A STUDY OF ALTERNATIVE CROPS FARMING IN DROUGHT PRONE AREAS

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Abstract: *Agriculture plays a vital role in India's economy. 54.6 per cent of the population is engaged in agriculture and allied activities (census 2011) and it contributes 17 per cent to the country's Gross Value Added (current price 2015-16, 2011-12 series). National Mission for Sustainable Agriculture (NMSA) is one of the eight Missions outlined under National Action Plan on Climate Change (NAPCC). Drought, flood or other extreme weather events are occurs. Drought is a climatic inconsistency characterised by deficient supply of moisture. Such a deficiency may be due to the inadequate and erratic distributions of rainfall. Farmers also cited several practices that involve reducing inputs such as herbicides, pesticides, insecticides, and alternative irrigation water methods. Mostly farmers are maintaining soil quality and moisture through methods such as biodynamic preps (natural animal products put on or in the fields), crop rotation, and minimizing tillage. In addition, many producers mentioned raising alternative crops and livestock such as drought-resistant corn, sorghum, soybeans, sunflowers, millet, and organic cattle and bison. These practices helped enhance soil nutrients, soil moisture, and farm diversity, which helped to withstand the effects of drought. Solely the present study made an attempt to study the alternative cropping pattern in drought prone areas of Kadapa district of Andhra Pradesh. The state of Andhra Pradesh is divided in two regions, i.e., Coastal Andhra, which comprises 9 Districts namely, Nellore, Krishna, Guntur, East Godavari, West Godavari, Visakhapatnam, Srikakulam, Vijayanagarm and Prakasm. Rayalaseema region consists of 4 Districts namely, Anantapur, Kurnool, Kadapa, and Chitoor. The four districts are under the crisis of drought. The average annual rainfall in Kadapa District is 696.6 mm. The rainfall generally increases from the North-West to the South-East in the District. The rainy season starts from June and lasts till November. October is the month with the highest normal rainfall. The rainfall in South-west monsoon period is most important for the sowings of dry crops in the District which covers 75 per cent of the total cropped area. The Majority of the people here are depending on Agriculture only. The major crops in the District are Paddy, Groundnut, Sunflower, Cotton, Betel leaves and Horticultural crops like Mango, Papaya, Banana, Lemon and Oranges. The gross cropped area in the District is 3,96,864 hectares, out of this, gross irrigated area is 1,85,292 hectares. With this background, an attempt has been made in this paper to study the Horticulture sector in dry lands particularly in drought prone areas of Kadapa district in the divided residuary Andhra Pradesh.*

Key Words: *Drought, Horticultural Crops, Micro-irrigation, Kadapa district.*

1. INTRODUCTION:

Agriculture the supplier of that basic human need, nutrition is the world's largest user of land, occupying more than one third of Earth's terrestrial surface and also using vast amounts of water. It affects our daily life in many ways, both directly and indirectly. Humans expect agriculture to Supply sufficient nutrients, economically and culturally valued foods, fibers and other products. Agriculture must also provide desirable employment and optimized land use and productivity In relation to limiting resources. It must coexist with the needs of urban and natural environments, Landscapes and a wide range of other ecosystem services. Agriculture is essential for inclusive Development because it produces food as well as economic wealth for many of the world's poorest - People wealth that allows for improved livelihoods through better health care, education, infrastructure improvements and greater investment in environmentally sound practices. For Sub--- Saharan Africa, growth generated by agriculture is eleven times more effective in reducing Poverty than GDP growth in any other sectors.

