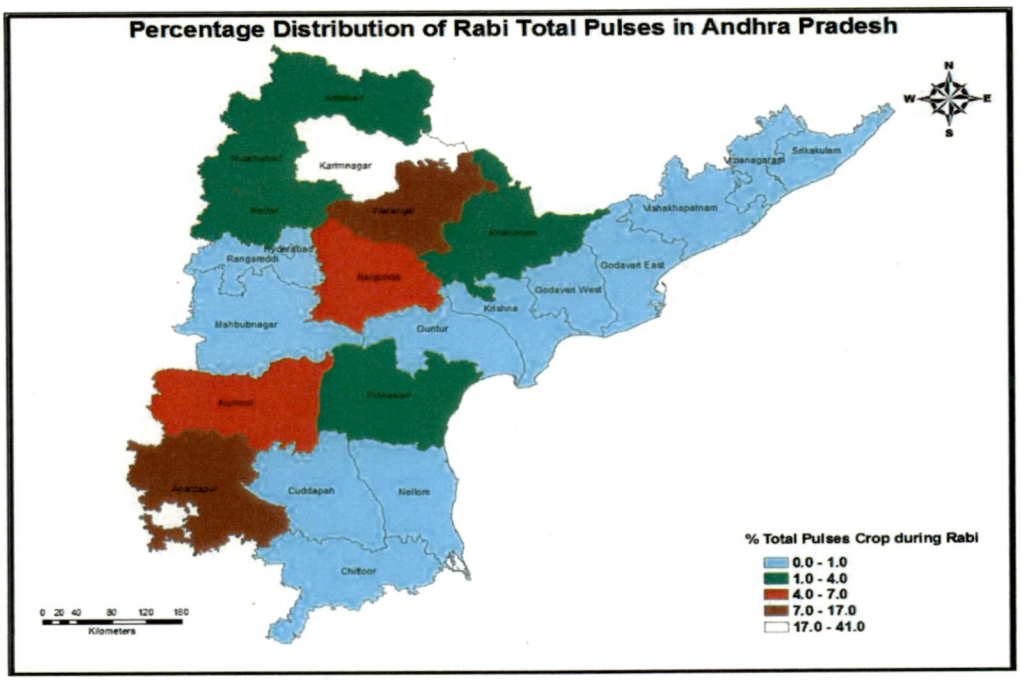
Table 5.9: District wise percentage of Total Pulses area during (2005-2010) in Andhra Pradesh.

S.No.	District	Area in (ha)	Total Pulses			
			Kharif (ha)	Kharif (%)	Rabi (ha)	Rabi (%)
1	Srikakulam	583700	0	0.0	0	0.0
2	Vizainagaram	653900	0	0.0	0	0.0
3	Visakhapatnam	749300	0	0.0	0	0.0
4	East Godavari	1080700	4	0.1	82	0.5
5	West Godavari	774200	117	3.7	191	1.2
6	Krishna	1602900	0	0.0	0	0.0

7	Guntur	1284600	241	7.7	21	0.1
8	Prakasam	795600	731	23.4	262	1.6
9	Nellore	1424000	91	2.9	88	0.5
10	Chittoor	1515200	117	3.7	120	0.7
11	Kadapa	1535900	253	8.1	42	0.3
12	Ananthapur	1913000	275	8.8	2779	17.1
13	Kurnool	872700	980	31.4	869	5.3
14	Mahabubnagar	969900	0	0.0	106	0.7
15	Rangareddy	1762600	0	0.0	0	0.0
16	Hyderabad	65000	0	0.0	0	0.0
17	Medak	1765800	0	0.0	670	4.1
18	Nizamabad	1307600	0	0.0	486	3.0
19	Adilabad	1612800	292	9.3	400	2.5
20	Karimnagar	1139100	0	0.0	6801	41.8
21	Warangal	1116100	0	0.0	1910	11.7
22	Khammam	1182300	0	0.0	284	1.7
23	Nalgonda	1843200	28	0.9	1157	7.1
	Total	**27550100**	**3124**	**100.0**	**16273**	**100.0**

Fig 5.9: Percentage Distribution of Kharif and Rabi Total pulses in Andhra Pradesh.





Horse gram is raised in Rabi seasons. The area under Horse gram is 0.59 lakh hectares or 0.5 percent of the total cropped area in the state. In **Rabi Horse gram** the area, productivity and production of Horse gram in the State for the last 5 years (2005-2010) are presented and the Horse gram production estimated in Karimnagar district is at the top with the (92.8%), followed by West Godavari (5.9%), and Chittoor (1.1%) in 2009-2010. These districts together accounted for 99.8 percent of the total area under this crop during 2009-2010 in the State.

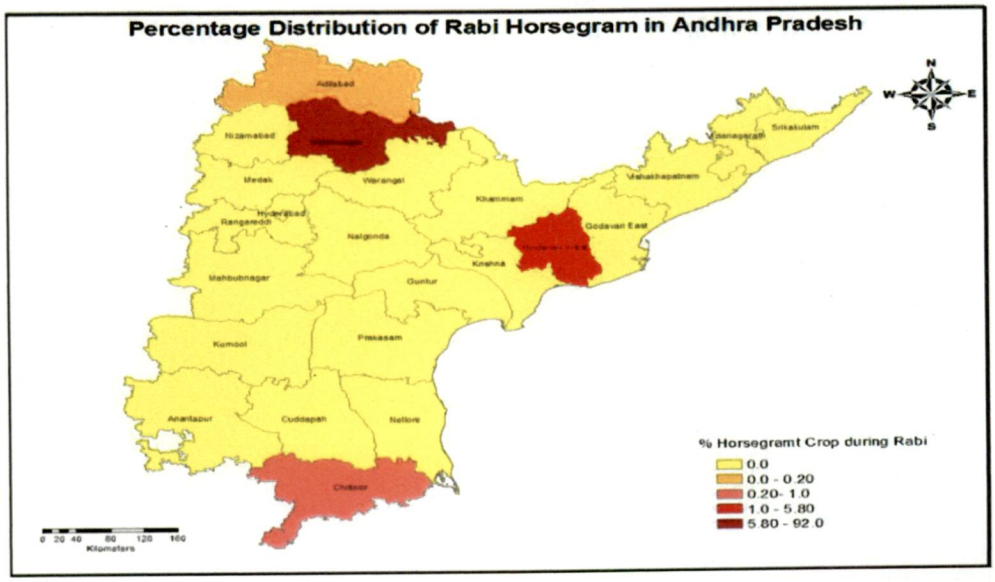
Table 5.10: District wise percentage of Horse gram area during (2005-2010) in Andhra Pradesh.

S.No.	District	Area in (ha)	Horse Gram	
			Rabi(ha)	Rabi (%)
1	Srikakulam	583700	0	0.0
2	Vizainagaram	653900	0	0.0
3	Visakhapatnam	749300	0	0.0
4	East Godavari	1080700	0	0.0
5	West Godavari	774200	27	5.9
6	Krishna	1602900	0	0.0
7	Guntur	1284600	0	0.0
8	Prakasam	795600	0	0.0
9	Nellore	1424000	0	0.0
10	Chittoor	1515200	5	1.1
11	Kadapa	1535900	0	0.0
12	Ananthapur	1913000	0	0.0
13	Kurnool	872700	0	0.0

14	Mahabubnagar	969900	0	0.0
15	Rangareddy	1762600	0	0.0
16	Hyderabad	65000	0	0.0
17	Medak	1765800	0	0.0
18	Nizamabad	1307600	0	0.0
19	Adilabad	1612800	1	0.2
20	Karimnagar	1139100	426	92.8
21	Warangal	1116100	0	0.0
22	Khammam	1182300	0	0.0
23	Nalgonda	1843200	0	0.0
	Total		**459**	**100.0**

Green gram crop is sown in both Kharif and Rabi seasons but it is more extensively in Kharif season. The crop is sown as an early Kharif crop in May and June and is harvested during August and September months. The area under Green gram during 2009-2010 was estimated as 3.07 lakh hectares which constituted 2.4 percent of the cropped area in the State. **The Kharif Green gram** is extensively sown in Prakasam (44.7%), Kurnool (29.8%), Kadapa (14.3%), and Nellore (5.6%) West Godavari (3.2%)Nalgonda (1.7%) and least for Guntur (0.2%) districts which together accounted for 69.1 percent of the total area under the crop in the State during 2009-2010.

Fig 5.10: Percentage Distribution of Kharif and Rabi Horse gram in Andhra Pradesh.

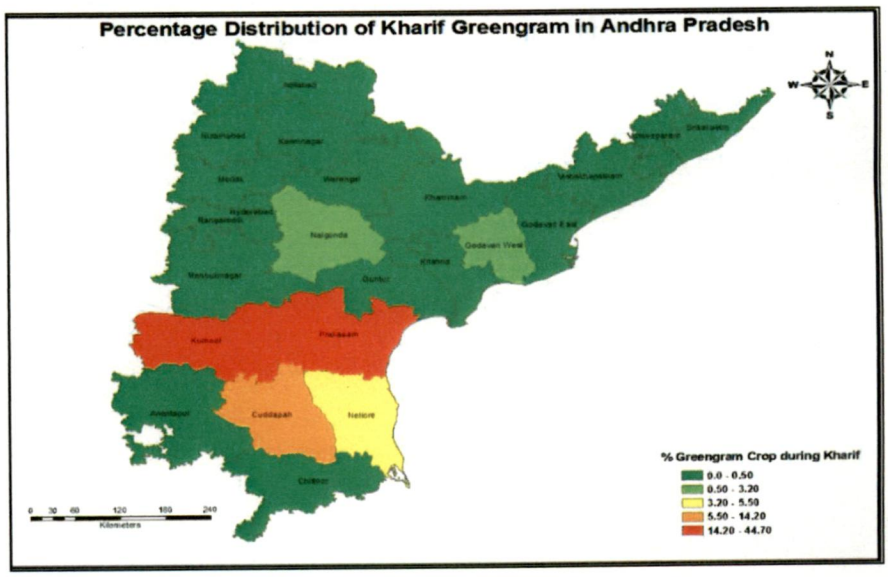


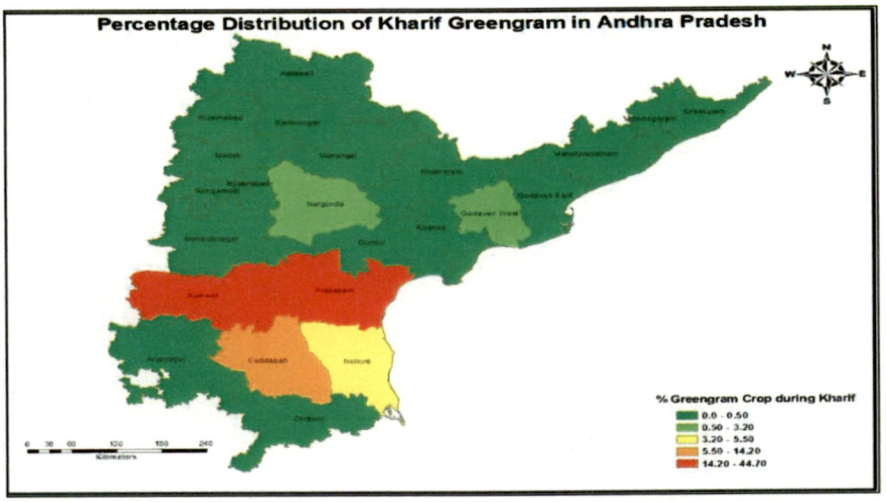
In **Rabi Green gram** area, productivity and production of Green gram in the State for the last 5 years (2005-2010) are presented and the Green gram production estimated in Karimnagar district is at the top with the (58.9%), followed by Warangal(14.5%), Adilabad (5.6%), Nizamabad(5.5%), Nellore(4.3%) and East Godavari is the bottom with the (0.9%) in 2009-2010.

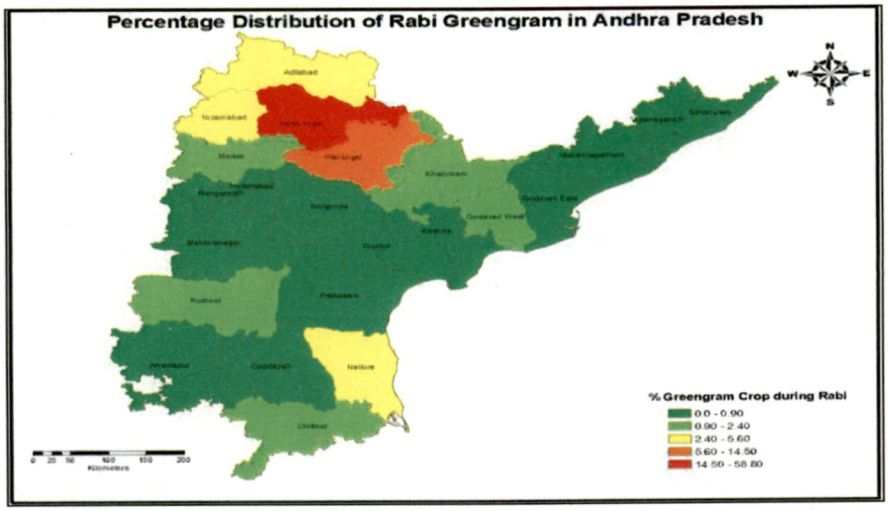
Table 5.11:District wise percentage of Green gram area during (2005-2010) in Andhra Pradesh.

S.No.	District	Area in (ha)	Green gram			
			Kharif (ha)	Kharif (%)	Rabi (ha)	Rabi (%)
1	Srikakulam	583700	0	0.0	0	0.0
2	Vizainagaram	653900	0	0.0	0	0.0
3	Visakhapatnam	749300	0	0.0	0	0.0
4	East Godavari	1080700	0	0.0	19	0.9
5	West Godavari	774200	53	3.2	40	2.0
6	Krishna	1602900	0	0.0	0	0.0
7	Guntur	1284600	3	0.2	7	0.3
8	Prakasam	795600	731	44.7	0	0.0
9	Nellore	1424000	91	5.6	88	4.3
10	Chittoor	1515200	9	0.6	50	2.5
11	Kadapa	1535900	233	14.3	0	0.0
12	Ananthapur	1913000	0	0.0	0	0.0
13	Kurnool	872700	487	29.8	36	1.8
14	Mahabubnagar	969900	0	0.0	0	0.0
15	Rangareddy	1762600	0	0.0	0	0.0
16	Hyderabad	65000	0	0.0	0	0.0
17	Medak	1765800	0	0.0	25	1.2
18	Nizamabad	1307600	0	0.0	112	5.5
19	Adilabad	1612800	0	0.0	114	5.6
20	Karimnagar	1139100	0	0.0	1195	58.9
21	Warangal	1116100	0	0.0	295	14.5
22	Khammam	1182300	0	0.0	49	2.4
23	Nalgonda	1843200	28	1.7	0	0.0
	Total	**2.8E+07**	**1635**	**100.0**	**2030**	**100.0**

Fig 5.11: Percentage Distribution of Kharif and Rabi Green gram in Andhra Pradesh.





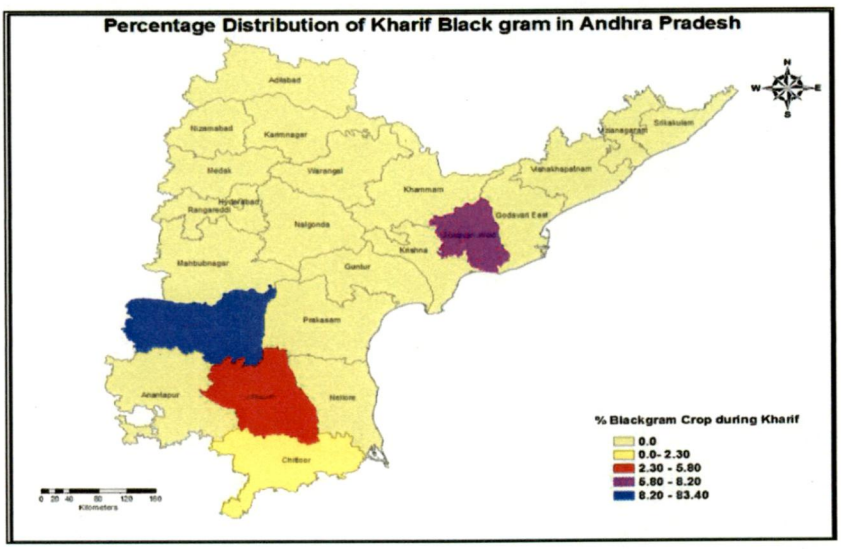


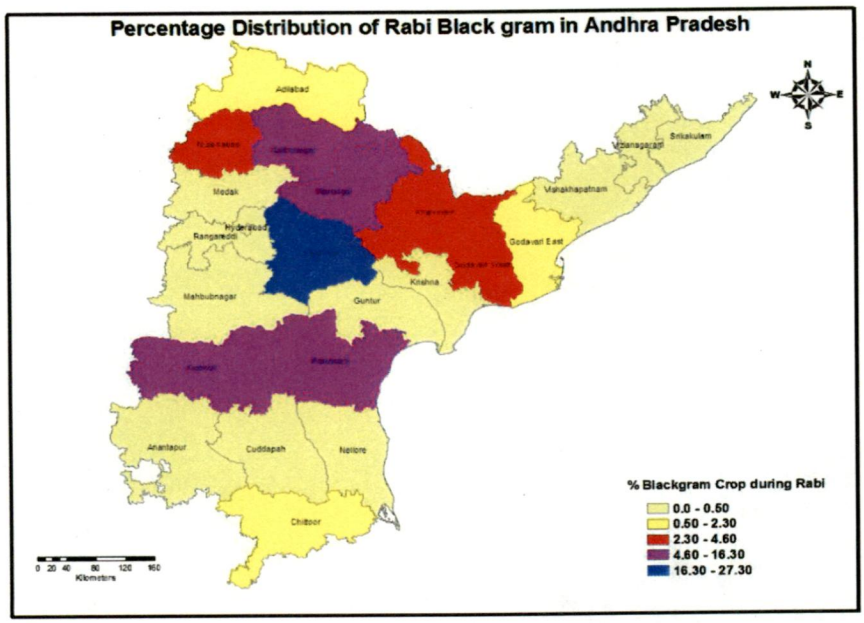
Black gram is cultivated in all the districts of the State both in Kharif and Rabi seasons but mostly in Rabi season. In **Kharif Black gram season** the area, productivity and production of Black gram in the State for the last 5 years (2005-2010) are presented and the Black gram largely grown in the districts of Kurnool district is at the top with the (83.5%), followed by West Godavari (8.3%), Kadapa (5.9%), and Chittoor is the bottom with the (2.4%) in 2009-2010. These districts together accounted for 100 percent of the total area under this crop during 2009-2010 in the State. In **Rabi Black gram season** the area, productivity and production of Black gram in the State for the last 5 years (2005-2010) are presented and the Black gram largely grown in the districts of Nalgonda district is at the top with the (27.4%), followed by Warangal (16.3%), Karimnagar (13.9%), Kurnool (12.4%), Prakasam (9.8%) and west Godavari (4.6%) in 2009-2010. These districts together accounted for 84.4 percent of the total area under this crop during 2009-2010 in the State.

Table 5.12:District wise percentage of Black gram area during (2005-2010) in Andhra Pradesh.