Nearly 70 per cent of rural population lives in dry farming areas and their livelihood depend on success or failure of the crops. Dryland Agriculture plays a significant role in Indian Agriculture occupying60 per cent of cultivated area and supports 40 per cent of human population and 60 per cent livestock population. The contribution (production) of rainfed agriculture in India is about 42 per cent of the total food grain, 75 per cent of oilseeds, 90 per cent of pulses and about 70 per cent of cotton. By the end of the 20th century the contribution of drylands will have to be 60 per cent if India is to provide adequate food to 1000 million people. Tremendous efforts both in the development and research fronts are essential to achieve this target. The dry farming areas in Andhra Pradesh are found in Kurnool, Anantapur,

Kadapa, and Chittoor districts. About 84 districts in India fall in the category of low rainfall area and to providing irrigation to all the drylands is expensive and takes long time. Even after providing all the irrigation potential in India 55 per cent area remains as rainfed**. (ANGRAU, Hyderabad. http://www.angrau.net/Publications.htm).**

Climate change impacts on agriculture is witnessed all over the world, but countries like India are more vulnerable in the view of high population depending on agriculture, excessive
pressure on natural resources and poor coping mechanisms. A large area of land under dryland agriculture is expected to undergo changes in rainfall patterns, temperature and extreme events over next several decades due climate change thus making rainfed agriculture more risk prone. Improved technologies and new policy initiatives are needed to enable framers cope with climate change impacts. **(Singh, AK., and Venkateswarlu, BV., 2009)**

Drought is a recurring climatic event and a global phenomenon, but its features vary from region to region. It is a chronic problem in arid and semi-arid regions and frequently occurs in humid regions as well. The common belief that drought occurs only in low rainfall areas is not true at all. Repeated occurrence of drought in the Indian state of Orissa, having an average annual rainfall of 1,300 mm, is an example **(Pandey, Sushil 2009).** Conceptually, drought is considered to describe a situation of limited rainfall substantially below what has been established as a 'normal' value for the area concerned, leading to adverse consequences for human welfare. Although drought is a climatically induced phenomenon, its impact depends on social and economic contexts as well. Considering its complex nature and wide variation across time and space, it is somewhat impractical to develop a universally applicable definition of drought. The definition also depends on the disciplinary perspective. Three such definitions based on meteorological, hydrological and agricultural perspectives are available **(Wilhite and Glantz 1985).**

The economic costs of drought can be enormous. For example, it has historically been associated with food shortages of varying intensities, including those that have resulted in major famines in various parts of Asia and Africa. In India, major droughts in 1918, 1957/58, and 1965 resulted in famines in the twentieth century **(FAO 2001).** The 1987 drought affected almost 60 per cent of the total cropped area and 285 million people across India **(Sinha 1999).**

Drought is a climatic inconsistency characterised by deficient supply of moisture. Such a deficiency may be due to the inadequate and erratic distributions of rainfall. Drought has different connotations in different situations: absence of soil moisture to a farmer, absence of rains for a meteorologist, and decrease or absence of water in storage reservoirs and irrigation canals for an irrigation engineer **(Maunder 1979: 338).** Developing countries have a lesser capacity to adapt and are more vulnerable to climate change damages. This condition is most severe among the poorest people **(IPCC, 2001).**

The need for diversification to horticulture sector was acknowledged by the Government of India in the mid-1980s by focusing its attention on investment in this sector. Resultantly, horticulture has moved from rural confines to becoming a commercial venture. The scenario of horticultural crops in India has become very encouraging. Horticulture crops cover an area of 23.8 million ha (m. ha) at present by registering increase of about 17.8 per cent as compared to 20.2 m ha in 2007-08. Area, production and productivity of with a production of about 283.4 million MT, horticulture production has witnessed an increase of about 34.3% during the period 2007-08 to 2015-16. The significant feature is that there has been improvement of productivity of horticulture crops, which increased by about 13.8% during this period. Area, Production and Productivity of Horticulture Crops during past 9 years are given in Table 4.

Table 1. Area, Production and Productivity of Horticulture Crops in India
(Area : m.Ha, Prod.: m. MT, Pvty. MT/ha)

Year	**Area,**	**Production**	**Productivity**
2007-08	20.2	211.0	10.4
2008-09	20.5	214.4	10.5
2009-10	20.8	223.2	10.7
2010-11	21.8	240.4	11.0
2011-12	23.2	257.3	11.1
2012-13	23.7	268.8	11. 3
2013-14	24.2	277.4	11.5
2014-15	23.4	280.99	12.01

Source: Annual Report 2016-17, Ministry of Agriculture and Farmers Welfare, New Delhi.