S.No.	District	Area in (ha)	Black gram			
			Kharif (ha)	Kharif (%)	Rabi (ha)	Rabi (%)
1	Srikakulam	583700	0	0.0	0	0.0
2	Vizainagaram	653900	0	0.0	0	0.0
3	Visakhapatnam	749300	0	0.0	0	0.0
4	East Godavari	1080700	0	0.0	63	2.3
5	West Godavari	774200	28	8.3	124	4.6
6	Krishna	1602900	0	0.0	0	0.0
7	Guntur	1284600	0	0.0	14	0.5
8	Prakasam	795600	0	0.0	262	9.8
9	Nellore	1424000	0	0.0	0	0.0
10	Chittoor	1515200	8	2.4	62	2.3
11	Kadapa	1535900	20	5.9	0	0.0
12	Ananthapur	1913000	0	0.0	0	0.0
13	Kurnool	872700	283	83.5	334	12.4
14	Mahabubnagar	969900	0	0.0	0	0.0
15	Rangareddy	1762600	0	0.0	0	0.0
16	Hyderabad	65000	0	0.0	0	0.0
17	Medak	1765800	0	0.0	0	0.0
18	Nizamabad	1307600	0	0.0	121	4.5
19	Adilabad	1612800	0	0.0	63	2.3
20	Karimnagar	1139100	0	0.0	373	13.9
21	Warangal	1116100	0	0.0	438	16.3
22	Khammam	1182300	0	0.0	96	3.6
23	Nalgonda	1843200	0	0.0	735	27.4
	Total	**27550100**	**339**	**100.0**	**2685**	**100.0**

Fig 5.12: Percentage Distribution of Kharif and Rabi Black gram in Andhra Pradesh.





Redgram is sown predominantly under rain-fed conditions in Kharif season. The crop is sown in the months of June to August in the State. This crop is largely grown in Nalgonda (20.6%), Kurnool (15.8%), and Adilabad (15.3%) Ananthapur (13.5%), Guntur (12.7%), Karimnagar (8.3%) and least in East Godavari (0.2%) Nalgonda district alone shared 20.6 percent of total area under this crop.These districts which accounted for 78.0 percent of the total area under this crop in the State during 2009-2010.

Table 5.13:District wise percentage of Red gram area during (2005-2010) in Andhra Pradesh.

S.No.	District	Area in (ha)	Redgram	
			Kharif(ha)	Kharif (%)
1	Srikakulam	583700	0	0.0
2	Vizainagaram	653900	0	0.0
3	Visakhapatnam	749300	0	0.0
4	East Godavari	1080700	4	0.2
5	West Godavari	774200	2	0.1
6	Krishna	1602900	0	0.0
7	Guntur	1284600	238	12.7
8	Prakasam	795600	0	0.0
9	Nellore	1424000	0	0.0
10	Chittoor	1515200	99	5.3
11	Kadapa	1535900	19	1.0
12	Ananthapur	1913000	253	13.5
13	Kurnool	872700	297	15.8
14	Mahabubnagar	969900	0	0.0
15	Rangareddy	1762600	0	0.0
16	Hyderabad	65000	0	0.0
17	Medak	1765800	0	0.0

18	Nizamabad	1307600	0	0.0
19	Adilabad	1612800	287	15.3
20	Karimnagar	1139100	156	8.3
21	Warangal	1116100	77	4.1
22	Khammam	1182300	61	3.2
23	Nalgonda	1843200	387	20.6
	Total	**27550100**	**1880**	**100.0**

Bengal Gram

Bengal gram is mostly grown in Rabi season. The crop is sown in the Month of October and November to a limited extent in the month of December also. The crop is grown externally under rain-fed conditions .The Crop is sown in Anantapur (61.9%), Warangal (10.9%), Kurnool (9.1%), and Karimnagar (5.8%), Medak (5.5%) and Adilabad (4.5%). These districts which accounted for 70.5 percent of the total area under the crop in the state during 2009-2010 and Anantapur district alone shares 61.9 percent of the total area under this crop.

Fig 5.13: Percentage Distribution of Kharif and Rabi Red gram in Andhra Pradesh.

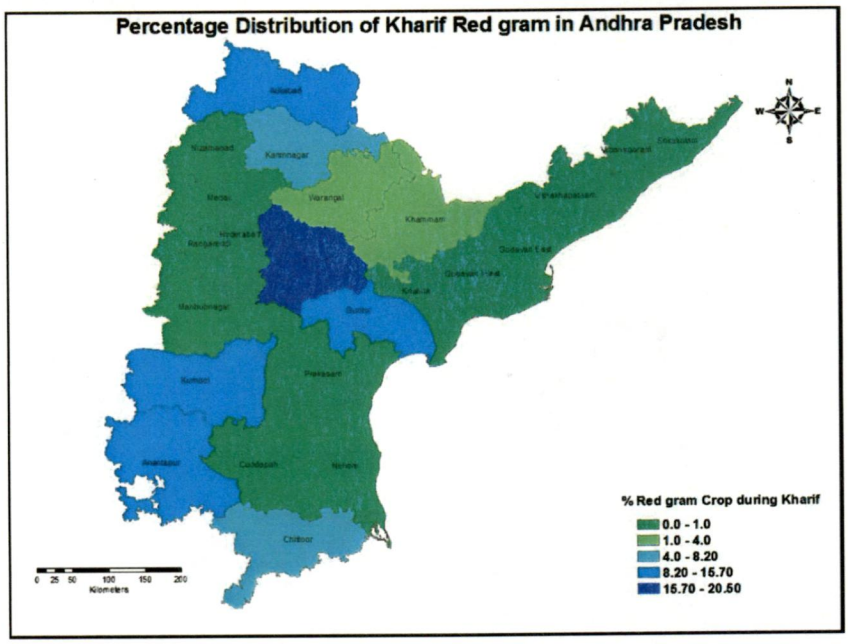
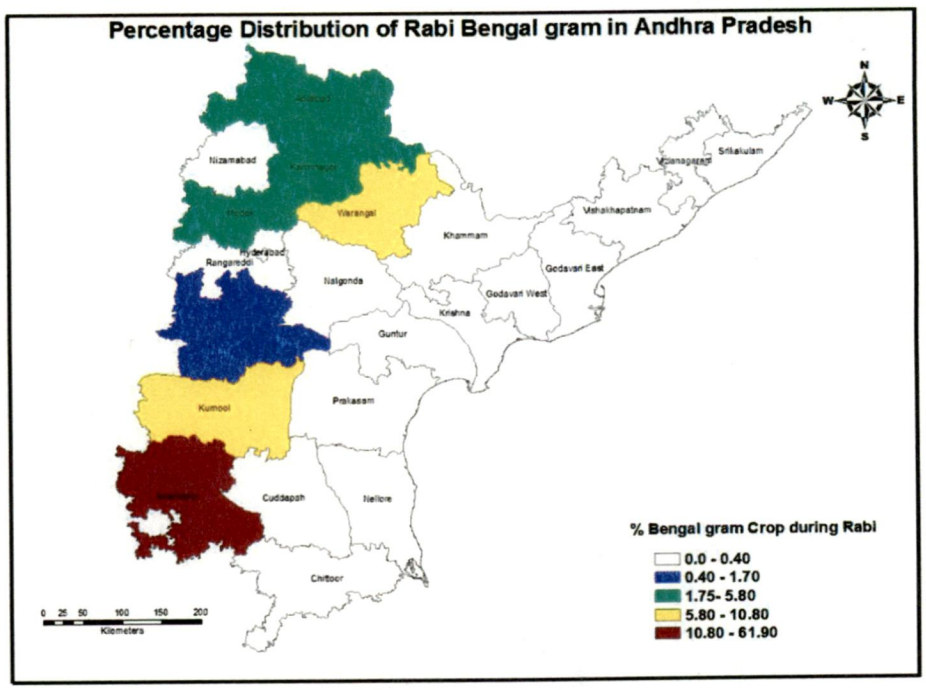


Table 5.14:District wise percentage of Bengal gram area during (2005-2010) in Andhra Pradesh.

S.No.	District	Area in (ha)	Bengal gram	
			Rabi(ha)	Rabi (%)
1	Srikakulam	583700	0	0.0
2	Vizainagaram	653900	0	0.0
3	Visakhapatnam	749300	0	0.0
4	East Godavari	1080700	0	0.0
5	West Godavari	774200	0	0.0
6	Krishna	1602900	0	0.0
7	Guntur	1284600	0	0.0

8	Prakasam	795600	0	0.0
9	Nellore	1424000	0	0.0
10	Chittoor	1515200	0	0.0
11	Kadapa	1535900	18	0.4
12	Ananthapur	1913000	2779	61.9
13	Kurnool	872700	410	9.1
14	Mahabubnagar	969900	79	1.8
15	Rangareddy	1762600	0	0.0
16	Hyderabad	65000	0	0.0
17	Medak	1765800	247	5.5
18	Nizamabad	1307600	0	0.0
19	Adilabad	1612800	204	4.5
20	Karimnagar	1139100	262	5.8
21	Warangal	1116100	488	10.9
22	Khammam	1182300	2	0.0
23	Nalgonda	1843200	0	0.0
	Total	**27550100**	**4489**	**100.0**

Fig 5.14: Percentage Distribution of Kharif and Rabi Bengal gram in Andhra Pradesh.



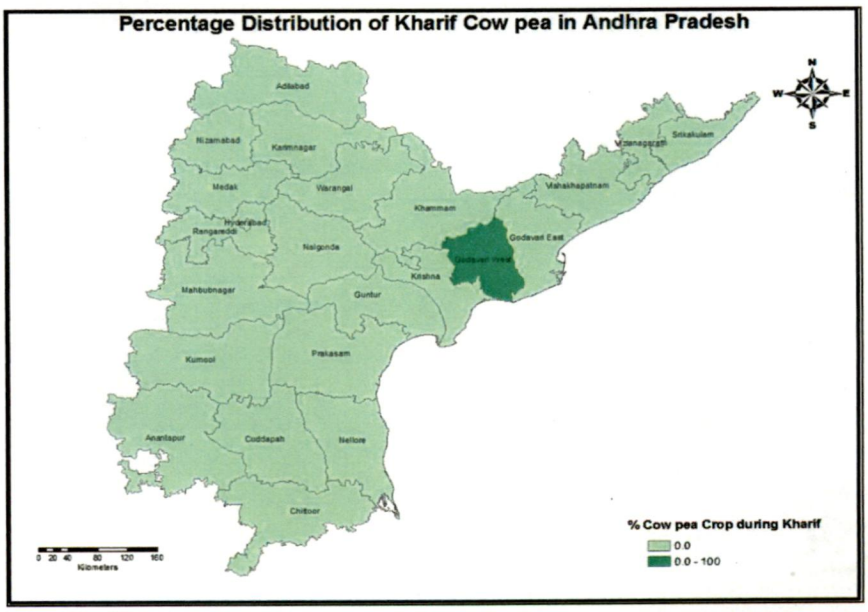
Cow gram

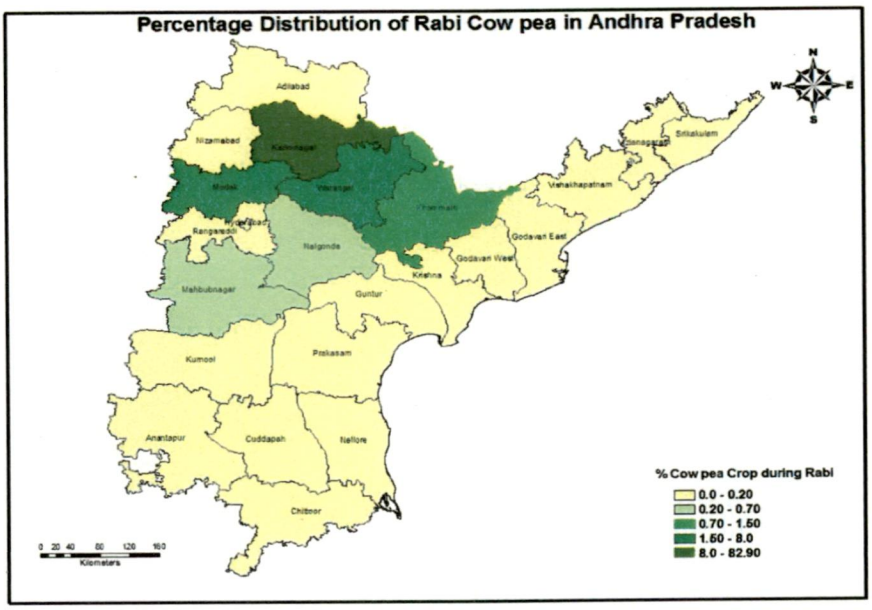
Cow gram is the principal crop extensively cultivated in all the districts of the State both in Kharif and Rabi seasons.In **Kharif Cow Gram** is highly grown in west Godavari (100%).In **Rabi Cow gram** the area, productivity and production of Horse gram in the State for the last 5 years (2005-2010) are presented and the Horse gram production estimated in Karimnagar district is at the top with the (83%), followed by Medak (8.0%), Warangal (5.8%), and Khammam (1.5%), in 2009-2010. These districts together accounted for 98.3 percent of the total area under this crop during 2009-2010 in the State.

Table 5.15:District wise percentage of Cow gram area during (2005-2010) in Andhra Pradesh.

S.No.	District	Area (ha)	Cowpea			
			Kharif(ha)	Kharif(%)	Rabi (ha)	Rabi(%)
1	Srikakulam	583700	0	0.0	0	0.0
2	Vizainagaram	653900	0	0.0	0	0.0
3	Visakhapatnam	749300	0	0.0	0	0.0
4	East Godavari	1080700	0	0.0	0	0.0
5	West Godavari	774200	34	100.0	0	0.0
6	Krishna	1602900	0	0.0	0	0.0
7	Guntur	1284600	0	0.0	0	0.0
8	Prakasam	795600	0	0.0	0	0.0
9	Nellore	1424000	0	0.0	0	0.0
10	Chittoor	1515200	0	0.0	0	0.0
11	Kadapa	1535900	0	0.0	5	0.1
12	Ananthapur	1913000	0	0.0	0	0.0
13	Kurnool	872700	0	0.0	0	0.0
14	Mahabubnagar	969900	0	0.0	27	0.5
15	Rangareddy	1762600	0	0.0	0	0.0
16	Hyderabad	65000	0	0.0	0	0.0
17	Medak	1765800	0	0.0	398	8.0
18	Nizamabad	1307600	0	0.0	0	0.0
19	Adilabad	1612800	0	0.0	14	0.3
20	Karimnagar	1139100	0	0.0	4110	83.0
21	Warangal	1116100	0	0.0	289	5.8
22	Khammam	1182300	0	0.0	76	1.5
23	Nalgonda	1843200	0	0.0	35	0.7
	Total	**27550100**	**34**	**100.0**	**4954**	**100.0**

Fig 5.15: Percentage Distribution of Kharif and Rabi Cow gram in Andhra Pradesh.





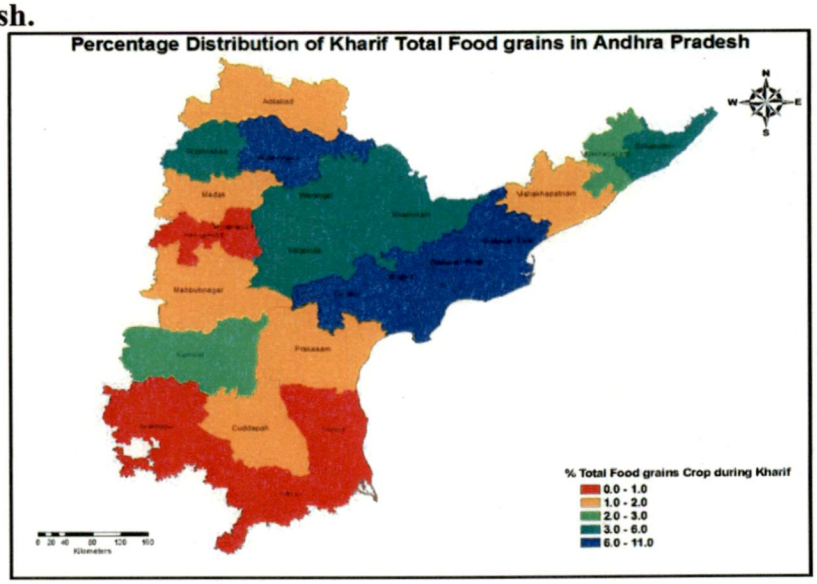
Total food grains extensively cultivated in all the districts of the State both in Kharif and Rabi seasons. 69.5 percent of the total Food-grains production during 2009-2010. In **Kharif season** the area, productivity and production of pulses in the State for the last 5 years (2005-2010) are presented and the pulses production estimated in Guntur district is at the top with the (11.5%), followed by Krishna(10.1%), West Godavari(10.1%), East Godavari (8.4%), Karimnagar (8.1%) Nalgonda (6.4%), and Srikakulam (5.5%) in 2009-2010. These districts are important for the crop accounted for 60.1 percent of the total area under the crop in the state during 2009-2010.In **Rabi season** the area, productivity and production of pulses in the State for the last 5 years (2005-2010) are presented and the pulses production estimated in West Godavari district is at the top with the (12.9%), followed by Nellore (11.3%), East Godavari(10.5%), Karimnagar (10.0%), Nalgonda (9.0%) and Krishna (6.6%) and Prakasam(5.9%) in 2009-2010. These districts are important for the crop accounted for 66.2 percent of the total area under the crop in the state during 2009-2010.

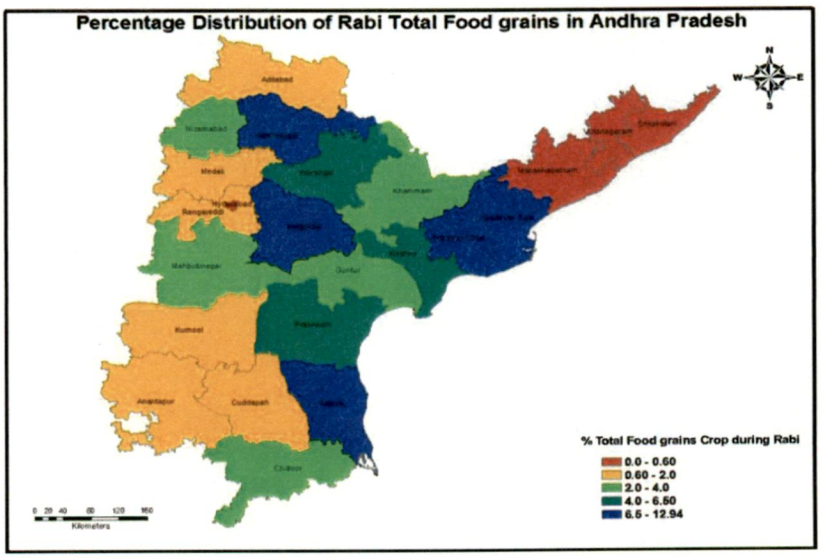
Table 5.16: District wise percentage of Total food grains area during (2005-2010) in Andhra Pradesh.

S.No.	District	Area in (ha)	Total Food grains			
			Kharif (ha)	Kharif (%)	Rabi (ha)	Rabi (%)
1	Srikakulam	583700	137808	5.5	6875	0.4
2	Vizainagaram	653900	85305	3.4	10626	0.6
3	Visakhapatnam	749300	58724	2.3	5792	0.3
4	East Godavari	1080700	211114	8.4	176341	10.5
5	West Godavari	774200	253684	10.1	216722	12.9
6	Krishna	1602900	255790	10.1	110256	6.6
7	Guntur	1284600	288995	11.5	47237	2.8

8	Prakasam	795600	58847	2.3	98924	5.9
9	Nellore	1424000	17701	0.7	189379	11.3
10	Chittoor	1515200	17320	0.7	68012	4.1
11	Kadapa	1535900	47174	1.9	24774	1.5
12	Ananthapur	1913000	31567	1.3	31239	1.9
13	Kurnool	872700	98454	3.9	34391	2.1
14	Mahabubnagar	969900	69434	2.8	57212	3.4
15	Rangareddy	1762600	23517	0.9	18624	1.1
16	Hyderabad	65000	0	0.0	0	0.0
17	Medak	1765800	58051	2.3	30451	1.8
18	Nizamabad	1307600	124170	4.9	74711	4.5
19	Adilabad	1612800	60361	2.4	19982	1.2
20	Karimnagar	1139100	204902	8.1	167179	10.0
21	Warangal	1116100	134552	5.3	84874	5.1
22	Khammam	1182300	125038	5.0	49359	2.9
23	Nalgonda	1843200	160819	6.4	151493	9.0
	Total	**27550100**	**2523327**	**100.0**	**1674453**	**100.0**

Fig 5.16: Percentage Distribution of Kharif and Rabi Total food grains in Andhra Pradesh.