India stands to be second largest producer of vegetables after China. India is a leader in production of vegetables like peas and okra. Besides, India occupies the second position in production of brinjal, cabbage, cauliflower and onion and third in potato and tomato in the world. Vegetables such as potato, tomato, okra and

cucurbits are produced abundantly in the country. India has retained its status as the second largest producer of fruits in the world. The country is first in the production of fruits like mango, banana, sapota, pomegranate and aolna.

The micro- irrigation technologies such as drip and sprinkler are the key interventions in water and improving crop productivity. Drip irrigation is the current technology adopted in countries where water is scarce. In this method, water is taken up to the plants continuously drop by drop, hence the method is known as drip irrigation. In this method, the internal pressure is greater than 1.5 to 2 kg / cm2 and it is about 2 to 16 liters / hr. which ensures the better plant growth. Water requirement is very less since water is delivered directly to the plant root-zone of the crop. On an average, water required by drip irrigation is only 20 to 30% of that required by conventional methods like such as flooding and furrow methods and there is net saving of 70 to 80 per cent. Application of water by drip system can increase the yield of vegetable crop, fruit crops. In the sprinkler method of irrigation, water is sprayed into the air and allowed to fall on the ground surface somewhat resembling rainfall. The spray is developed by the flow of water under pressure through small orifices or nozzles. The sprinkler works at different pressures depending on the type of sprinklers. The micro-irrigation methods such as sprinkler and drip irrigation should be popularized. These are one of the important strategies to reduce the impact of drought. Considering these, it is proposed to take up a study to identify issues and opportunities that enhance the coping capacities of sustainable horticulture crops in dealing with the climate induced natural disasters like drought.

2. OBJECTIVES:

- To describe land use pattern in the drought prone areas of the State;
- To explore various alternate methods of irrigation and how far alternative irrigation methods to contribute horticulture crops

3. METHODOLOGY:

The study is based on secondary data and literature collected from the different sources such as government publications from Chief Planning Office, Kadapa, Crop and Seasonal reports, published research reports /papers and related websites.

4. REVIEW OF LITERATURE:

In this section, briefly anlaysed previous study findings though the literatures.

Hughes (1999), in which the technical and the social are intimately linked. The technology includes the hard ware or the gadget, software, the knowledge underlying the construction of the gadget and social organization required to implement the technology. in this sense the technical and the social are linked closely. The social includes economic, political and cultural dimensions in a broad sense. The economic dimension in the ultimate analysis is social in nature as for example, which sections of the society would be interested in increasing productivity by adopting new technologies. Further technologies operate in a political and cultural context. Political context is responsible for technological choices and in evolving appropriate policy interventions. Let us begin by looking at economic dimension.

Dreze and Sen (1989) have rightly observed the total absence of security in case of the lives of the poor. Lack of resources and access to technology and finances coupled with high dependence of the majority of people on climate sensitive sectors (i.e. agriculture, forestry and fisheries) have made India seriously concerned about possible impacts of climate induced natural disasters **(Chatterjee K., A. Chatterjee, S. Das, 2005).** Since agriculture is the major water-consuming sector in India, demand management in agriculture in water-scarce and water-stressed regions would be central to reduce the aggregate demand for water to match the available future supplies **(Kumar 2008).** However, the water demand for different sectors has been growing continuously **(Saleth 1996; Vaidyanathan 1999)** and demand management becomes the overall key strategy for managing scarce water resources **(Molden et al 2001).** The successful adoption of Micro Irrigation requires, in addition to technical and economic efficiency, two additional preconditions, viz, technical knowledge about the technologies and accessibility of technologies through institutional support systems **(Namara 2005).**

5. ALTERNATIVE CROPS FARMING IN ANDHRA PRADESH:

Since, this state possesses diversified demographical, socio-cultural and dialectical variations; it is divided into three geographical regions, namely, Coastal Andhra, Rayalaseema.

Rain-fed agriculture faces several constraints such as high spatial variability, dependence on uncertain rain, fewer rainy days, over-exploitation of groundwater, impoverishment of soils and preponderance of the poor in arid and semi-arid terrains. Moreover, climate change is likely to accentuate the problem further. In the State of Andhra Pradesh, around 56 per cent of the net sown area is under rain-fed agriculture. Classifying a district as rain-fed if less than 30 per cent of its net sown area is not under dependable irrigation, the following districts qualify as rain-fed districts: Anantapur, Chittoor, Kadapa, Kurnool, Prakasam, Visakhapatnam and Vizianagaram. Of these, Anantapur is

arid, Kadapa and Kurnool are semi-arid, Chittoor and Prakasam are wet semi-arid and Visakhapatnam and Vizianagaram are sub-humid. Droughts occur more frequently in arid, dry and semi-arid districts**.** Pulses are the major crop in the rain-fed as well as in irrigated districts. Groundnut is the predominant crop in the dry areas of Anantapur and Chittoor; chickpea in Kurnool and Prakasam. Black gram is the main crop in the dry areas of irrigated districts and cotton in Guntur. The percentage of cropped area under rain-fed crops has increased over time for cotton and maize at the cost of groundnut and sunflower.

Among the various agro-forestry models, agri-horticulture is highly suitable for the Rayalaseema region, both for arable and non-arable lands with limited water for irrigation. A separate system has to be created using a network of piped water supply on payment mode and islands of Special Horticulture Zones (SHZs) should be developed on the pattern of SEZ. In these zones, paddy and other water intensive crops need to be discouraged and special emphasis should be given to perennial fruit plants with forward and backward linkages. The Sub-Committee on Rain-fed Agriculture suggested some promising tree based systems for the districts of Andhra Pradesh **(CESS report , 2016)**

According to Horticultural Statistics at a Glance **(2015)** Andhra Pradesh is the fifth largest producer of horticultrure crops. State produces about 21.0 m MT of horticulture produce from an area of 1.6 m. ha. accounting for 7.6 per cent of total horticulture production in the country. Major share of production is from vegetables (38.9 per cent) and fruits (50.1per cent).

- Andhra Pradesh has emerged as the second largest fruit producing State in the country and its share accounts for 11.8% of total production of fruits in the country. The main fruits are mango, banana, citrus, papaya, guava and sapota.
- Andhra Pradesh contributes about 5.0% to the total vegetable production in the country. The main vegetables in the state are brinjal, okra, onion and tomato.
- During 2013-14, 27.85 lakh MT of fruits have been traded in organized markets with average price of Rs. 14.01/Kg.
- Similarly, 5.19 lakh MT of vegetables have been traded in organized markets with average price of Rs. 17.71/ Kg.

The newly formed Andhra Pradesh State, popularly known as the “rice bowl of India”, while majority of the population (62%) for their livelihood depend on agriculture related activities, it contributes only 27.84 per cent to the state Gross Domestic Product (GSDP) and is growing at 5.9 per cent (2014-15). The State covers an area of 160,204 square KMs accounting for 4.87 per cent of total area in the country, Coastal Andhra 92,906 Sq KMs (58 per cent of State area) and Rayalaseema covering an area of 67,298 Sq KMs (42 per cent of State area). For several decades, more than 70 per cent of population was dependent on agriculture related activities. At all India level this percentage has been reduced to 58 per cent and the recent National Sample Survey Organisation (NSSO) 70th round indicated that this is declining further to 48 per cent. Andhra Pradesh is set to scale new heights in agriculture in the coming years with renewed focus on Micro irrigation, System of Rice Intensification (SRI) cultivation, Micronutrient application, development of dry land agriculture, farm mechanization, increasing storage capacity and other agriculture related strategies.