Chillies and Turmeric

Chillies and Turmeric is the important crop in condiments and Spices group. Andhra Pradesh State stands first in the country in terms of area and production of Chillies and Turmeric crops during 2009-2010. The crop is grown both under irrigated and unirrigated conditions in both Kharif and Rabi seasons.

In **Kharif Chillies and Turmeric** the area, productivity and production of Sugarcane and Onion Rice in the State for the last 5 years (2005-2010) are presented and the Chillies and Turmeric production estimated in Guntur district is at the top with the (24.9%), followed by Khammam (17.2%), Warangal (16.0%), Kurnool (7.6%), Krishna (5.8%),and Prakasam (5.0%) in 2009-2010 and Guntur district alone accounts for 24.9 percent of total area under the crop during 2009-2010.These districts together accounted 76.5 percent of the total area under the crop in the state.

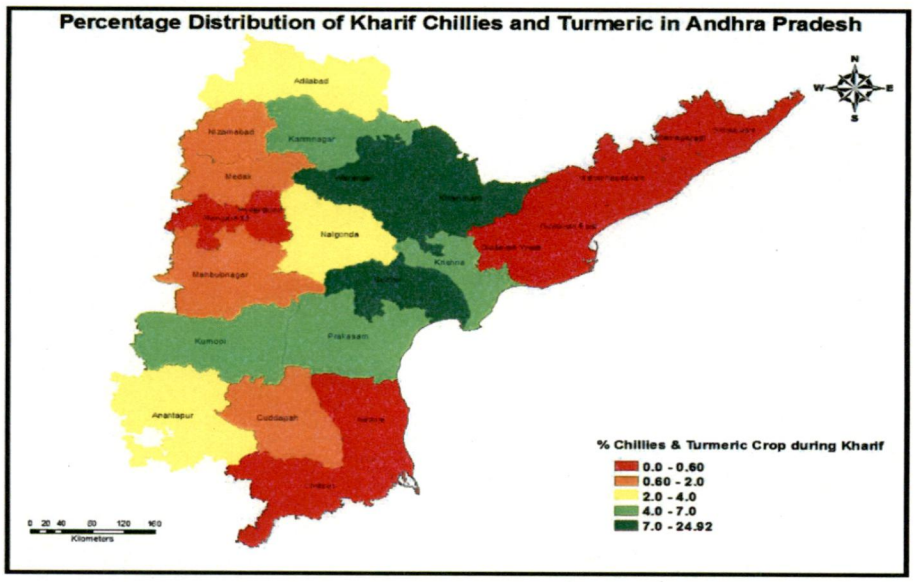
In **Rabi Chillies and Turmeric** the area, productivity and production of Sugarcane and Onion Rice in the State for the last 5 years (2005-2010) are presented and the Chillies and Turmeric production estimated in Khammam district is at the top with the (21.7%), followed by Warangal (20.0%),west Godavari (7.5%),Srikakulam (7.0%),Chittoor (5.2%), and Vishakhapatnam (5.1%) in 2009-2010.These districts together accounted for 66.5 percent of the total area under the crop in the state during 2009-2010.

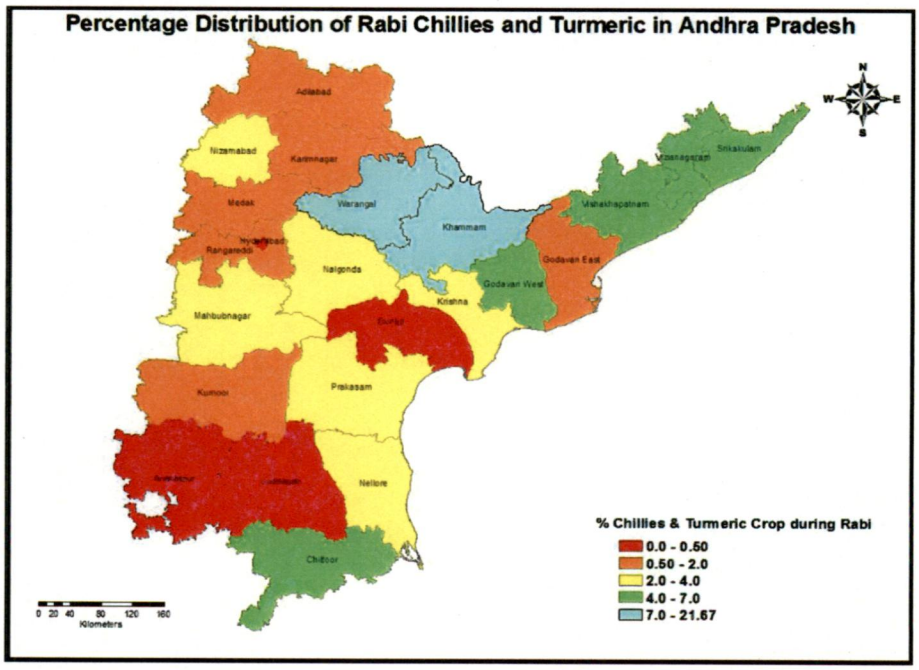
Table 5.17: District wise percentage of Chillies and Turmeric area during (2005-2010) in Andhra Pradesh.

S.No.	District	Area in (ha)	Chillies and Turmeric			
			Kharif (ha)	Kharif (%)	Rabi (ha)	Rabi (%)
1	Srikakulam	583700	29	0.0	2867	7.0
2	Vizainagaram	653900	286	0.3	1946	4.7
3	Visakhapatnam	749300	595	0.7	2092	5.1
4	East Godavari	1080700	240	0.3	379	0.9
5	West Godavari	774200	23	0.0	3086	7.5
6	Krishna	1602900	4951	5.8	1181	2.9
7	Guntur	284600	21270	24.9	36	0.1
8	Prakasam	795600	4282	5.0	1184	2.9
9	Nellore	1424000	282	0.3	1775	4.3
10	Chittoor	1515200	386	0.5	2159	5.2
11	Kadapa	1535900	1665	2.0	234	0.6
12	Ananthapur	1913000	2178	2.6	58	0.1
13	Kurnool	872700	6465	7.6	384	0.9

14	Mahabubnagar	969900	1872	2.2	1522	3.7
15	Rangareddy	1762600	124	0.1	757	1.8
16	Hyderabad	65000	0	0.0	0	0.0
17	Medak	1765800	819	1.0	833	2.0
18	Nizamabad	1307600	775	0.9	1026	2.5
19	Adilabad	1612800	3510	4.1	459	1.1
20	Karimnagar	1139100	4391	5.1	576	1.4
21	Warangal	116100	13621	16.0	8235	20.0
22	Khammam	1182300	14720	17.2	8930	21.7
23	Nalgonda	1843200	2853	3.3	1478	3.6
	Total	**27550100**	**85337**	**100.0**	**41197**	**100.0**

Fig 5.17 Percentage Distribution of Kharif and Rabi Chillies and Turmeric in Andhra Pradesh





Sugarcane and Onion

Sugarcane and Onion is an important commercial crop in the state. It is mainly an Irrigated crop. Adsali variety crop which is grown only in Nizamabad district and it is a long duration crop of more than one year sown in the month of December/January and harvested in February/March of the succeeding year.**In Kharif Sugarcane and Onion** the area, productivity and production of Sugarcane and Onion Rice in the State for the last 5 years (2005-2010) are presented and the Sugarcane and Onion production estimated.Kurnool district is at the top with the (64.5%), followed by Kadapa (11.1%), Guntur (9.0%), Anantapur (5.4%) and Mahabubnagar (3.5%) in 2009-2010. These districts together accounted for 93.5 percent of the total area under this crop during 2009-2010 in the State.

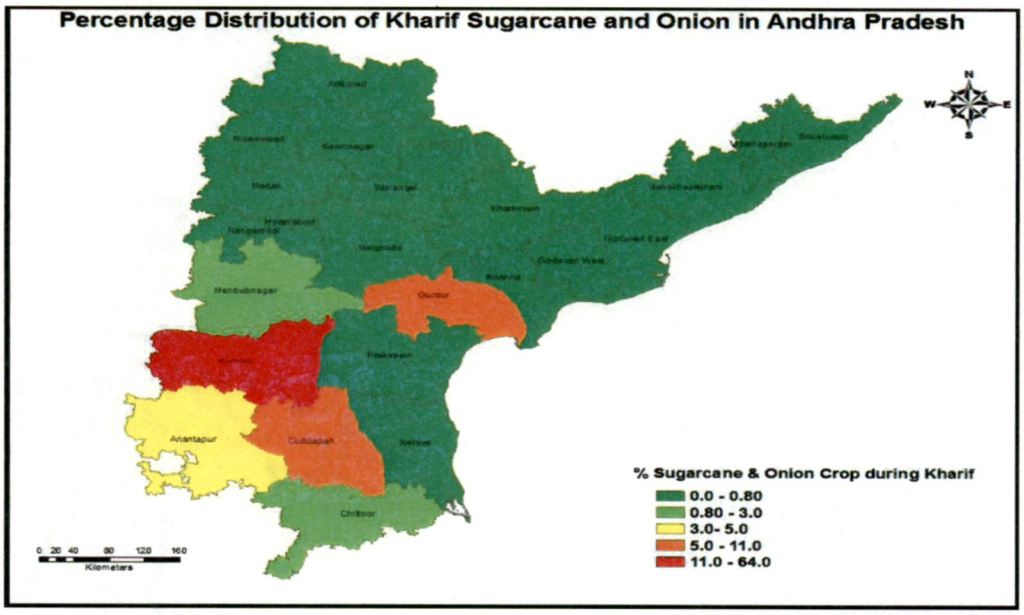
In Rabi Sugarcane and Onion the area, productivity and production of Sugarcane and Onion Rice in the State for the last 5 years (2005-2010) are presented and the Sugarcane and Onion production estimated in Medak district is at the top with the (20.3%), followed by Kurnool (15.8%), Rangareddy (15.1%), Nizamabad (11.5%) and Srikakulam (7.8%) in 2009-2010. These districts together accounted for 70.5 percent of the total area under this crop during 2009-2010 in the State.

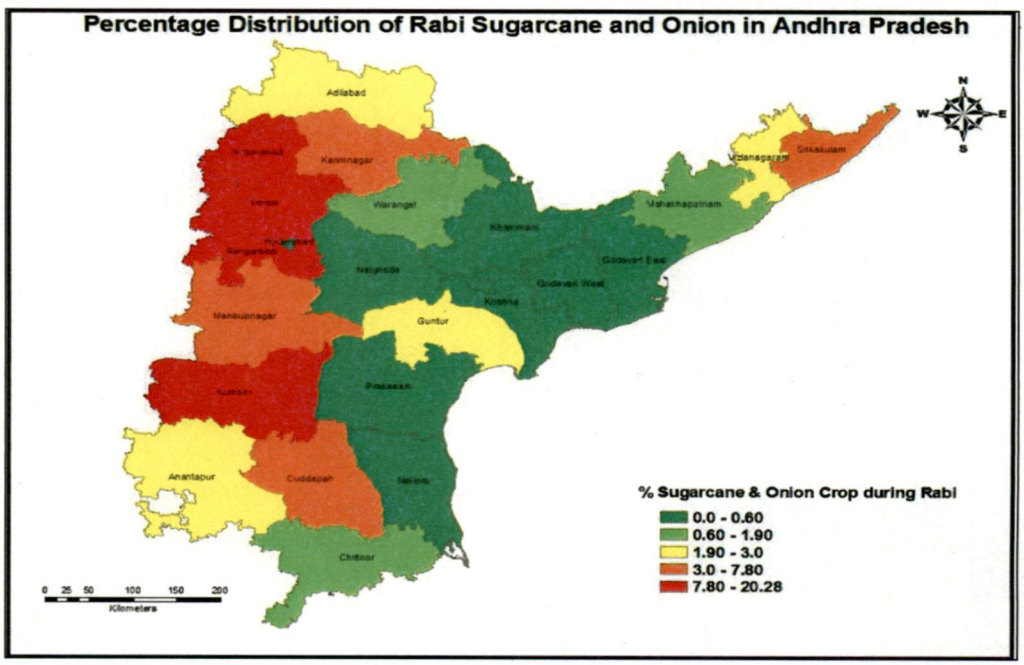
Table 5.18 District wise percentage of Sugarcane and Onion area during (2005-2010) in Andhra Pradesh

S.No.	District	Area in (ha)	Sugarcane & Onions			
			Kharif (ha)	Kharif (%)	Rabi (ha)	Rabi (%)
1	Srikakulam	583700	42	0.3	1226	7.8
2	Vizainagaram	653900	91	0.6	416	2.7
3	Visakhapatnam	749300	36	0.2	160	1.0
4	East Godavari	1080700	7	0.0	0	0.0
5	West Godavari	774200	0	0.0	0	0.0
6	Krishna	1602900	61	0.4	101	0.6
7	Guntur	1284600	1327	9.0	372	2.4
8	Prakasam	795600	22	0.1	26	0.2
9	Nellore	1424000	86	0.6	9	0.1
10	Chittoor	1515200	254	1.7	253	1.6
11	Kadapa	1535900	1633	11.1	653	4.2
12	Ananthapur	1913000	799	5.4	353	2.3
13	Kurnool	872700	9518	64.5	2468	15.8
14	Mahabubnagar	969900	515	3.5	649	4.1
15	Rangareddy	1762600	125	0.8	2363	15.1
16	Hyderabad	65000	0	0.0	0	0.0
17	Medak	1765800	56	0.4	3174	20.3

18	Nizamabad	1307600	45	0.3	1792	11.5
19	Adilabad	1612800	38	0.3	496	3.2
20	Karimnagar	1139100	54	0.4	803	5.1
21	Warangal	1116100	51	0.3	306	2.0
22	Khammam	1182300	1	0.0	5	0.0
23	Nalgonda	1843200	0	0.0	25	0.2
	Total	**27550100**	**14761**	**100.0**	**15650**	**100.0**

Fig 5.18 Percentage Distribution of Kharif and Rabi Sugarcane and Onion in Andhra Pradesh





Groundnut

Groundnut is one of the important Oilseed crops mostly cultivated under rain fed conditions and is cultivated in almost all districts. The area under Oilseeds during 2009-2010 was 22.23 lakh hectares which constituted 17.7 percent of the total cropped area in the State.Out of which, groundnut alone accounted for 58.52 percent of the total area under Oilseeds.

In **Kharif season** the area, productivity and production of Groundnut in the State for the last 5 years (2005-2010) are presented and the Groundnut production estimated in Kadapa district is at the top with the (21.8%), followed by Nellore (19.5%), Chittoor (19.3%), Anantapur (10.1%), Kurnool (8.7%) and Mahabubnagar (8.0%) and Prakasam the bottom with the (5.7%)in 2009-2010. These districts together accounted for 93.1 percent of the total area under the crop in the state during 2009-2010.

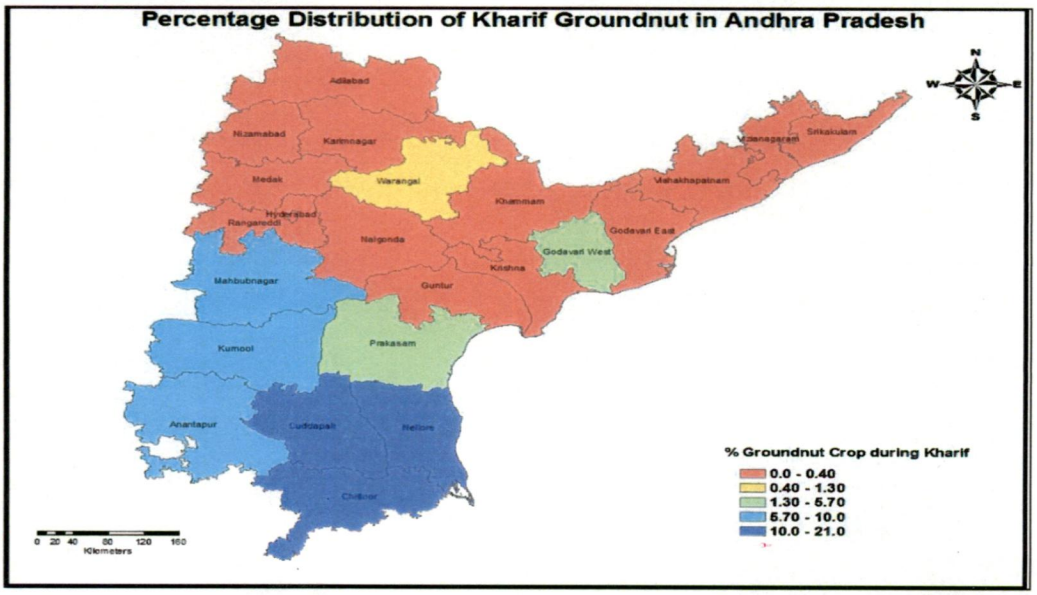
In **Rabi season** the area, productivity and production of Groundnut in the State for the last 5 years (2005-2010) are presented and the Groundnut production estimated in Mahabubnagar district is at the top with the (21.2%), followed by Warangal(12.0%), Kurnool (10.7%), Kadapa (9.2%), Anantapur (8.9%) and Chittoor (7.2%) in 2009-2010.These districts together accounted for 69.2 percent of the total area under the crop in the state during 2009-2010.

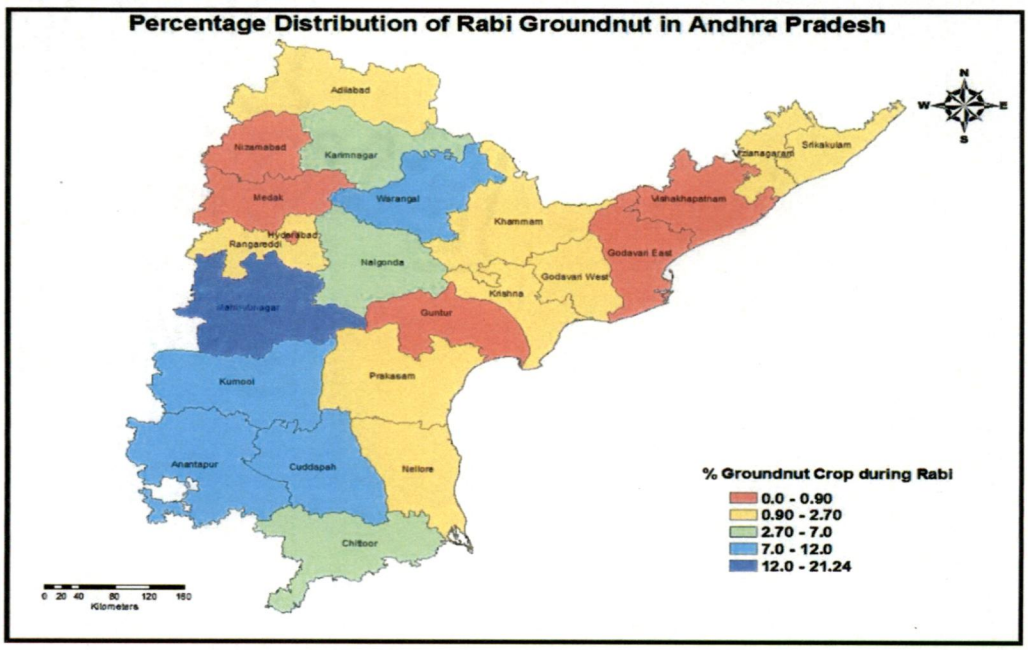
Table 5.19:District wise percentage of Groundnut area during (2005-2010) in Andhra Pradesh.

S.No	District	Area in (ha)	Groundnut			
			Kharif (ha)	Kharif (%)	Rabi (ha)	Rabi (%)
1	Srikakulam	583700	0	0.0	6832	2.8
2	Vizainagaram	653900	0	0.0	3626	1.5
3	Visakhapatnam	749300	3	0.0	995	0.4
4	East Godavari	1080700	15	0.0	262	0.1
5	West Godavari	774200	1371	4.2	2920	1.2
6	Krishna	1602900	2	0.0	2817	1.1
7	Guntur	1284600	111	0.3	1602	0.6
8	Prakasam	795600	1878	5.7	4163	1.7
9	Nellore	1424000	6388	19.5	6153	2.5
10	Chittoor	1515200	6342	19.3	17796	7.2
11	Kadapa	1535900	7154	21.8	22785	9.2
12	Ananthapur	1913000	3313	10.1	22006	8.9
13	Kurnool	872700	2872	8.7	26638	10.7
14	Mahabubnagar	969900	2625	8.0	52654	21.2
15	Rangareddy	1762600	18	0.1	4381	1.8

16	Hyderabad	65000	0	0.0	0	0.0
17	Medak	1765800	2	0.0	2246	0.9
18	Nizamabad	1307600	0	0.0	2052	0.8
19	Adilabad	1612800	86	0.3	3516	1.4
20	Karimnagar	1139100	10	0.0	13631	5.5
21	Warangal	1116100	452	1.4	29848	12.0
22	Khammam	1182300	39	0.1	4130	1.7
23	Nalgonda	1843200	153	0.5	16799	6.8
	Total		**32834**	**100.0**	**247852**	**100.0**

Fig 5.19: Percentage Distribution of Kharif and Rabi Groundnut in Andhra Pradesh.



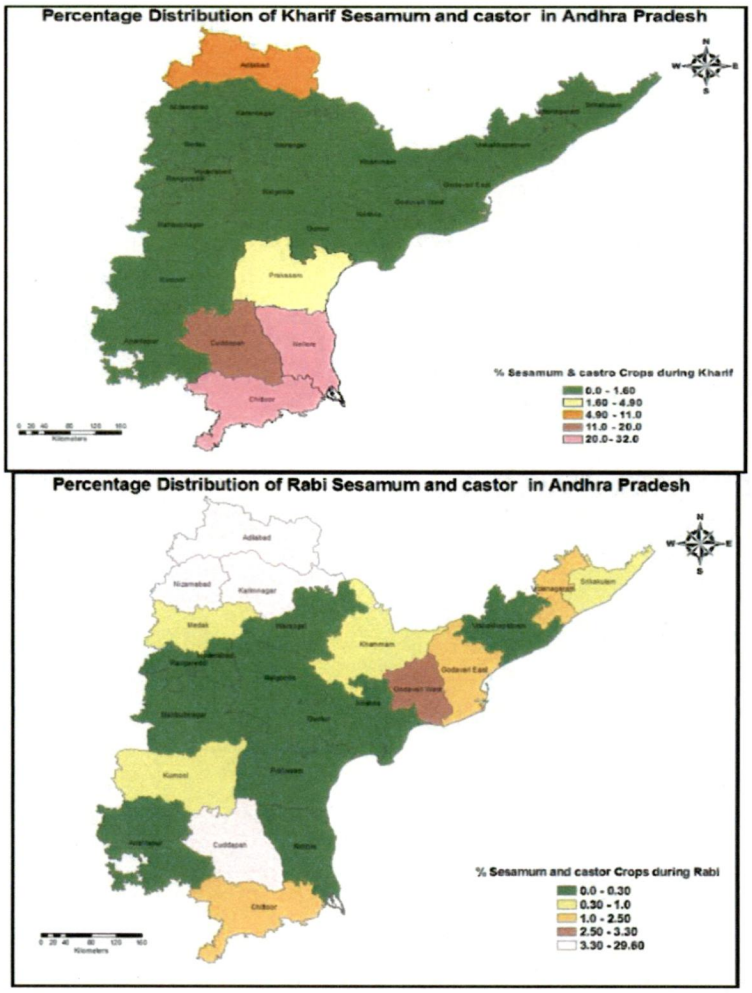


Sesamum and castor crops cultivated both in Kharif and Rabi seasons in the state. Kharif crop is sown in the months of June and July and Rabi crop is sown in October. In **Kharif season** the area, productivity and production of Sesamum and Castor in the State for the last 5 years (2005-2010) are presented and the Sesamum and Castor production estimated in Chittoor district is at the top with the (32.0%), followed by Nellore (28.7%), Kadapa (20.7%), Adilabad (11.6%), Prakasam (5.0%) and Kurnool is the bottom with the (0.7%) in 2009-2010. These districts together accounted for 95 percent of the total area under this crop in the state during 2009-2010. In **Rabi season** the area, productivity and production of Sesamum and Castor in the State for the last 5 years (2005-2010) are presented and the Sesamum and Castor production estimated in Karimnagar district is at the top with the (29.6%), followed by Kadapa (21.3%), Nizamabad (18.6%), Adilabad (16.0%), and west Godavari (3.3%).These districts together accounted for 88.9 percent of the total area under this crop in the state during 2009-2010.

Table 5.20:District wise percentage of Sesamum and Castor area during (2005-2010) in Andhra Pradesh.

S.No	District	Area in (ha)	Sesamum & Castor in Kharif in ha			
			Kharif (ha)	Kharif (%)	Rabi (ha)	Rabi (%)
1	Srikakulam	583700	0	0.0	120	0.9
2	Vizainagaram	653900	0	0.0	262	2.0
3	Visakhapatnam	749300	0	0.0	0	0.0
4	East Godavari	1080700	0	0.0	340	2.5
5	West Godavari	774200	5	1.7	445	3.3
6	Krishna	1602900	0	0.0	0	0.0
7	Guntur	1284600	0	0.0	14	0.1
8	Prakasam	795600	15	5.0	20	0.1
9	Nellore	1424000	87	28.7	45	0.3
10	Chittoor	1515200	97	32.0	326	2.4
11	Kadapa	1535900	62	20.5	2866	21.3
12	Ananthapur	1913000	0	0.0	0	0.0
13	Kurnool	872700	2	0.7	77	0.6
14	Mahabubnagar	969900	0	0.0	0	0.0
15	Rangareddy	1762600	0	0.0	0	0.0
16	Hyderabad	65000	0	0.0	0	0.0
17	Medak	1765800	0	0.0	146	1.1
18	Nizamabad	1307600	0	0.0	2500	18.6
19	Adilabad	1612800	35	11.6	2149	16.0
20	Karimnagar	1139100	0	0.0	3975	29.6
21	Warangal	1116100	0	0.0	32	0.2
22	Khammam	1182300	0	0.0	89	0.7
23	Nalgonda	1843200	0	0.0	20	0.1
	Total	**27550100**	**303**	**100.0**	**13426**	**100.0**

Fig 5.20: Percentage Distribution of Kharif and Rabi Sesamum and Castor in Andhra Pradesh.



Sunflower is an important oil seed crop in the State. It is cultivated both in Kharif and Rabi seasons. In **Kharif season** the area, productivity and production of Sunflower in the State for the last 5 years (2005-2010) are presented and the Sunflower production estimated in Anantapur district is at the top with the (56.5%), followed by Kurnool (21.3%), Kadapa (11.7%), Nellore (4.4%), and Prakasam (3.4%).These districts together accounted for 88.9 percent of the total area under this crop in the state during 2009-2010.These districts together accounted for 97.3 percent of the total area under this crop in the state during 2009-2010.

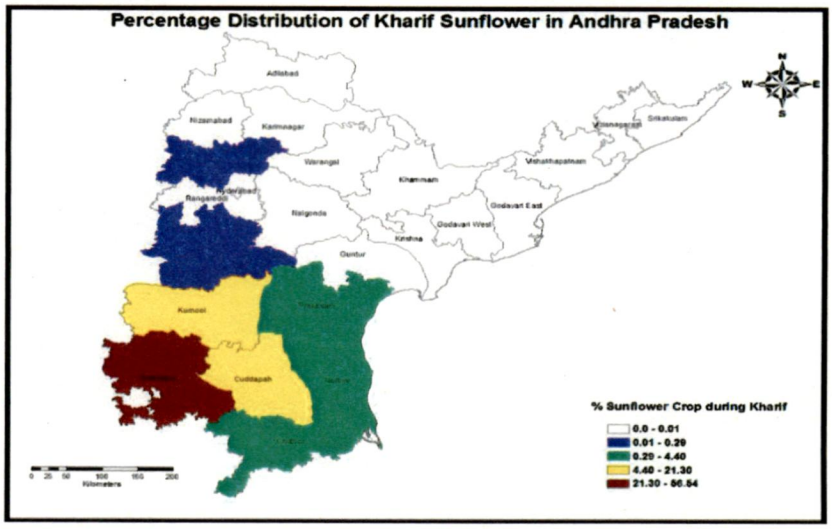
In **Rabi season** the area, productivity and production of Sunflower in the State for the last 5 years (2005-2010) are presented and the Sunflower production estimated in Kadapa district is at the top with the (23.0%), followed by nizamabad (16.9%), Kurnool (16.3%), Anantapur (10.1%), and Prakasam (9.2%) and Medak(7.5%).These districts together accounted for 88.9 percent of the total area under this crop in the state during 2009-2010.

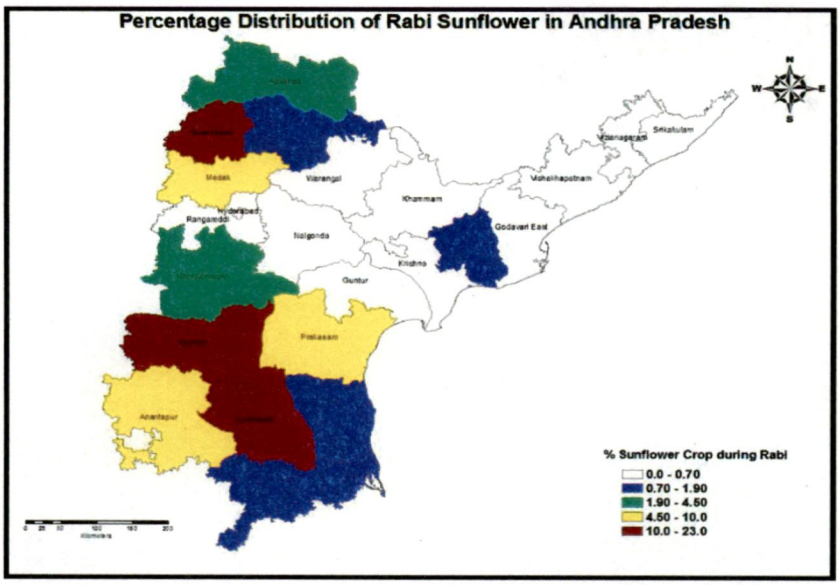
These districts together accounted for 83 percent of the total area under this crop in the state during 2009-2010.

Table 5.21:District wise percentage of Sunflower area during (2005-2010) in Andhra Pradesh.

S.No.	District	Area in (ha)	Sunflower in Kharif in ha			
			Kharif(ha)	Kharif (%)	Rabi (ha)	Rabi (%)
1	Srikakulam	583700	0	0.0	864	0.7
2	Vizainagaram	653900	0	0.0	2	0.0
3	Visakhapatnam	749300	0	0.0	77	0.1
4	East Godavari	1080700	0	0.0	530	0.4
5	West Godavari	774200	0	0.0	2362	2.0
6	Krishna	1602900	0	0.0	144	0.1
7	Guntur	1284600	0	0.0	330	0.3
8	Prakasam	795600	771	3.4	10928	9.2
9	Nellore	1424000	995	4.4	1402	1.2
10	Chittoor	1515200	472	2.1	1917	1.6
11	Kadapa	1535900	2651	11.7	27304	23.0
12	Ananthapur	1913000	12765	56.5	11942	10.1
13	Kurnool	872700	4814	21.3	19302	16.3
14	Mahabubnagar	969900	66	0.3	5411	4.6
15	Rangareddy	1762600	4	0.0	388	0.3
16	Hyderabad	65000	0	0.0	0	0.0
17	Medak	1765800	38	0.2	8914	7.5
18	Nizamabad	1307600	0	0.0	20018	16.9
19	Adilabad	1612800	0	0.0	3704	3.1
20	Karimnagar	1139100	0	0.0	1163	1.0
21	Warangal	1116100	0	0.0	790	0.7
22	Khammam	182300	0	0.0	503	0.4
23	Nalgonda	1843200	0	0.0	476	0.4
	Total	**27550100**	**22576**	**100.0**	**118471**	**100.0**

Fig 5.21 Percentage Distribution of Kharif and Rabi Sunflower in Andhra Pradesh





coconut area, productivity and production of Coconut in the State for the last 5 years (2005-2010) are presented and the Coconut production estimated in west Godavari district is at the top with the (46.7%), followed by East Godavari (38.9%), Chittoor (6.3%), Krishna (2.5%), and khammam (9.2%).These districts together accounted for 96.4 percent of the total area under this crop in the state during 2009-2010.

Table 5.22:District wise percentage of Coconut area during (2005-2010) in Andhra Pradesh.

S.No.	District	Area in (ha)	Coconut in ha	Coconut in %
1	Srikakulam	583700	0	0.0
2	Vizainagaram	653900	0	0.0
3	Visakhapatnam	749300	224	0.5
4	East Godavari	1080700	18756	38.9
5	West Godavari	774200	22564	46.7
6	Krishna	1602900	1185	2.5
7	Guntur	1284600	137	0.3
8	Prakasam	795600	27	0.1
9	Nellore	1424000	436	0.9
10	Chittoor	1515200	3047	6.3
11	Kadapa	1535900	96	0.2
12	Ananthapur	1913000	780	1.6
13	Kurnool	872700	13	0.0
14	Mahabubnagar	969900	11	0.0
15	Rangareddy	1762600	13	0.0
16	Hyderabad	65000	0	0.0
17	Medak	1765800	1	0.0
18	Nizamabad	1307600	0	0.0
19	Adilabad	1612800	0	0.0

20	Karimnagar	1139100	0	0.0
21	Warangal	1116100	0	0.0
22	Khammam	1182300	943	2.0
23	Nalgonda	1843200	36	0.1
	Total	**27550100**	**48269**	**100.0**

Total Oil Seeds

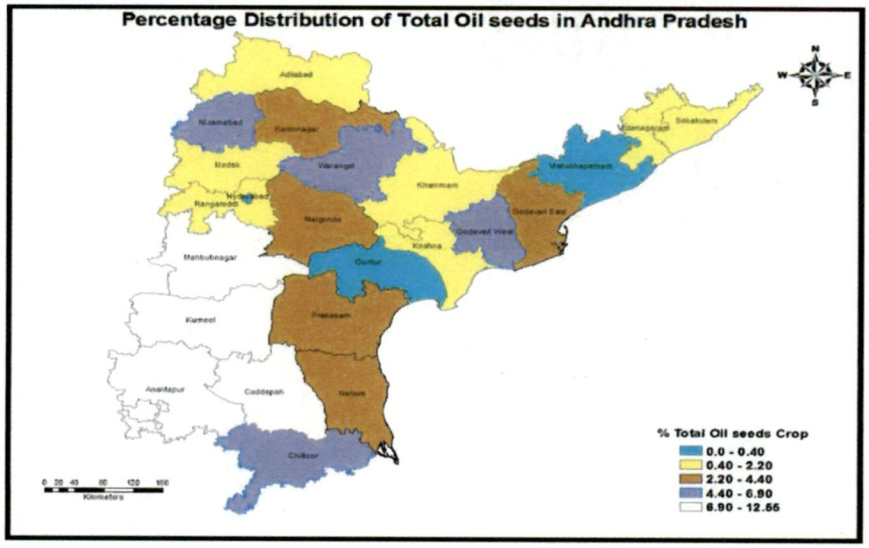
Andhra Pradesh is one of the important States in the country growing Oil Seed crops like Groundnut, Sunflower and Castor. The area under Oil seeds during 2009-2010 was 21.19 lakh hectares which constituted 16.9 percent of the total cropped area in the State. In **Total Oil seeds** area, productivity and production of Oil seeds in the State for the last 5 years (2005-2010) are presented and the Oil seeds production estimated in Kadapa district is at the top with the (12.6%), followed by Mahabubnagar (12.2%), Kurnool (10.9%), Anantapur (10.1%), West Godavari (7.0%), Warangal (6.3%)and Chittoor (6.0%) in 2009-2010.These districts together accounted for 65.1 percent of the total area under the crop in the state during 2009-2010.

Table 5.23: District wise percentage of Total oil seeds area during (2005-2010) in Andhra Pradesh.

S.No.	District	Area in (ha)	Total Oil Seeds (ha)	Total Oil Seeds (%)
1	Srikakulam	583700	7821	1.6
2	Vizainagaram	653900	4956	1.0
3	Visakhapatnam	749300	1768	0.4
4	East Godavari	1080700	22224	4.4
5	West Godavari	774200	34920	7.0
6	Krishna	1602900	6314	1.3
7	Guntur	1284600	2196	0.4
8	Prakasam	795600	17819	3.6
9	Nellore	1424000	16226	3.2
10	Chittoor	1515200	30003	6.0
11	Kadapa	1535900	62921	12.6
12	Ananthapur	1913000	50835	10.1
13	Kurnool	872700	54715	10.9
14	Mahabubnagar	969900	60944	12.2
15	Rangareddy	1762600	4859	1.0
16	Hyderabad	65000	0	0.0
17	Medak	1765800	11375	2.3
18	Nizamabad	1307600	26933	5.4
19	Adilabad	1612800	9719	1.9
20	Karimnagar	1139100	19182	3.8
21	Warangal	1116100	31345	6.3

22	Khammam	1182300	6437	1.3
23	Nalgonda	1843200	17484	3.5
	Total	**27550100**	**500996**	**100.0**

Fig 5.22 Percentage Distribution of Total oil seeds in Andhra Pradesh



Tobacco

Tobacco is the major export crop in the state. Andhra Pradesh is ranked first in area and second in Production of Tobacco among the states in the country. The crop is mainly sown during Rabi season. There are two varieties of Tobacco viz: Virginia and natu.West Godavari (62.0%), Krishna (7.5%), Nellore (4.3%), and Vizainagaram (3.9%).These districts together account for 78.5 percent of the total area in the State during 2009-2010.

Table 5.24:District wise percentage of Tobacco area during (2005-2010) in Andhra Pradesh.

S.No.	District	Area in (ha)	Total Tobacco (ha)	Total Tobacco %)
1	Srikakulam	583700	53	0.2
2	Vizainagaram	653900	1291	3.9
3	Visakhapatnam	749300	547	1.7
4	East Godavari	1080700	890	2.7
5	West Godavari	774200	20426	62.0
6	Krishna	1602900	2483	7.5
7	Guntur	1284600	0	0.0
8	Prakasam	795600	30	0.1
9	Nellore	1424000	1408	4.3
10	Chittoor	1515200	7	0.0
11	Kadapa	1535900	8	0.0
12	Ananthapur	1913000	1	0.0

13	Kurnool	872700	89	0.3
14	Mahabubnagar	969900	153	0.5
15	Rangareddy	1762600	0	0.0
16	Hyderabad	65000	0	0.0
17	Medak	1765800	0	0.0
18	Nizamabad	1307600	0	0.0
19	Adilabad	1612800	72	0.2
20	Karimnagar	1139100	601	1.8
21	Warangal	1116100	7	0.0
22	Khammam	1182300	4899	14.9
23	Nalgonda	1843200	0	0.0
	Total	**27550100**	**32965**	**100.0**

Cotton

Cotton is an important Fibre crop grown in Kharif season in the state, mainly as un-irrigated crop. Andhra Pradesh is one of the first three states along with Gujarat, Maharashtra in India in respect of area and production of cotton. During **Kharif season**, the crop is mainly raised as a rain-fed crop in the districtsWarangal (45.7%), Karimnaga r(18.8%), Guntur (8.8%), khammam (5.5%), Prakasam (4.8%) and Kadapa (4.2%) Area under Cotton during the year 2009-2010 was 14.68 lakhs hectares. which is accounted for 11.7 percent of gross cropped area in the state. These districts together accounted for 79.0 percent total area under the crop in the State during 2009-2010.

Fig 5.23: Percentage Distribution of Kharif and Rabi Tobacco in Andhra Pradesh.