Table:2 District – wise Agro-Climatic characterization and classification

District	Annual Rainfall (mm)	Climate (based on Moisture Index)	Net Irrigated area (per centage)
Anantapur	552	Arid	11
Chittoor	925	Semi-arid	38
Kadapa	699	Semi-arid	28
East Godavari	1190	Dry Sub-humid	64
Guntur	896	Semi-arid	63
Krishna	1022	Semi-arid	64
Kurnool	670	Semi-arid	23
Nellore	1091	Semi-arid	75
Prakasam	880	Semi-arid	33
Srikakulam	1139	Dry sub-humid	56
Visakhapatnam	1148	Dry sub-humid	29
Vizianagaram	1138	Dry sub-humid	44
West Godavari	1093	Semi-arid	82

Source: District Database of Agricultural Statistics: A Database Management System, 2015.

The above table 2. presents the large area under dryland in Andhra Pradesh. The state of Andhra Pradesh is consists of two regions namely, Coastal and Rayalaseema Region. There are four districts comes under the Rayalaseema Region, namely, Anantapur, Kurnool, Chittoor, and Kadapa. These four districts are Drought Prone areas. The district wise agro-economic and classification of Andhra Pradesh is given in the above table. In table 3. clearly shows that the area under dryland agriculture in Rayalaseema region. Mostly the region is the leading in Horticultural crops.

Table 3. Area under Dryland agriculture in Rayalaseema Region

District	Cultivated Area (Hectares)	Area under Dryland Agriculture(un rrigated) (Hectares)	Per centage of area under dry land
Anantapur	10,20,158	9,59,112	94.0
Chittoor	5,49,264	4,46,181	81.2
Kadapa	3,92,628	3,57,192	91.7
Kurnool	9,79,172	8,76,421	89.5
Total	29,41,222	26,38,906	90.2

Source: District Hand Book Statistics, 2015-16

The government is implementing strategies to make Rayalaseema as a **Horticulture hub.** It is targeted to cover one million farmers in next three years under Farmer Producer Organisations for Agriculture & Allied sectors in order to establish forward and backward linkages and to promote the products of Andhra Pradesh to global standards. It contributes about 8.18% of the State GVA and is moving towards value enhancement in addition to focus on production. The Government is keen to encourage horticulture in a big way and it is expected that value addition from this sub-sector will soon cross the agriculture share.

Wide range of agro-climatic conditions of Andhra Pradesh are conducive for growing a large variety of Horticultural crops, including, root and tuber crops, ornamental crops, plantation crops like coconut, cashew and cocoa etc. During the year 2016-17, the Government has set a target of 20 per cent growth in output and to achieve this, there is need for new initiatives, new interventions and implementations with the support and coordination of farmers and entrepreneurs.

Horticulture is the main segment; it contributes about 5.6 per cent of the State GDP and is moving towards value enhancement in addition to focus on production. 14.74 Lakh Ha. area is under Horticulture with production of 188.22 lakhs MTS of Horticulture crops in Andhra Pradesh. The area under fruits is 5.76 lakhs Ha, Vegetables 2.33 lakhs Ha, Spices 2.21 lakh Ha and Plantation crops 4.27 lakh Ha. During the year 2015-16 the Government has set a target of 20 per cent growth in output and to achieve this, there is need for new initiatives, new interventions and implementations with the support and coordination of farmers and entrepreneurs. **Andhra Pradesh ranks 1st in the production of Oil Palm, Tomato, Chillies, Turmeric and Mango; 2nd in production of loose flowers in India.**

Table 4. Horticultural Crops – Area and Production during 2015-16

Category of Crop	Area (lakh ha)	Production (Lakh MT)
Fruits	5.76	100.48
Vegetables	2.33	53.26
Flowers	0.17	1.35
Plantation Crops	4.27	22.14
Spices	2.21	10.90
Spice	0.005	005 0.090
Total	14.74	188.22

Source: Socio-Economic Survey, 2015.

AP Micro Irrigation Project (APMIP) is a first comprehensive and unique project being implemented in a big way in Andhra Pradesh for enhancing crop productivity by improving water use efficiency through Micro-irrigation systems to benefit the farmers. It is an ongoing project and 5.99 lakh ha. has been covered under Micro irrigation in all the districts in the State, benefiting 5.33 lakh farmers, with a total financial out lay of Rs.2841.26 crores. The aim of the Project is to improve the economic conditions of the farmers by conserving water, bringing additional area into cultivation with the available water resources and also enhancing the crop productivity, quality, facilitates judicious usage of ground water, conserving ground water resources, saving in power consumption and saving in cost of cultivation.