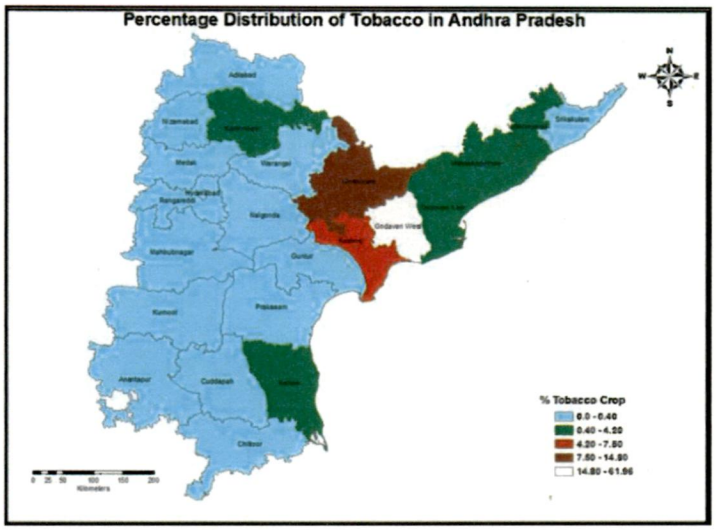
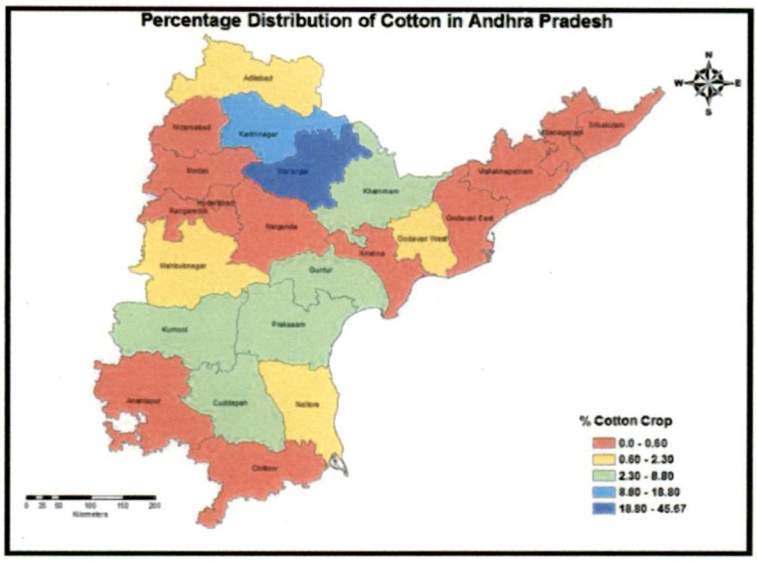


Table 5.25:District wise percentage of Cotton area during (2005-2010) in Andhra Pradesh.

S.No.	District	Area in (ha)	Total Cotton (ha)	Total Cotton (%)
1	Srikakulam	583700	0	0.0
2	Vizainagaram	653900	0	0.0
3	Visakhapatnam	749300	0	0.0
4	East Godavari	1080700	66	0.0
5	West Godavari	774200	3592	1.7
6	Krishna	1602900	1379	0.7
7	Guntur	1284600	18263	8.8
8	Prakasam	795600	9886	4.8
9	Nellore	1424000	3030	1.5
10	Chittoor	1515200	4	0.0
11	Kadapa	1535900	8639	4.2
12	Ananthapur	1913000	1107	0.5
13	Kurnool	872700	7735	3.7
14	Mahabubnagar	969900	4850	2.3
15	Rangareddy	1762600	0	0.0
16	Hyderabad	65000	0	0.0
17	Medak	1765800	0	0.0
18	Nizamabad	1307600	212	0.1
19	Adilabad	1612800	3352	1.6
20	Karimnagar	1139100	39094	18.8
21	Warangal	1116100	94783	45.7
22	Khammam	1182300	11377	5.5
23	Nalgonda	1843200	160	0.1
	Total	**27550100**	**207529**	**100.0**

Fig 5.24: Percentage Distribution of Cotton in Andhra Pradesh.



Total fodder crops

Total fodder crops are sown mostly in one season under rain fed conditions in the State. This crop extensively cultivated in all the districts of the state. The area, productivity and production of total fodder crop in the State for the last 5 years (2005-2010) are presented and the rice crop production estimated in Rangareddy district is at the top with the (24.8%), followed by Chittoor (14.0%), Nizamabad (12.8%), Krishna (11.4%),Mahabubnagar (6.8%), Khammam (6.5%) and Prakasam (4.5%).These districts together accounted for 80.8 percent of the total area under this crop in the state during 2009-2010.

Table 5.26:District wise percentage of Total fodder crop area during (2005-2010) in Andhra Pradesh.

S.No.	District	Area in (ha)	Total Fodder Crops(ha)	Total Fodder Crops (%)
1	Srikakulam	583700	3	0.0
2	Vizainagaram	653900	0	0.0
3	Visakhapatnam	749300	11	0.1
4	East Godavari	1080700	257	2.3
5	West Godavari	774200	148	1.3
6	Krishna	1602900	1257	11.4
7	Guntur	1284600	113	1.0
8	Prakasam	795600	541	4.9
9	Nellore	1424000	225	2.0
10	Chittoor	1515200	1544	14.0
11	Kadapa	1535900	86	0.8
12	Ananthapur	1913000	64	0.6
13	Kurnool	872700	283	2.6
14	Mahabubnagar	969900	745	6.8
15	Rangareddy	1762600	2727	24.8
16	Hyderabad	65000	0	0.0
17	Medak	1765800	344	3.1
18	Nizamabad	1307600	1412	12.8
19	Adilabad	1612800	23	0.2
20	Karimnagar	1139100	144	1.3
21	Warangal	1116100	19	0.2
22	Khammam	1182300	713	6.5
23	Nalgonda	1843200	347	3.2
	Total	**27550100**	**11006**	**100.0**

Non food crops

Non food crops are sown mostly in one season under rain fed conditions in the State. This crop extensively cultivated in all the districts of the state. The area, productivity and

production of total fodder crop in the State for the last 5 years (2005-2010) are presented and the rice crop production estimated in Chittoor district is at the top with the (27.5%), followed by Ananthapur (23.4%), East Godavari (8.5%), Kadapa (7.2%),Rangareddy(7.0%), Kurnool (5.0%) and Guntur (4.7%).These districts together accounted for 83.3 percent of the total area under this crop in the state during 2009-2010.

Table 5.27: District wise percentage of Non food crops area during (2005-2010) in Andhra Pradesh.

S.No	District	Area in (ha)	Non Food Crops(ha)	Non Food Crops %)
1	Srikakulam	583700	20	0.1
2	Vizainagaram	653900	692	2.7
3	Visakhapatnam	749300	791	3.0
4	East Godavari	1080700	2210	8.5
5	West Godavari	774200	410	1.6
6	Krishna	1602900	830	3.2
7	Guntur	1284600	1218	4.7
8	Prakasam	795600	414	1.6
9	Nellore	1424000	515	2.0
10	Chittoor	1515200	7165	27.5
11	Kadapa	1535900	1886	7.2
12	Ananthapur	1913000	6091	23.4
13	Kurnool	872700	1311	5.0
14	Mahabubnagar	969900	126	0.5
15	Rangareddy	1762600	1836	7.0
16	Hyderabad	65000	0	0.0
17	Medak	1765800	295	1.1
18	Nizamabad	1307600	35	0.1
19	Adilabad	1612800	3	0.0
20	Karimnagar	1139100	46	0.2
21	Warangal	1116100	14	0.1
22	Khammam	1182300	98	0.4
23	Nalgonda	1843200	57	0.2
	Total	**27550100**	**26063**	**100.0**

Total non food crops

Total non food crops are sown mostly in one season under rain fed conditions in the State. This crop extensively cultivated in all the districts of the state.The area, productivity and production of total fodder crop in the State for the last 5 years (2005-2010) are presented and the rice crop production estimated in Warangal district is at the top with the (16.2%), followed by Kadapa (9.4%), Mahabubnagar (8.6%), Kurnool (8.2%),Karimnagar & West

Godavari (7.6%), Ananthapur (7.5%) and Chittoor (5.0%).These districts together accounted for 62.5 percent of the total area under this crop in the state during 2009-2010.

Table 5.28: District wise percentage of Total non food crops area during (2005-2010) in Andhra Pradesh

S.No	District	Area in (ha)	Total Non Food Crops(ha)	Total Non Food Crops (%)
1	Srikakulam	583700	7897	1.0
2	Vizainagaram	653900	6939	0.9
3	Visakhapatnam	749300	3117	0.4
4	East Godavari	1080700	25647	3.3
5	West Godavari	774200	59496	7.6
6	Krishna	1602900	12263	1.6
7	Guntur	1284600	21790	2.8
8	Prakasam	795600	28690	3.7
9	Nellore	1424000	21404	2.7
10	Chittoor	1515200	38723	5.0
11	Kadapa	1535900	73540	9.4
12	Ananthapur	1913000	58098	7.5
13	Kurnool	872700	64133	8.2
14	Mahabubnagar	969900	66818	8.6
15	Rangareddy	1762600	9422	1.2
16	Hyderabad	65000	0	0.0
17	Medak	1765800	12014	1.5
18	Nizamabad	1307600	28592	3.7
19	Adilabad	1612800	13169	1.7
20	Karimnagar	1139100	59067	7.6
21	Warangal	1116100	126168	16.2
22	Khammam	1182300	23524	3.0
23	Nalgonda	1843200	18048	2.3
	Total	**27550100**	**778559**	**100.0**

Total gross area of all cultivated crops in each season given below.This all crops extensively cultivated in all the districts of the state of Andhra Pradesh.In **Kharif season** the area, productivity and production of crops in the State for the last 5 years (2005-2010) are presented and the crop production estimated in Guntur district is at the top with the (10.0%), followed by West Godavari (9.5%), Krishna(8.4%),Karimnagar (8.2%), East Godavari (7.7%),Warangal (7.4%), and Nalgonda(5.7%).These districts together accounted for 56.9 percent of the total area under this crop season in the state during 2009-2010.

In **Rabi season** the area, productivity and production of crops in the State for the last 5 years (2005-2010) are presented and the crop production estimated in West Godavari district is at the top with the (11.7%), followed by Nellore (8.7%), East Godavari (8.2%), Karimnagar (7.8%), %), Nalgonda (7.1%),Krishna (5.9%),and Chittoor(5.3) These districts together accounted for 54.7percent of the total area under this crop season in the state during 2009-2010.

Table 5.29: District wise percentage of Total irrigated gross area during (2005-2010) in Andhra Pradesh.

S.No.	District	Area in (ha)	Total Gross Area Irrigated			
			Kharif (ha)	Kharif (%)	Rabi (ha)	Rabi (%)
1	Srikakulam	583700	150624	4.2	29709	1.2
2	Vizainagaram	653900	109687	3.1	30945	1.3
3	Visakhapatnam	749300	91094	2.6	33699	1.4
4	East Godavari	1080700	274123	7.7	201228	8.2
5	West Godavari	774200	336930	9.5	285293	11.7
6	Krishna	1602900	300172	8.4	143066	5.9
7	Guntur	1284600	354386	10.0	53851	2.2
8	Prakasam	795600	94309	2.7	120260	4.9
9	Nellore	1424000	62673	1.8	211741	8.7
10	Chittoor	1515200	69015	1.9	129055	5.3
11	Kadapa	1535900	94648	2.7	84290	3.5
12	Ananthapur	1913000	85641	2.4	67965	2.8
13	Kurnool	872700	143252	4.0	87990	3.6
14	Mahabubnagar	969900	89881	2.5	121573	5.0
15	Rangareddy	1762600	46538	1.3	36841	1.5
16	Hyderabad	65000	0	0.0	0	0.0
17	Medak	1765800	96626	2.7	80008	3.3
18	Nizamabad	1307600	156970	4.4	122591	5.0
19	Adilabad	1612800	76478	2.2	33204	1.4
20	Karimnagar	1139100	292756	8.2	191364	7.8
21	Warangal	1116100	263498	7.4	127972	5.2
22	Khammam	1182300	165124	4.6	75613	3.1
23	Nalgonda	1843200	201014	5.7	172749	7.1
	Total	**27550100**	**3555459**	**100.0**	**2441007**	**100.0**

5.4. Recommendations:

The agro climatic zones of Andhra Pradesh have been classified based on my research work on crop productivity in different crop season in every district of state. Based on my work results, we have recommended the best agro climatic zones of Andhra Pradesh according to performance of the area, productivity and production of crops in the State for the last 5 years (2005-2010) are presented below:

In **Kharif** season the **rice crop** production estimated in West Godavari district is at the top and followed by East Godavari, Krishna, Guntur, and Nalgonda. These districts together accounted for 64.3 percent of the total area under this crop in the state during 2005-2010.In **Rabi** season the **rice crop** production estimated in West Godavari district is at the top with the, followed by East Godavari, Krishna, Guntur, Nalgonda. These districts together accounted for 66.7 percent of the total area under this crop in the state during 2009-2010.

In **Rabi** season the **wheat crop** production estimated in Adilabad district is at the top and followed by Medak, Rangareddy, nizamabad, and Anantapur. These districts together accounted for 94.6 percent of the total area under this crop during 2009-2010 in the State.

In **Kharif** season the **Jowar crop** production estimated in Kurnool district is at the top and followed by Anantapur and Kadapa .These districts together accounted for 94.6 percent of the total area under this crop during 2005-2010 in the State. In **Rabi** season the **Jowar crop** production estimated in Kurnool district is at the top with the, followed by Nizamabad Anantapur Guntur, Adilabad. These districts together accounted for 97.1 percent of the total area under this crop during 2009-2010 in the State.

In **Kharif** season the **Bajra crop** production estimated in Prakasam district is at the Top and followed by Kadapa, Chittoor, Nellore, and Anantapur .These districts together accounted for 99.0 percent of the total area under this crop during 2005- 2010 in the State. In **Rabi** season the **Bajra crop** production estimated in Nizamaba District is at the top with the, followed by Kadapa, Adilabad, and Kurnool. These districts together accounted for 97.5 percent of the total area under this crop during 2005-2010 in the State.

In **Kharif** season the **Maize crop** production estimated in Karimnagar district is at the Top and followed by Nizamabad, Warangal, Adilabad, some part of Anantapur. These districts together accounted for 95.7 percent of the total area under this crop during 2005-2010 in the State. In **Rabi** season the **Maize crop** production estimated in Karimnagar district is at the top with the, followed by West Godavari ,Warangal ,Guntur, Khammam .These districts together accounted for 77.9 percent of the total area under this crop during 2005-2010 in the State.

In **Kharif** season the **Ragi crop** production estimated in Anantapur district is at the top and followed by Chittoor, Vishakhapatnam, Nellore and Kadapa. These districts together accounted for 99.8 percent of the total area under this crop in the state during 2005-2010.In **Rabi** season the **Ragi crop** production estimated in Prakasam district is at the top and followed by Srikakakulam, Vizainagaram, Chittoor and Vishakhapatnam. These districts together accounted for 93.7 percent of the total area under this crop in the state during 2005-2010.

In **Kharif** season the **Minor millets** production estimated in Karimnagar district is at the top and followed by Nizamabad, Kurnool, Warangal, Adilabad .These districts together accounted for 87.7 percent of the total area under this crop in the state during 2005-2010.In **Rabi** season the **Ragi crop** production estimated in Karimnagar district is at the top and followed by west Godavari, nizamabad, Warangal, Guntur. These districts together accounted for 70.1 percent of the total area under this crop in the state during 2005-2010.

In **Kharif** season the **other pulses** production estimated in Anantapur district is at the top and followed by Adilabad, Chittoor, and Kurnool .These districts together accounted for 100 percent of the total area under this crop in the state during 2005-2010.In **Rabi** season the **other pulses** production estimated in Warangal district is at the top and followed by Karimnagar and Nizamabad these districts together accounted for 99.5 percent of the total area under this crop in the state during 2005-2010.

In **Kharif** season the **Total pulses** production estimated in Kurnool district is at the top and followed by Prakasam, Adilabad, Anantapur, and Kadapa. These districts together accounted for 88.7 percent of the total area under this crop in the state during 2005-2010.

In **Rabi** season the **Total pulses** production estimated in Karimnagar district is at the top and followed by Anantapur, Warangal, Nalgonda, Kurnool .These districts together accounted for 87.1percent of the total area under this crop in the state during 2005-2010.

In **Kharif** season the **Red Gram** production estimated in Nalgonda district is at the top and followed by Kurnool, Adilabad, Ananthapur and Guntur. These districts together accounted for 78.0 percent of the total area under this crop in the state during 2005-2010.

In **Rabi** season the **Bengal gram** production estimated in Anantapur district is at the top and followed by Warangal, Kurnool, Karimnagar, and Medak .These districts together accounted for 61.9 percent of the total area under this crop in the state during 2005-2010.

In **Kharif** season the **Green gram** production estimated in Prakasam district is at the top and followed by Kurnool, Kadapa, Nellore and West Godavari. These districts together accounted for 69.1 percent of the total area under this crop in the state during 2005-2010.In **Rabi** season the **Green gram** production estimated in Karimnagar district is at the top and followed by Warangal, Adilabad Nizamabad, and Nellore. These districts together accounted for 85.1percent of the total area under this crop in the state during 2005-2010.

In **Kharif** season the **Black gram** production estimated in Kurnool district is at the top and followed by West Godavari, Kadapa and Chittoor. These districts together accounted for 100 percent of the total area under this crop in the state during 2005-2010.In **Rabi** season the **Black gram** production estimated in Nalgonda district is at the top and followed by Warangal, Karimnagar, Kurnool and Prakasam.These districts together accounted for 84.4 percent of the total area under this crop in the state during 2005-2010.

In **Rabi** season the **Horse gram** production estimated in Karimnagar district is at the top and followed by West Godavari and Chittoor. These districts together accounted for 99.8 percent of the total area under this crop in the state during 2005-2010.

In **Kharif** season the **Cow gram** production estimated in west Godavari. This district alone accounted for 100 percent of the total area under this crop in the state during 2005-2010.In **Rabi** season the **Cow gram** production estimated in Karimnagar district is at the top and followed by Medak, Warangal, and Khammam. These districts together accounted for 98.3 percent of the total area under this crop in the state during 2005-2010.

In **Kharif** season the **Sugarcane and Onion** production estimated in Kurnool district is at the top and followed by Kadapa, Guntur, Anantapur and Mahabubnagar. These districts together accounted for 93.5 percent of the total area under this crop in the state during 2005-2010.In **Rabi** season the **Sugarcane and Onion** production estimated in Medak district is at the top and followed by Kurnool, Rangareddy Nizamabad and Srikakulam. These districts together accounted for 70.5 percent of the total area under this crop in the state during 2005-2010.

In **Kharif** season the **Chillies and Turmeric** production estimated in Guntur district is at the top and followed by Khammam, Warangal, Kurnool, and Krishna. These districts together accounted for 76.5 percent of the total area under this crop in the state during 2005-2010.In **Rabi** season the **Chillies and Turmeric** production estimated in Khammam district is at the top and followed by Warangal, west Godavari, Srikakulam, and Chittoor. These districts together accounted for 66.5 percent of the total area under this crop in the state during 2005-2010.

The Oil **seeds** production estimated in Kadapa district is at the top and followed by Mahabubnagar (12.2%), Kurnool (10.9%), Anantapur (10.1%), and West Godavari. These districts together accounted for 65.1 percent of the total area under this crop in the state during 2005-2010.

In **Kharif** season the **Groundnut** production estimated in Kadapa district is at the top and followed by Nellore, Chittoor, Anantapur, and Kurnool. These districts together accounted for 93.1 percent of the total area under this crop in the state during 2005-2010.In **Rabi** season the **Groundnut** production estimated in Mahabubnagar district is at the top and followed by Warangal, Kurnool, Kadapa and Anantapur. These districts together accounted for 69.2 percent of the total area under this crop in the state during 2005-2010.

In **Kharif** season the **Sesamum and Castor** production estimated in Chittoor district is at the top and followed by Nellore, Kadapa, Adilabad, and Prakasam. These districts together accounted for 95.0 percent of the total area under this crop in the state during 2005-2010.In **Rabi** season the **Sesamum and Castor** production estimated in Karimnagar district is at the top and followed by Kadapa, Nizamabad, Adilabad and west Godavari. These districts together accounted for 88.9 percent of the total area under this crop in the state during 2005-2010.

In **Kharif** season the **Sunflower** production estimated in Anantapur district is at the top and followed by Kurnool, Kadapa, Nellore, and Prakasam. These districts together accounted for 97.3 percent of the total area under this crop in the state during 2005-2010.In **Rabi** season the **Sunflower** production estimated in Kadapa district is at the top and followed by nizamabad, Kurnool, Anantapur, and Prakasam. These districts together accounted for 83.0 percent of the total area under this crop in the state during 2005-2010.

The **coconut** production estimated in west Godavari district is at the top and followed by East Godavari, Chittoor, Krishna, and khammam. These districts together accounted for 96.4 percent of the total area under this crop in the state during 2005-2010.

In **Kharif** season the **Cotton production** estimated in Warangal district is at the top and followed by Karimnagar, Guntur, khammam, Prakasam. These districts together accounted for 79.0 percent of the total area under this crop in the state during 2005-2010.

In **Rabi** season the **Tobacco** production estimated in West Godavari district is at the top and followed by Krishna, Nellore, and Vizainagaram. These districts together accounted for 78.5 percent of the total area under this crop in the state during 2005-2010.

5.5 Conclusion:

Cultivation of crops appropriate to agro climatic zones is always beneficial.Farmers get good productions and best utilize natural resources using only little industrial inputs in the cultivation of crops.

CHAPTER 6

SUMMARY AND CONCLUSION

This research was carried out to find best agro-climatic zones of Andhra Pradesh the prominence of agriculture sector is gauged by its contribution to the State or National economy. The income from agriculture sector of the state is only a little over 1/3 of the state's GSDP providing livelihood to about 70% of the population in Andhra Pradesh.

Based on Hargreaves (1971) classification it is could be summarized that the state is agro climatically identified as a moderately deficit state. The climatic conditions of a region affect the agricultural cropping pattern and different areas, thus, produce different crops. Amongst a host of climatic factors, rainfall, temperature, humidity, wind velocity and duration of sunshine etc. affect the cropping pattern in a significant way. Annual rainfall and its distribution over the entire year, and the regimes of diurnal and annual temperatures are, by far, the prominent factors affecting agriculture and the life style of the people. On the basis of climatic conditions and agricultural produce Andhra Pradesh has been divided into these agro-climatic zones given below.

I strongly concluded the above agro climatic zones are the best for cultivation of crops in season wise in each and every district of Andhra Pradesh, so that farmers will get good returns out of it, farmers social and economic status will increase with using best agro climatic zones these zones are needed to achieve the required prosperity

Best agro-climatic zones of Andhra pradesh

S.No	Crop	Season	Best suited districts of AP falling in differentAgro-Climatic zones				
1	Rice	Kharif	W.Godavari	E.Godavari	Krishna	Guntur	Nalgonda
		Rabi	W.Godavari	E.Godavari	Krishna	Guntur	Nalgonda
2	Wheat	Rabi	Adilabad	Medak	Ranga reddy	Nizamabad	Anantapur
3	Jowar	Kharif	Kurnool	Anantapur	Kadapa		
		Rabi	Kurnool	Nizamabad	Anantapur	Guntur	Adilabad
4	Bajra	Kharif	Prakasam	Kadapa	Chittoor	Nellore	Anantapur
		Rabi	Nizamabad	Kadapa	Adilabad	Kurnool	
5	Maize	Kharif	Karimnagar	Nizamabad	Warangal	Adilabad	
		Rabi	Karimnagar	W.Godavari	Warangal	Guntur	Khammam
6	Ragi	Kharif	Anantapur	Chittoor	Vishakhapatnam	Nellore	Kadapa
		Rabi	Prakasam	Srikakulam	Vizainagaram	Chittoor	Vishakha-patnam
7	Millets	Kharif	Karimnagar	Nizamabad	Kurnool	Warangal	Prakasam
		Rabi	Karimnagar	W.Godavari	Nizamabad	Warangal	Guntur
8	Pulses	Kharif	Kurnool	Prakasam	Adilabad	Anantapur	Kadapa
		Rabi	Karimnagar	Anantapur	Warangal	Nalgonda	Kurnool
9	Red gram	Kharif	Nalgonda	Kurnool	Adilabad	Anantapur	Guntur
10	Bengal gram	Rabi	Anantapur	Warangal	Kurnool	Karimnagar	Medak
11	Green gram	Kharif	Prakasam	Kurnool	Kadapa	Nellore	W.Godavari
		Rabi	Karimnagar	Warangal	Adilabad	Nizamabad	Nellore
12	Black gram	Kharif	Kurnool	W.Godavari	Kadapa	Chittoor	
		Rabi	Nalgonda	Warangal	Karimnagar	Kurnool	Prakasam
13	Horse gram	Rabi	Karimnagar	W.Godavari	Chittoor		
14	Cow gram	Kharif	W.Godavari				
		Rabi	Karimnagar	Medak	Warangal	Khammam	
15	Sugarcane & Onion	Kharif	Kurnool	Kadapa	Guntur	Anantapur	Mahabubnagar
		Rabi	Medak	Kurnool	Ranga reddy	Nizamabad	Srikakulam
16	Chillies & Turmeric	Kharif	Guntur	Khammam	Warangal	Kurnool	Krishna.
		Rabi	Khammam	Warangal	W.Godavari	Srikakulam	Chittoor
17	Oil seeds		Kadapa	Mahabubnagar	Kurnool	Anantapur	W.Godavari
18	Ground nut	Kharif	Kadapa	Nellore	Chittoor	Anantapur	Kurnool
		Rabi	Mahabubnagar	Warangal	Kurnool	Kadapa	Anantapur
19	Sesamum & Castor	Kharif	Chittoor	Nellore	Kadapa	Adilabad	Prakasam
		Rabi	Karimnagar	Kadapa	Nizamabad	Adilabad	W.Godavari
20	Sunflower	Kharif	Anantapur	Kurnool	Kadapa	Nellore	Prakasam
		Rabi	Kadapa	Nizamabad	Kurnool	Anantapur	Prakasam
21	Tobacco	Rabi	W.Godavari	Krishna	Nellore	Vizainagaram	
22	Cotton	Kharif	Warangal	Karimnagar	Guntur	Khammam	Prakasam
23	Coconut		W.Godavari	E.Godavari	Chittoor	Krishna	Khammam

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Annexure-1

Weather of Andhra Pradesh

S. No	Station	Altitude	Latitude	Longitude	NPP	Precipitation	PET	Prec. deficit	Mean Temp	Sunshine	Wind Speed
		(m)	^{0}N	^{0}E	(t/ha)	(mm)	(mm)	(%)	^{0}C	(hr)	(km/hr)
1	Addanki	20	15.8	80.0	13.0	858.0	1802.7	52.4	28.5	6.9	7.6
2	Adilabad	280	19.7	78.5	15.4	1075.2	1682.0	36.1	27.0	8.0	5.5
3	Adoni	400	15.6	77.3	11.9	761.3	1987.9	61.7	28.5	7.1	8.9
4	Akividu	20	16.6	81.4	16.3	1178.1	1748.9	32.6	28.0	8.4	7.7
5	Alwal	580	17.5	78.5	12.6	815.9	1572.3	48.1	26.5	5.7	10.0
6	Amadalavalasa	20	18.4	83.9	14.8	1012.9	1575.3	35.7	27.1	7.7	8.5
7	Amalapuram	0	16.6	82.0	15.9	1126.7	1561.6	27.8	27.8	8.3	7.7
8	Amaravathi	300	16.6	80.4	13.2	864.8	1899.6	54.5	28.3	7.2	7.7
9	Anakapalle	40	17.7	83.0	14.4	980.4	1565.4	37.4	28.2	7.9	9.8
10	Anantapur	340	14.7	77.6	9.3	559.5	1750.7	68.0	27.6	8.6	11.9
11	Asifabad	260	19.4	79.3	17.7	1339.1	1682.0	20.4	27.0	8.0	5.5
12	Atmakur	280	14.6	79.6	11.3	709.0	1930.4	63.3	28.9	7.6	7.4
13	Badepally	560	16.8	78.2	13.6	904.1	1572.3	42.5	26.3	7.9	10.0
14	Badrachalam	40	17.7	80.9	15.0	1040.5	2022.6	48.6	28.5	7.4	7.1
15	Banaganapalli	140	15.3	78.2	11.3	709.0	1930.4	63.3	28.9	7.6	7.4
16	Bandarulanka	260	16.6	81.9	15.9	1126.7	1561.6	27.8	27.8	8.3	7.7
17	Banswada	0	18.4	77.9	15.6	1098.0	1676.9	34.5	28.0	8.7	3.8
18	Bapatla	380	15.9	80.5	12.9	845.3	1733.6	51.2	28.5	6.5	7.6
19	Bhattiprolu	0	16.1	80.8	14.8	1020.1	1733.6	41.2	27.8	7.3	10.2
20	Bellampalle	200	19.1	79.5	15.7	1105.1	1682.0	34.3	28.5	8.3	5.9
21	Betamcherla	420	15.5	78.2	11.3	709.0	1930.4	63.3	28.9	7.6	7.4
22	Bhainsa	360	19.1	78.0	15.6	1098.0	1676.9	34.5	28.0	8.7	3.8
23	Bhimavaram	0	16.6	81.5	15.9	1126.7	1748.9	35.6	28.0	8.4	7.7
24	Bheemunipatnam	20	17.9	83.5	14.4	980.4	1565.4	37.4	28.2	7.9	9.1
25	Bhongir	0	17.5	78.9	12.6	815.9	1572.3	48.1	26.5	8.7	10.0
26	Bobbili	460	18.6	83.4	20.2	1667.2	1575.3	-5.8	22.9	6.6	8.5
27	Bodhan	200	18.7	77.9	15.6	1098.0	1676.9	34.5	28.0	8.7	3.8
28	Budvel	340	14.8	79.3	12.5	810.6	1919.3	57.8	30.2	7.6	6.1
29	Bugganipalle	420	15.5	78.2	11.3	709.0	1930.4	63.3	28.9	7.6	7.4
30	Challapalle	0	16.1	81.0	14.8	1020.1	1733.6	41.2	27.8	7.3	10.2
31	Chandur	180	18.6	78.0	17.7	1339.1	1682.0	20.4	27.0	8.0	5.5
32	Chatakonda	120	17.6	80.7	15.0	1040.5	2022.6	48.6	28.5	7.4	7.1
33	Chilakaluripet	500	16.1	80.2	12.9	845.3	1802.7	53.1	28.5	6.9	7.6
34	Chirala	40	15.8	80.4	12.9	845.3	1733.6	51.2	28.5	6.9	7.6
35	Chittoor	0	13.2	79.1	14.7	1013.3	1776.7	43.0	28.4	7.7	5.1
36	Cuddapah	360	14.5	78.8	12.5	810.6	1919.3	57.8	30.2	7.6	6.1
37	Devarakonda	120	16.7	78.9	12.2	781.0	1802.7	56.7	28.9	7.1	5.9
38	Dharmavaram	280	14.4	77.7	9.3	559.5	1919.3	70.8	27.6	8.6	11.9

39	Dhone	340	15.4	77.9	11.3	706.6	1930.4	63.4	28.9	7.6	7.4
40	Eluru	360	16.7	81.1	15.5	1086.7	1748.9	37.9	28.4	6.9	12.0
41	Gadwal	20	16.2	77.8	11.9	761.3	1987.9	61.7	28.5	7.1	8.9
42	Ghatkesar	280	17.5	78.7	12.6	815.9	1572.3	48.1	26.5	8.7	10.0
43	Giddalur	280	15.2	79.2	11.3	709.0	1919.3	63.1	30.2	7.6	6.1
44	Gooty	340	15.1	77.6	9.3	559.5	1750.7	68.0	27.6	8.6	11.9
45	Gudivada	0	16.4	81.0	15.5	1086.7	1748.9	37.9	28.4	6.9	12.0
46	Gudur	20	14.2	79.9	15.2	1072.4	1763.5	39.2	29.2	7.8	5.2
47	Guntakal	440	15.2	77.4	8.9	533.9	1750.7	69.5	28.1	7.4	5.9
48	Guntur	40	16.3	80.4	15.1	1050.5	1733.6	39.4	28.4	6.9	12.0
49	Hindupur	600	13.8	77.5	12.5	816.3	1623.0	49.7	27.6	8.6	11.9
50	Hyderabad	520	17.4	78.5	12.5	810.1	1572.3	48.5	26.3	7.9	10.0
51	Ichchapuram	0	19.1	84.7	15.2	1063.0	1446.4	26.5	26.6	6.0	14.8
52	Jaggaiahpet	80	16.9	80.1	15.0	1040.5	1802.7	42.3	28.5	7.4	7.1
53	Jagityal	260	18.8	78.9	15.7	1105.1	1676.9	34.1	28.5	8.3	5.9
54	Jammalamadugu	160	14.8	78.4	12.5	810.6	1919.3	57.8	30.2	7.6	6.1
55	Jangaon	440	17.7	79.2	14.1	947.9	2022.6	53.1	27.7	8.4	9.0
56	Kadiri	500	14.1	78.2	11.1	696.4	1919.3	63.7	24.9	7.4	8.7
57	Kaghaznagar	240	19.4	79.5	15.7	1105.1	1682.0	34.3	28.5	8.3	5.9
58	Kaikalur	20	16.6	81.2	14.7	1009.8	1748.9	42.3	28.0	8.4	7.7
59	Kakinada	0	17.0	82.2	15.4	1082.1	1561.6	30.7	27.8	8.3	7.7
60	Kalyandurg	520	14.6	77.1	9.3	559.5	1750.7	68.0	27.6	8.6	11.9
61	Kamalapuram	120	14.6	78.7	12.5	810.6	1919.3	57.8	30.2	7.6	3.8
62	Kamareddy	520	18.3	78.4	15.7	1110.3	1676.9	33.8	28.0	8.7	7.6
63	Kandukur	20	15.2	79.9	13.0	858.0	1763.5	51.3	28.5	6.9	7.6
64	Kanigiri	140	15.4	79.5	13.0	858.0	1763.5	51.3	28.5	6.9	12.0
65	Kankipadu	0	16.4	80.8	13.9	932.3	1733.6	46.2	28.4	6.9	10.0
66	Kapra	500	17.5	78.6	12.5	810.1	1572.3	48.5	26.3	7.9	5.9
67	Karimnagar	260	18.4	79.1	15.7	1105.1	2022.6	45.4	28.5	8.3	5.2
68	Kavali	20	14.9	80.0	15.2	1072.4	1763.5	39.2	29.2	7.8	12.0
69	Kondapalle	40	16.6	80.5	15.1	1050.5	1733.6	39.4	28.4	6.9	3.8
70	Koratla	260	18.8	78.7	15.6	1098.0	1676.9	34.5	28.0	8.7	7.1
71	Kothagudem	120	17.6	80.6	15.6	1040.5	2022.6	48.5	28.4	7.37	7.08
72	Kovurpalle	20	14.8	80.0	15.2	1072.4	1763.5	39.2	29.2	7.8	5.2
73	Kovvur	0	17.0	81.7	16.3	1178.1	1561.6	24.6	27.8	8.3	7.7
74	Kukatpalle	560	17.5	78.4	12.6	815.9	1572.3	48.1	26.5	5.7	10.0
75	Kuppam	760	12.8	78.3	13.7	910.8	1776.7	48.7	24.9	7.4	8.7
76	Kurnool	280	15.8	78.0	11.3	706.6	1930.4	63.4	28.9	7.6	7.4
77	Kyatampalle	140	18.0	79.4	15.7	1105.1	2022.6	45.4	28.5	8.3	5.9
78	Macherla	120	16.5	79.4	11.0	687.7	1802.7	61.9	28.9	7.1	5.9
79	Machilipatnam	0	16.2	81.1	14.8	1020.1	1733.6	41.2	27.8	7.3	10.2
80	Madanapalle	760	13.6	78.5	11.1	696.4	1776.7	60.8	24.9	7.4	8.7
81	Mahabubnagar	560	16.4	78.1	13.6	904.1	1987.9	54.5	28.5	7.1	8.9
82	Mancherial	160	18.9	79.5	15.7	1105.1	2022.6	45.4	28.5	8.3	5.9
83	Mandamarri	260	19.0	79.5	15.7	1105.1	2022.6	45.4	28.5	8.3	5.9
84	Mandapeta	0	16.9	81.9	15.4	1082.1	1561.6	30.7	27.8	8.3	7.7

85	Mangalagiri	0	16.4	80.6	15.1	1050.5	1733.6	39.4	28.4	6.9	12.0
86	Manugur	80	17.9	80.8	15.0	1040.5	2022.6	48.6	28.5	7.4	7.1
87	Markapur	180	15.7	79.3	13.0	858.0	1802.7	52.4	28.5	6.9	7.6
88	Medak	440	18.1	78.3	15.7	1110.3	1572.3	29.4	26.5	5.7	10.0
89	Miryalaguda	120	16.9	79.6	11.0	687.7	1802.7	61.9	28.9	7.1	5.9
90	Nagari	200	13.3	79.6	15.1	1048.0	1776.7	41.0	28.4	7.7	5.1
91	Nagarkurnool	480	16.5	78.3	13.6	904.1	1930.4	53.2	28.9	7.6	7.4
92	Naidupet	20	13.9	79.9	14.0	942.9	1763.5	46.5	29.2	7.8	5.2
93	Nalgonda	280	17.1	79.3	12.2	781.0	1802.7	56.7	28.9	7.1	5.9
94	Nandigama	20	16.8	80.3	15.1	1050.5	1802.7	41.7	28.5	7.4	7.1
95	Nandikotkur	260	15.9	78.3	11.3	706.6	1930.4	63.4	28.9	7.6	7.4
96	Nandyal	200	15.5	78.5	11.3	709.0	1930.4	63.3	28.9	7.6	7.4
97	Narasaraopet	0	16.2	80.1	12.9	845.3	1802.7	53.1	28.9	7.1	5.9
98	Narasannapet	60	17.7	78.8	14.8	1012.9	1575.3	35.7	27.1	7.7	8.5
99	Narayanavanam	180	13.4	79.6	14.0	942.9	1776.7	46.9	28.4	7.7	5.1
100	Narayanpet	520	16.7	77.5	13.6	904.1	1987.9	54.5	28.5	7.1	8.9
101	Narsapur	360	16.4	81.7	15.6	1098.0	1676.9	34.5	28.0	8.7	3.8
102	Narsingi	500	18.0	78.4	15.7	1110.3	1572.3	29.4	26.5	5.7	10.0
103	Narsipatnam	180	17.7	82.6	14.4	980.4	1565.4	37.4	28.2	7.9	9.8
104	Naspur	160	18.9	79.5	15.7	1105.1	2022.6	45.4	28.5	8.3	5.9
105	Nellore	0	14.5	80.0	15.2	1072.4	1763.5	39.2	29.2	7.8	5.2
106	Nidadavole	20	16.9	81.7	16.3	1178.1	1561.6	24.6	27.8	8.3	7.7
107	Nirmal	340	19.1	78.3	15.6	1098.0	1676.9	34.5	28.0	8.7	3.8
108	Nizamabad	380	18.7	78.1	15.6	1098.0	1676.9	34.5	28.0	8.7	3.8
109	Nuzvid	120	16.8	80.9	15.5	1086.7	1748.9	37.9	28.4	6.9	12.0
110	Ongole	0	15.5	80.1	13.0	858.0	1763.5	51.3	28.5	6.9	7.6
111	Pakala	500	13.5	79.1	14.0	942.9	1776.7	46.9	28.4	7.7	5.1
112	Palacole	0	16.5	81.7	15.9	1126.7	1561.6	27.8	27.8	8.3	7.7
113	Palamner	700	13.2	78.8	11.1	696.4	1776.7	60.8	24.9	7.4	8.7
114	Palwancha	120	18.3	78.4	15.0	1040.5	2022.6	48.6	28.5	7.4	7.1
115	Patancheru	520	17.5	78.3	12.6	815.9	1572.3	48.1	26.5	5.7	10.0
116	Pedana	0	16.3	81.2	14.7	1009.8	1748.9	42.3	28.0	8.4	7.7
117	Peddapuram	20	17.1	82.1	15.4	1082.1	1561.6	30.7	27.8	8.3	7.7
118	Pendurthi	60	17.8	83.2	14.4	980.4	1565.4	37.4	28.2	7.9	9.8
119	Penugonda	0	16.7	81.8	15.9	1126.7	1561.6	27.8	27.8	8.3	7.7
120	Penukonda	620	14.1	77.6	9.3	559.5	1623.0	65.5	27.6	8.6	11.9
121	Pithapuram	0	17.1	82.3	15.4	1082.1	1561.6	30.7	27.8	8.3	7.7
122	Ponnur	0	16.1	80.6	12.9	845.3	1733.6	51.2	28.4	6.9	12.0
123	Proddutur	140	14.8	78.6	12.5	810.6	1919.3	57.8	30.2	7.6	6.1
124	Pulivendula	240	14.4	78.2	12.5	810.6	1919.3	57.8	30.2	7.6	6.1
125	Punganuru	740	13.4	78.6	11.1	696.4	1776.7	60.8	24.9	7.4	8.7
126	Puttur	180	13.4	79.6	14.0	942.9	1776.7	46.9	28.4	7.7	5.1
127	Quthbullapur	520	17.5	78.5	12.5	810.1	1572.3	48.5	26.3	7.9	10.0
128	Rajam	0	18.5	83.7	14.8	1012.9	1575.3	35.7	27.1	7.7	8.5
129	Rajampet	60	14.2	79.2	12.5	810.6	1919.3	57.8	30.2	7.6	6.1
130	Rajahmundry	140	17.0	81.8	16.3	1178.1	1561.6	24.6	27.8	8.3	7.7

131	Rajendranagar	540	17.3	78.4	12.5	810.1	1572.3	48.5	26.3	7.9	10.0
132	Ramachandrapuram	520	16.8	82.0	12.5	810.1	1572.3	48.5	26.3	7.9	10.0
133	Ramagundam	240	18.8	79.4	15.7	1105.1	2022.6	45.4	28.5	8.3	5.9
134	Rampachodavaram	200	17.4	81.8	16.3	1178.1	1561.6	24.6	27.8	8.3	7.7
135	Rayachoty	360	14.1	78.8	12.5	810.6	1919.3	57.8	30.2	7.6	6.1
136	Rayadurg	640	14.7	76.9	8.9	533.9	1750.7	69.5	28.1	7.4	5.9
137	Renigunta	280	13.6	79.5	14.0	942.9	1776.7	46.9	28.4	7.7	5.1
138	Repalle	0	16.0	80.8	14.8	1020.1	1733.6	41.2	27.8	7.3	10.2
139	Sadasivpet	540	17.6	78.0	14.2	963.5	1908.7	49.5	26.5	7.8	9.4
140	Salur	160	18.5	83.2	20.2	1667.2	1565.4	-6.5	22.9	6.6	9.8
141	Sangareddy	500	17.6	78.1	12.6	815.9	1572.3	48.1	26.5	5.7	10.0
142	Sattenaplle	40	16.4	80.2	15.1	1050.5	1802.7	41.7	28.4	6.9	12.0
143	Secunderabad	520	17.5	78.6	12.6	815.9	1572.3	48.1	26.5	5.7	10.0
144	Shamsabad	160	17.4	78.4	11.4	718.0	1367.4	47.5	25.8	7.4	3.0
145	Siddipet	500	18.1	78.9	15.7	1110.3	2022.6	45.1	27.7	8.4	3.0
146	Singarayakonda	0	15.3	80.0	13.0	858.0	1763.5	51.3	28.5	6.9	7.6
147	Sirsilla	340	18.4	78.8	15.7	1110.3	1676.9	33.8	28.5	8.3	5.9
148	Srikakulam	20	18.3	83.9	14.8	1012.9	1575.3	35.7	27.1	7.7	8.5
149	Srikalahasti	40	13.8	79.7	14.0	942.9	1763.5	46.5	29.2	7.8	5.2
150	Sullurupeta	20	13.7	80.0	14.0	942.9	1509.1	37.5	28.6	7.6	8.4
151	Suryapet	200	17.1	79.6	12.2	781.0	1802.7	56.7	28.5	7.4	7.1
152	Tadepallegudem	40	16.8	81.5	16.3	1178.1	1561.6	24.6	27.8	8.3	7.7
153	Tadipatri	220	14.9	78.0	9.3	559.5	1930.4	71.0	27.6	8.6	11.9
154	Tandur	440	17.3	77.6	13.6	904.1	1908.7	52.6	26.5	7.8	9.4
155	Tanuku	0	16.8	81.7	16.3	1178.1	1561.6	24.6	27.8	8.3	7.7
156	Tenali	0	16.2	80.7	15.1	1050.5	1733.6	39.4	28.4	6.9	12.0
157	Tirumala	600	13.7	79.4	14.0	942.9	1776.7	46.9	28.4	7.7	5.1
158	Tirupati	700	13.7	79.4	14.0	942.9	1776.7	46.9	28.4	7.7	5.1
159	Tuni	80	17.4	82.6	15.4	1082.1	1561.6	30.7	27.8	8.3	7.7
160	Uppalkalan	520	17.4	78.6	12.5	810.1	1572.3	48.5	26.3	7.9	10.0
161	Uravakonda	440	15.0	77.3	9.3	559.5	1750.7	68.0	27.6	8.6	11.9
162	Venkatagiri	80	14.0	79.6	14.0	942.9	1763.5	46.5	29.2	7.8	5.2
163	Vetapalem	0	15.8	80.3	12.9	845.3	1733.6	51.2	28.5	6.9	7.6
164	Vikarabad	180	17.3	77.9	12.5	810.2	1572.0	48.5	26.3	7.9	10.0
165	Vijayapuri	0	17.3	78.6	11.0	687.7	1802.7	61.9	28.9	7.1	5.9
166	Vijayawada	620	16.5	80.7	15.1	1050.5	1733.6	39.4	28.4	6.9	12.0
167	Vinukonda	100	16.1	79.7	11.0	687.7	1802.7	61.9	28.9	7.1	5.9
168	Vishakhapatnam	40	17.7	83.2	14.4	980.4	1565.4	37.4	28.2	7.9	9.8
169	Vizianagaram	60	18.1	83.4	14.4	980.4	1565.4	37.4	28.2	7.9	9.8
170	Wanaparthy	380	16.4	78.1	13.6	904.1	1930.4	53.2	28.9	7.6	7.4
171	Warangal	280	18.0	79.6	14.1	947.9	2022.6	53.1	27.7	8.4	9.0
172	Yellandu	220	17.6	80.3	15.0	1040.5	2022.6	48.6	28.5	7.4	7.1
173	Yemmiganur	340	15.8	77.5	11.9	761.3	1987.9	61.7	28.5	7.1	8.9
174	Yerraguntla	180	14.6	78.5	12.5	810.6	1919.3	57.8	30.2	7.6	6.1
175	Zaheerabad	600	17.7	77.6	14.2	963.5	1908.7	49.5	26.5	7.8	9.4
	Mean				**13.8**	**938.0**	**1752.0**	**45.8**	**28.0**	**7.6**	**7.9**

Physico chemical characterstics of soils of Andhra Pradesh.

S.No	Station	Soil Depth (cm)	Sand (%)	Silt (%)	Clay (%)	Soil Type (Min)	Drainage Class	pH	CEC of Clay (mmol)	CEC of Soil (mmol)
1	Addanki	100	47	29	24	Clay (light)	moderately well	6.4	38	12
2	Adilabad	100	16	29	55	Clay (light)	poor	7.9	75	44
3	Adoni	100	20	24	56	Loam	poor	6.8	68	42
4	Akividu	100	20	24	56	Clay (light)	poor	6.8	68	42
5	Alwal	100	47	29	24	Clay (light)	moderately well	6.4	38	12
6	Amadalavalasa	100	39	41	20	Loam	poor	6.2	32	9
7	Amalapuram	100	82	10	8	Loam	somewhat excessive	5.4	27	4
8	Amaravathi	100	35	47	18	Clay (light)	poor	8	65	14
9	Anakapalle	100	82	10	8	Loam	somewhat excessive	5.4	27	4
10	Anantapur	100	16	29	55	Loam .	poor	7.9	75	44
11	Asifabad	100	47	29	24	Clay (light)	moderately well	6.4	38	12
12	Atmakur	100	39	41	20	Clay (light)	poor	7.3	62	16
13	Badepally	100	47	29	24	Clay (light)	moderately well	6.4	38	12
14	Badrachalam	100	20	24	56	Clay (light)	poor	6.8	68	42
15	Banaganapalli	100	16	29	55	Clay (light)	poor	7.9	75	44
16	Bandarulanka	100	82	10	8	Loam	somewhat excessive	5.4	27	4
17	Banswada	100	16	29	55	Clay (light)	poor	7.9	75	44
18	Bapatla	100	82	10	8	Loam	somewhat excessive	5.4	27	4
19	Bhattiprolu	100	35	47	18	Clay (light)	poor	8	65	14
20	Bellampalle	100	20	24	56	Clay (light)	poor	6.8	68	42
21	Betamcherla	10	43	34	23	Loam	imperfectly	7.6	42	15
22	Bhainsa	100	20	24	56	Clay (light)	poor	6.8	68	42
23	Bhimavaram	100	20	24	56	Clay (light)	poor	6.8	68	42
24	Bheemunipatnam	100	82	10	8	Loam	somewhat excessive	5.4	27	4
25	Bhongir	100	47	29	24	Clay (light)	moderately well	6.4	38	12
26	Bobbili	100	49	28	23	Loam	moderately well	6.2	32	9
27	Bodhan	100	16	29	55	Clay (light)	poor	7.9	75	44

28	Budvel	10	43	34	23	Clay (light)	imperfectly	7.6	42	15
29	Bugganipalle	10	43	34	23	Loam	imperfectly	7.6	42	15
30	Challapalle	100	35	47	18	Clay (light)	poor	8	65	14
31	Chandur	100	16	29	55	Clay (light)	poor	7.9	75	44
32	Chatakonda	00	47	29	24	Clay (light)	moderately well	6.4	38	12
33	Chilakaluripet	100	20	24	56	Clay (light)	poor	6.8	68	12
34	Chirala	100	82	10	8	Loam	somewhat excessive	5.4	27	4
35	Chittoor	100	47	29	24	Clay (light)	moderately well	6.4	38	12
36	Cuddapah	100	16	29	55	Clay (light)	poor	7.9	75	44
37	Devarakonda	100	47	29	24	Clay (light)	moderately well	6.4	38	12
38	Dharmavaram	100	47	29	24	Clay (light)	moderately well	6.4	38	12
39	Dhone	100	47	29	24	Clay (light)	moderately well	6.4	38	12
40	Eluru	100	20	24	56	Clay (light)	poor	6.8	68	42
41	Gadwal	100	20	24	56	Loam	poor	6.8	68	42
42	Ghatkesar	100	47	29	24	Clay (light)	moderately well	6.4	38	12
43	Giddalur	100	16	29	55	Clay (light)	poor	7.9	75	44
44	Gooty	100	47	29	24	Clay (light)	moderately well	6.4	38	12
45	Gudivada	100	35	47	18	Clay (light)	poor	8	65	14
46	Gudur	100	47	30	23	Sandy clay loam	poor	4.8	13	6
47	Guntakal	100	16	29	55	Loam	poor	7.9	75	44
48	Guntur	100	20	24	6	Clay (light)	poor	6.8	68	42
49	Hindupur	100	47	29	24	Clay (light)	moderately well	6.4	38	12
50	Hyderabad	100	47	29	24	Clay (light)	moderately well	6.4	38	12
51	Ichchapuram	100	49	28	23	Loam	moderately well	6.2	32	9
52	Jaggaiahpet	100	47	29	24	Loam	moderately well	6.4	38	12
53	Jagityal	100	20	24	56	Clay (light)	poor	6.8	68	42
54	Jammalamadugu	10	43	34	23	Clay (light)	imperfectly	7.6	42	15
55	Jangaon	100	47	29	24	Clay (light)	moderately well	6.4	38	12
56	Kadiri	100	47	29	24	Clay (light)	moderately well	6.4	38	12
57	Kaghaznagar	100	47	29	24	Clay (light)	moderately well	6.4	38	12
58	Kaikalur	100	20	24	56	Clay (light)	Poor	6.8	68	42
59	Kakinada	100	49	28	23	Sandy clay loam	moderately well	6.2	32	9
60	Kalyandurg	100	16	29	55	Sandy clay loam	poor	7.9	75	44

61	Kamalapuram	100	16	29	55	Loam	poor	7.9	75	44
62	Kamareddy	100	47	29	24	Clay (light)	moderately well	6.4	38	12
63	Kandukur	100	20	24	56	Clay (light)	poor	6.8	68	42
64	Kanigiri	100	47	29	24	Clay (light)	moderately well	6.4	38	12
65	Kankipadu	100	35	47	18	Clay (light)	poor	8	65	14
66	Kapra	100	47	29	24	Clay (light)	moderately well	6.4	38	12
67	Karimnagar	100	47	29	24	Clay (light)	moderately well	6.4	38	12
68	Kavali	100	47	29	24	Clay (light)	moderately well	6.4	38	12
69	Kondapalle	100	43	34	23	Clay (light)	imperfectly	6.2	32	9
70	Koratla	100	20	24	56	Sandy clay loam	poor	6.8	68	42
71	Kothagudem	100	20	24	56	Clay (light)	Poor	6.8	68	42
72	Kovurpalle	100	47	29	24	Clay (light)	moderately well	6.4	38	12
73	Kovvur	100	20	24	56	Clay (light)	poor	8	65	14
74	Kukatpalle	100	47	29	24	Clay (light)	moderately well	6.4	38	12
75	Kuppam	100	47	29	24	Clay (light)	moderately well	6.4	38	12
76	Kurnool	100	20	24	56	Clay (light)	poor	6.8	68	42
77	Kyatampalle	100	47	29	24	Loam	moderately well	6.4	38	12
78	Macherla	100	20	24	56	Clay (light)	poor	6.8	68	42
79	Machilipatnam	100	82	10	8	Loam	somewhat excessive	5.4	27	4
80	Madanapalle	100	47	29	24	Clay (light)	moderately well	6.4	38	12
81	Mahabubnagar	100	21	28	51	Loam	moderately well	7.1	58	36
82	Mancherial	100	47	29	24	Clay (light)	moderately well	6.4	38	12
83	Mandamarri	100	47	29	24	Clay (light)	moderately well	6.4	38	12
84	Mandapeta	100	35	47	18	Clay (light)	poor	8	65	14
85	Mangalagiri	100	35	47	18	Clay (light)	poor	8	65	14
86	Manugur	100	20	24	56	Clay (light)	poor	6.8	68	42
87	Markapur	100	47	29	24	Clay (light)	moderately well	6.4	38	12
88	Medak	100	47	29	24	Clay (light)	moderately well	6.4	38	12
89	Miryalaguda	100	47	29	24	Clay (light)	moderately well	6.4	38	12
90	Nagari	100	16	29	55	Clay (light)	poor	7.9	75	44
91	Nagarkurnool	100	47	29	24	Clay (light)	moderately well	6.4	38	12
92	Naidupet	100	47	29	24	Clay (light)	moderately well	6.4	38	12
93	Nalgonda	100	47	29	24	Clay (light)	moderately well	6.4	38	12

94	Nandigama	100	20	24	56	Loam	poor	6.8	68	42
95	Nandikotkur	100	16	29	55	Clay (light)	poor	7.9	75	44
96	Nandyal	100	16	29	55	Clay (light)	poor	7.9	75	44
97	Narasaraopet	100	47	29	24	Clay (light)	moderately well	6.4	38	12
98	Narasannapet	100	47	29	24	Clay (light)	moderately well	6.4	38	12
99	Narayanavanam	10	43	34	23	Clay (light)	imperfectly	7.6	42	15
100	Narayanpet	100	21	28	51	Loam	moderately well	7.1	58	36
101	Narsapur	100	82	10	8	Clay (light)	somewhat excessive	5.4	27	4
102	Narsingi	100	47	29	24	Clay (light)	moderately well	6.4	38	12
103	Narsipatnam	100	39	41	20	Clay (light)	poor	7.3	62	16
104	Naspur	100	20	24	56	Loam	poor	6.8	68	42
105	Nellore	100	39	41	20	Clay (light)	poor	7.3	62	16
106	Nidadavole	100	35	47	18	Loam	poor	8	65	14
107	Nirmal	100	20	24	56	Clay (light)	poor	6.8	68	42
108	Nizamabad	100	20	24	56	Clay (light)	poor	7.4	71	43
109	Nuzvid	100	49	28	23	Clay (light)	moderately well	6.2	32	9
110	Ongole	100	20	24	56	Sandy clay loam	poor	6.8	68	42
111	Pakala	100	16	29	55	Clay (light)	poor	7.9	75	44
112	Palacole	100	20	24	56	Clay (light)	poor	6.8	68	42
113	Palamner	100	47	29	24	Clay (light)	moderately well	6.4	38	12
114	Palwancha	100	47	29	24	Clay (light)	moderately well	6.4	38	12
115	Patancheru	100	47	29	24	Clay (light)	moderately well	6.4	38	12
116	Pedana	100	35	47	18	Clay (light)	poor	5.4	27	4
117	Peddapuram	100	49	28	23	Loam	moderately well	6.2	32	9
118	Pendurthi	100	79	11	10	Sandy clay loam	moderately well	6.3	32	4
119	Penugonda	100	35	47	18	Clay (light)	poor	8	65	14
120	Penukonda	100	47	29	24	Clay (light)	moderately well	6.4	38	12
121	Pithapuram	100	49	28	23	Clay (light)	moderately well	6.2	32	9
122	Ponnur	100	20	24	56	Sandy clay loam	poor	6.8	68	42
123	Proddutur	100	16	29	55	Clay (light)	poor	7.9	75	44
124	Pulivendula	100	47	29	24	Clay (light)	moderately well	6.4	38	12
125	Punganuru	100	47	29	24	Clay (light)	moderately well	6.4	38	12
126	Puttur	10	43	34	23	Clay (light)	imperfectly	7.6	42	15

127	Quthbullapur	100	47	29	24	Clay (light)	moderately well	6.4	38	12
128	Rajam	100	49	28	23	Clay (light)	moderately well	6.2	32	9
129	Rajampet	100	16	29	55	Loam	poor	7.9	75	44
130	Rajahmundry	100	35	47	18	Clay (light)	poor	8	65	14
131	Rajendranagar	100	47	29	24	Clay (light)	moderately well	6.4	38	12
132	Ramachandrapuram	100	35	47	18	Clay (light)	poor	8	65	14
133	Ramagundam	100	20	24	56	Clay (light)	poor	6.8	68	42
134	Rampachodavaram	100	81	7	12	Loam	moderately well	6.3	28	6
135	Rayachoty	100	47	29	24	Sandy clay loam	moderately well	6.4	38	12
136	Rayadurg	100	16	29	55	Clay (light)	poor	7.9	75	44
137	Renigunta	100	16	29	55	Loam	poor	7.9	75	44
138	Repalle	100	35	47	18	Clay (light)	poor	8	65	14
139	Sadasivpet	100	49	29	22	Clay (light)	poor	7.9	75	44
140	Salur	100	81	7	12	Clay (light)	moderately well	6.3	28	6
141	Sangareddy	100	47	29	24	Sandy clay loam	moderately well	6.4	38	12
142	Sattenaplle	100	47	29	24	Clay (light)	moderately well	6.4	38	12
143	Secunderabad	100	47	29	24	Clay (light)	moderately well	6.4	38	12
144	Shamsabad	100	47	29	24	Loam	moderately well	6.4	38	12
145	Siddipet	100	47	29	24	Loam	moderately well	6.4	38	12
146	Singarayakonda	100	82	10	8	Clay (light)	somewhat excessive	5.4	27	4
147	Sirsilla	100	47	29	24	Loam	moderately well	6.4	38	12
148	Srikakulam	100	82	10	8	Clay (light)	somewhat excessive	5.4	27	4
149	Srikalahasti	100	16	29	55	Clay (light)	poor	7.9	75	44
150	Sullurupeta	100	47	29	24	Clay (light)	moderately well	6.4	38	12
151	Suryapet	100	47	29	24	Clay (light)	moderately well	6.4	38	12
152	Tadepallegudem	100	20	24	56	Clay (light)	poor	6.8	68	42
153	Tadipatri	100	47	29	24	Clay (light)	moderately well	6.4	38	12
154	Tandur	100	16	29	55	Clay (light)	poor	7.9	75	44
155	Tanuku	100	35	47	18	Clay (light)	poor	8	65	14
156	Tenali	100	20	24	56	Clay (light)	poor	6.8	68	42
157	Tirumala	10	43	34	23	Loam	imperfectly	7.1	58	36
158	Tirupati	100	43	34	23	Clay (light)	imperfectly	7.9	75	44
159	Tuni	100	82	10	8	Clay (light)	somewhat excessive	5.4	27	4

160	Uppalkalan	100	47	29	24	Clay (light)	moderately well	6.4	38	12
161	Uravakonda	100	16	29	55	Clay (light)	poor	7.9	75	44
162	Venkatagiri	100	47	29	24	Loam	moderately well	6.4	38	12
163	Vetapalem	100	82	10	8	Loam	somewhat excessive	5.4	27	
164	Vikarabad	100	21	28	51	Loam	moderately well	7.1	58	36
165	Vijayapuri	100	47	29	24	Clay (light)	moderately well	6.4	38	12
166	Vijayawada	100	35	47	18	Loam	poor	8	65	14
167	Vinukonda	100	47	29	24	Clay (light)	moderately well	6.4	38	12
168	Vishakhapatnam	100	82	10	8	Clay (light)	somewhat excessive	5.4	27	4
169	Vizianagaram	100	79	11	10	Loam	moderately well	6.3	32	4
170	Wanaparthy	100	21	28	51	Loam	moderately well	7.1	58	36
171	Warangal	100	47	29	24	Loam	moderately well	6.4	38	12
172	Yellandu	100	47	29	24	Loam	moderately well	6.4	38	12
173	Yemmiganur	100	20	24	56	Clay (light)	poor	6.8	68	42
174	Yerraguntla	100	16	29	55	Loam	poor	7.9	75	44
175	Zaheerabad	100	16	29	55	Clay (light)	poor	7.9	75	44
	Mean	**96.4**	**39.7**	**28.3**	**32.0**			**6.8**	**50.3**	**21.5**

Annexure-3

Agroclimatic classification of Andhra Pradesh.

S.No	Station	Hargreeves		Thornthwaite		De Martone	
		MAI	Classification	MAI	Classification	MAI	Classification
1	Addanki	0.17	moderately deficient	-83.16	semi arid	22.3	semi arid
2	Adilabad	0.11	moderately deficient	-89.47	semi arid	29.0	moderately arid
3	Adoni	0.10	moderately deficient	-90.00	semi arid	19.8	semi arid
4	Akividu	0.10	moderately deficient	-90.00	dry subhumid	31.0	slightly humid

5	Alwal	0.17	moderately deficient	-83.16	semi arid	22.3	semi arid
6	Amadalavalasa	0.19	moderately deficient	-80.63	semi arid	27.3	moderately arid
7	Amalapuram	0.20	somewhat deficient	-80.00	dry subhumid	29.8	moderately arid
8	Amaravathi	0.12	moderately deficient	-87.69	semi arid	22.6	semi arid
9	Anakapalle	0.20	moderately deficient	-80.00	semi arid	25.7	moderately arid
10	Anantapur	0.11	very deficient	-89.47	arid	14.9	dry (or)arid
11	Asifabad	0.17	somewhat deficient	-83.16	dry subhumid	36.2	moderately humid
12	Atmakur	0.12	moderately deficient	-88.23	semi arid	18.2	semi arid
13	Badepally	0.17	moderately deficient	-83.16	semi arid	24.9	moderately arid
14	Badrachalam	0.10	moderately deficient	-90.00	semi arid	27.1	moderately arid
15	Banaganapalli	0.11	moderately deficient	-89.47	semi arid	18.2	semi arid
16	Bandarulanka	0.20	somewhat deficient	-80.00	dry subhumid	29.8	moderately arid
17	Banswada	0.11	moderately deficient	-89.47	semi arid	28.9	moderately arid
18	Bapatla	0.20	moderately deficient	-80.00	semi arid	22.0	semi arid
19	Bhattiprolu	0.12	moderately deficient	-87.69	semi arid	27.0	moderately arid
20	Bellampalle	0.10	moderately deficient	-90.00	semi arid	28.7	moderately arid
21	Betamcherla	0.18	moderately deficient	-81.90	semi arid	18.2	semi arid
22	Bhainsa	0.10	moderately deficient	-90.00	semi arid	28.9	moderately arid
23	Bhimavaram	0.10	moderately deficient	-90.00	semi arid	29.6	moderately arid
24	Bheemunipatnam	0.20	moderately deficient	-80.00	semi arid	25.7	moderately arid
25	Bhongir	0.17	moderately deficient	-83.16	semi arid	22.3	semi arid
26	Bobbili	0.19	somewhat deficient	-80.63	moist subhumid	50.7	very humid
27	Bodhan	0.11	moderately deficient	-89.47	semi arid	28.9	moderately arid
28	Budvel	0.18	moderately deficient	-81.90	semi arid	20.2	semi arid
29	Bugganipalle	0.18	moderately deficient	-81.90	semi arid	18.2	semi arid
30	Challapalle	0.12	moderately deficient	-87.69	semi arid	27.0	moderately arid
31	Chandur	0.11	somewhat deficient	-89.47	dry subhumid	36.2	moderately humid
32	Chatakonda	0.17	moderately deficient	-83.16	semi arid	27.1	moderately arid
33	Chilakaluripet	0.10	moderately deficient	-90.00	semi arid	22.0	semi arid
34	Chirala	0.20	moderately deficient	-80.00	semi arid	22.0	semi arid

35	Chittoor	0.17	moderately deficient	-83.16	semi arid	26.4	moderately arid
36	Cuddapah	0.11	moderately deficient	-89.47	semi arid	20.2	semi arid
37	Devarakonda	0.17	moderately deficient	-83.16	semi arid	20.1	semi arid
38	Dharmavaram	0.17	very deficient	-83.16	arid	14.9	dry (or)arid
39	Dhone	0.17	moderately deficient	-83.16	semi arid	18.2	semi arid
40	Eluru	0.10	moderately deficient	-90.00	semi arid	28.3	moderately arid
41	Gadwal	0.10	moderately deficient	-90.00	semi arid	19.8	semi arid
42	Ghatkesar	0.17	moderately deficient	-83.16	semi arid	22.3	semi arid
43	Giddalur	0.11	moderately deficient	-89.47	semi arid	17.7	semi arid
44	Gooty	0.17	very deficient	-83.16	arid	14.9	dry (or)arid
45	Gudivada	0.12	moderately deficient	-87.69	semi arid	28.3	moderately arid
46	Gudur	0.37	moderately deficient	-63.08	semi arid	27.4	moderately arid
47	Guntakal	0.11	very deficient	-89.47	arid	14.0	dry (or)arid
48	Guntur	0.10	moderately deficient	-90.00	semi arid	27.3	moderately arid
49	Hindupur	0.17	moderately deficient	-83.16	semi arid	21.7	semi arid
50	Hyderabad	0.17	moderately deficient	-83.16	semi arid	22.3	semi arid
51	Ichchapuram	0.19	somewhat deficient	-80.63	dry subhumid	29.0	moderately arid
52	Jaggaiahpet	0.17	moderately deficient	-83.16	semi arid	27.1	moderately arid
53	Jagityal	0.10	moderately deficient	-90.00	semi arid	28.7	moderately arid
54	Jammalamadugu	0.18	moderately deficient	-81.90	semi arid	20.2	semi arid
55	Jangaon	0.17	moderately deficient	-83.16	semi arid	25.2	moderately arid
56	Kadiri	0.17	moderately deficient	-83.16	semi arid	20.0	semi arid
57	Kaghaznagar	0.17	moderately deficient	-83.16	semi arid	28.7	moderately arid
58	Kaikalur	0.10	moderately deficient	-90.00	semi arid	26.6	moderately arid
59	Kakinada	0.19	moderately deficient	-80.63	dry subhumid	28.6	moderately arid
60	Kalyandurg	0.11	very deficient	-89.47	arid	14.9	dry (or)arid
61	Kamalapuram	0.11	moderately deficient	-89.47	semi arid	20.2	semi arid
62	Kamareddy	0.17	moderately deficient	-83.16	semi arid	29.2	moderately arid
63	Kandukur	0.10	moderately deficient	-90.00	semi arid	22.3	semi arid
64	Kanigiri	0.17	moderately deficient	-83.16	semi arid	22.3	semi arid

65	Kankipadu	0.12	moderately deficient	-87.69	semi arid	24.3	moderately arid
66	Kapra	0.17	moderately deficient	-83.16	semi arid	22.3	semi arid
67	Karimnagar	0.17	moderately deficient	-83.16	semi arid	28.7	moderately arid
68	Kavali	0.17	moderately deficient	-83.16	semi arid	27.4	moderately arid
69	Kondapalle	0.19	moderately deficient	-80.63	semi arid	27.3	moderately arid
70	Koratla	0.10	moderately deficient	-90.00	semi arid	28.9	moderately arid
71	Kothagudem	0.51	moderately deficient	-48.55	semi arid	27.1	moderately arid
72	Kovurpalle	0.17	moderately deficient	-83.16	semi arid	27.4	moderately arid
73	Kovvur	0.12	somewhat deficient	-87.69	dry subhumid	31.2	slightly humid
74	Kukatpalle	0.17	moderately deficient	-83.16	semi arid	22.3	semi arid
75	Kuppam	0.17	moderately deficient	-83.16	semi arid	26.1	moderately arid
76	Kurnool	0.10	moderately deficient	-90.00	semi arid	18.2	semi arid
77	Kyatampalle	0.17	moderately deficient	-83.16	semi arid	28.7	moderately arid
78	Macherla	0.10	moderately deficient	-90.00	semi arid	17.7	semi arid
79	Machilipatnam	0.20	moderately deficient	-80.00	semi arid	27.0	moderately arid
80	Madanapalle	0.17	moderately deficient	-83.16	semi arid	20.0	semi arid
81	Mahabubnagar	0.12	moderately deficient	-87.76	semi arid	23.5	semi arid
82	Mancherial	0.17	moderately deficient	-83.16	semi arid	28.7	moderately arid
83	Mandamarri	0.17	moderately deficient	-83.16	semi arid	28.7	moderately arid
84	Mandapeta	0.12	moderately deficient	-87.69	moist subhumid	28.6	moderately arid
85	Mangalagiri	0.12	moderately deficient	-87.69	semi arid	27.3	moderately arid
86	Manugur	0.10	moderately deficient	-90.00	semi arid	27.1	moderately arid
87	Markapur	0.17	moderately deficient	-83.16	semi arid	22.3	semi arid
88	Medak	0.17	somewhat deficient	-83.16	dry subhumid	30.4	slightly humid
89	Miryalaguda	0.17	moderately deficient	-83.16	semi arid	17.7	semi arid
90	Nagari	0.11	moderately deficient	-89.47	semi arid	27.3	moderately arid
91	Nagarkurnool	0.17	moderately deficient	-83.16	semi arid	23.2	semi arid
92	Naidupet	0.17	moderately deficient	-83.16	semi arid	24.1	moderately arid
93	Nalgonda	0.17	moderately deficient	-83.16	semi arid	20.1	semi arid
94	Nandigama	0.10	moderately deficient	-90.00	semi arid	27.3	moderately arid

95	Nandikotkur	0.11	moderately deficient	-89.47	semi arid	18.2	semi arid
96	Nandyal	0.11	moderately deficient	-89.47	semi arid	18.2	semi arid
97	Narasaraopet	0.17	moderately deficient	-83.16	semi arid	21.7	semi arid
98	Narasannapet	0.17	moderately deficient	-83.16	semi arid	27.3	moderately arid
99	Narayanavanam	0.18	moderately deficient	-81.90	semi arid	24.5	moderately arid
100	Narayanpet	0.12	moderately deficient	-87.76	semi arid	23.5	semi arid
101	Narsapur	0.20	moderately deficient	-80.00	semi arid	28.9	moderately arid
102	Narsingi	0.17	somewhat deficient	-83.16	dry subhumid	30.4	slightly humid
103	Narsipatnam	0.12	moderately deficient	-88.23	semi arid	25.7	moderately arid
104	Naspur	0.10	moderately deficient	-90.00	semi arid	28.7	moderately arid
105	Nellore	0.12	moderately deficient	-88.23	semi arid	27.4	moderately arid
106	Nidadavole	0.12	somewhat deficient	-87.69	dry subhumid	31.2	slightly humid
107	Nirmal	0.10	moderately deficient	-90.00	semi arid	28.9	moderately arid
108	Nizamabad	0.10	moderately deficient	-89.58	semi arid	28.9	moderately arid
109	Nuzvid	0.19	moderately deficient	-80.63	semi arid	28.3	moderately arid
110	Ongole	0.10	moderately deficient	-90.00	semi arid	22.3	semi arid
111	Pakala	0.11	moderately deficient	-89.47	semi arid	24.5	moderately arid
112	Palacole	0.10	somewhat deficient	-90.00	dry subhumid	29.8	moderately arid
113	Palamner	0.17	moderately deficient	-83.16	semi arid	20.0	semi arid
114	Palwancha	0.17	moderately deficient	-83.16	semi arid	27.1	moderately arid
115	Patancheru	0.17	moderately deficient	-83.16	semi arid	22.3	semi arid
116	Pedana	0.20	moderately deficient	-80.00	semi arid	26.6	moderately arid
117	Peddapuram	0.19	moderately deficient	-80.63	dry subhumid	28.6	moderately arid
118	Pendurthi	0.20	moderately deficient	-80.31	semi arid	25.7	moderately arid
119	Penugonda	0.12	somewhat deficient	-87.69	dry subhumid	29.8	moderately arid
120	Penukonda	0.17	moderately deficient	-83.16	semi arid	14.9	dry (or)arid
121	Pithapuram	0.19	moderately deficient	-80.63	dry subhumid	28.6	moderately arid
122	Ponnur	0.10	moderately deficient	-90.00	semi arid	22.0	semi arid
123	Proddutur	0.11	moderately deficient	-89.47	semi arid	20.2	semi arid
124	Pulivendula	0.17	moderately deficient	-83.16	semi arid	20.2	semi arid

125	Punganuru	0.17	moderately deficient	-83.16	semi arid	20.0	semi arid
126	Puttur	0.18	moderately deficient	-81.90	semi arid	24.5	moderately arid
127	Quthbullapur	0.17	moderately deficient	-83.16	semi arid	22.3	semi arid
128	Rajam	0.19	moderately deficient	-80.63	semi arid	27.3	moderately arid
129	Rajampet	0.11	moderately deficient	-89.47	semi arid	20.2	semi arid
130	Rajahmundry	0.12	somewhat deficient	-87.69	dry subhumid	31.2	slightly humid
131	Rajendranagar	0.17	moderately deficient	-83.16	semi arid	22.3	semi arid
132	Ramachandrapuram	0.12	moderately deficient	-87.69	semi arid	22.3	semi arid
133	Ramagundam	0.10	moderately deficient	-90.00	semi arid	28.7	moderately arid
134	Rampachodavaram	0.23	somewhat deficient	-77.50	dry subhumid	31.2	slightly humid
135	Rayachoty	0.17	moderately deficient	-83.16	semi arid	20.2	semi arid
136	Rayadurg	0.11	very deficient	-89.47	semi arid	14.0	dry (or)arid
137	Renigunta	0.11	moderately deficient	-89.47	semi arid	24.5	moderately arid
138	Repalle	0.12	moderately deficient	-87.69	semi arid	27.0	moderately arid
139	Sadasivpet	0.11	moderately deficient	-89.47	semi arid	26.4	moderately arid
140	Salur	0.23	adequate moisture	-77.50	moist subhumid	50.7	humid
141	Sangareddy	0.17	moderately deficient	-83.16	semi arid	22.3	semi arid
142	Sattenaplle	0.17	moderately deficient	-83.16	semi arid	27.3	moderately arid
143	Secunderabad	0.17	moderately deficient	-83.16	semi arid	22.3	semi arid
144	Shamsabad	0.17	moderately deficient	-83.16	semi arid	20.1	semi arid
145	Siddipet	0.17	moderately deficient	-83.16	semi arid	29.5	moderately arid
146	Singarayakonda	0.20	moderately deficient	-80.00	semi arid	22.3	semi arid
147	Sirsilla	0.17	moderately deficient	-83.16	semi arid	28.9	moderately arid
148	Srikakulam	0.20	moderately deficient	-80.00	semi arid	27.3	moderately arid
149	Srikalahasti	0.11	moderately deficient	-89.47	semi arid	24.1	moderately arid
150	Sullurupeta	0.17	moderately deficient	-83.16	semi arid	24.4	moderately arid
151	Suryapet	0.17	moderately deficient	83.16	semi arid	20.3	semi arid
152	Tadepallegudem	0.10	somewhat deficient	-90.00	dry subhumid	31.2	slightly humid
153	Tadipatri	0.17	very deficient	-83.16	arid	14.9	dry (or)arid
154	Tandur	0.11	moderately deficient	-89.47	semi arid	24.8	moderately arid

155	Tanuku	0.12	somewhat deficient	-87.69	dry subhumid	31.2	slightly humid
156	Tenali	0.10	moderately deficient	-90.00	semi arid	27.3	moderately arid
157	Tirumala	0.12	moderately deficient	-87.76	semi arid	24.5	moderately arid
158	Tirupati	0.11	moderately deficient	-89.47	semi arid	24.5	moderately arid
159	Tuni	0.20	moderately deficient	-80.00	dry subhumid	28.6	moderately arid
160	Uppalkalan	0.17	moderately deficient	-83.16	semi arid	22.3	semi arid
161	Uravakonda	0.11	very deficient	-89.47	semi arid	14.9	dry (or)arid
162	Venkatagiri	0.17	moderately deficient	-83.16	semi arid	24.1	moderately arid
163	Vetapalem	0.20	moderately deficient	-80.00	semi arid	22.0	semi arid
164	Vikarabad	0.12	excess moisture	-87.76	arid	190.8	excessively humid
165	Vijayapuri	0.17	moderately deficient	-83.16	semi arid	17.7	semi arid
166	Vijayawada	0.12	moderately deficient	-87.69	semi arid	27.3	moderately arid
167	Vinukonda	0.17	moderately deficient	-83.16	semi arid	17.7	semi arid
168	Vishakhapatnam	0.20	moderately deficient	-80.00	semi arid	25.7	moderately arid
169	Vizianagaram	0.20	moderately deficient	-80.31	semi arid	25.7	moderately arid
170	Wanaparthy	0.12	moderately deficient	-87.76	semi arid	23.2	semi arid
171	Warangal	0.17	moderately deficient	-83.16	semi arid	25.2	moderately arid
172	Yellandu	0.17	moderately deficient	-83.16	semi arid	27.1	moderately arid
173	Yemmiganur	0.10	moderately deficient	-90.00	semi arid	19.8	semi arid
174	Yerraguntla	0.11	moderately deficient	-89.47	semi arid	20.2	semi arid
175	Zaheerabad	0.11	moderately deficient	-89.47	semi arid	26.4	moderately arid