In view of deficit Rainfall, Rain shadow regions, unpredictable rains and considerable depletion of ground water, drip irrigation is a viable option for farmers. ***To achieve the concept of "More crop per Drop "Micro irrigation is to be taken up particularly in the districts of Rayalaseema, which are most drought prone and backward areas.*** **A**PMIP is being implemented with the assistance from Government of India, State Government and farmer contribution.

Micro Irrigation is being implemented under PMKSY with funding pattern of 60:40 between central and state Government from 2015-16 onwards. Government of India (GOI) allocated Rs.260.00 Crores for implementation of Micro Irrigation in an area of 1.50 lakh ha. during the year 2016-17. So far, an area of 52,094 ha. has been covered under the scheme under Micro Irrigation. Andhra Pradesh Ranks 2nd next to Gujarat in implementation of Micro Irrigation programme. The following table 5. shows that the achievement of Micro Irrigation Project in both Coastal and Rayalaseema region of the State of Andhra Pradesh.

Table 5. District wise achievements from 2003-04 to 2015-16

S. No.	District	Physical Achievement (Area in ha)		
		Drip	Sprinkler	Total
1	Srikakulam	6651 (1.3)	5340 (2.7)	11991 (1.7)
2	Vizianagaram	11647 (2.3)	6300 (3.2)	17947 (2.5)
3	Vishakapatnam	10708 (2.1)	5741 (2.9)	16449 (2.3)
2	East Godavari	16686 (3.3)	4072 (2.1)	20758 (2.9)
5	West Godavari	43465 (8.6)	6679 (3.4)	50144 (7.2)
6	Krishna	20310 (4.0)	8698 (4.5)	29008 (4.1)
7	Guntur	12325 (2.4)	9904 (5.1)	22229 (3.2)
8	Prakasham	25394 (5.0)	10571 (5.4)	35965 (5.1)
9	Nellore	23309 (4.6)	13832 (7.1)	37141 (5.3)
10	Chittoor	81427 (16.2)	14137 (7.3)	95564 (13.7)
11	Kadapa	80379 (16.0)	21366 (11.0)	101745 (14.6)
12	Anantapur	137156 (27.4)	65815 (34.0)	202971 (29.2)
13	Kurnool	30445 (6.09)	20766 (10.7)	51211 (7.3)
Total		499902 (100)	193221 (100)	693123 (100)

Source: Horticulture Department Figures insides the parentheses are percentages

The state of Andhra Pradesh has been experiencing severe water stress due to continuous drought situation over the last 3 years. There is therefore an imperative need to promote judicious use of water, particularly in-respect to agricultural activities. With this in view the Government has launched a massive Micro Irrigation Project in 2003-04 throughout the state, with special emphasis on water stress mandals.

6. KADAPA SCENARIO:

The Rayalaseema region faces frequent droughts which result in partial or major crop losses. The total districts of Rayalaseema are consisting of four; they are Kadapa, Kurnool, Anantapur and Chittoor. Except Anantapur all districts are comes under semi-arid category. A large proportion of net sown area is concentrated in rain-fed Rayalaseema. Agriculture in Kadapa district is risky because of its drought prone nature. Year wise drought affected mandals are given in the table 1.7.1. But in the recent years, there is a secular increase in the rainfall as well as in the irrigated area. Many more irrigation projects are under construction which will improve the irrigation coverage once they are completed. The district has diverse soils and cropping patterns. Rice, groundnut, bengal gram, red gram, cotton and jowar are the major crops in the district.

Table 6. Year-wise Drought Mandals declared in Kadapa District

Drought Year	Affected Mandals in Kadapa District
2005-06	17
2006-07	33
2007-08	29
2008-09	22
2009-10	51
2010-11	36
2011-12	51
2012-13	43
2013-14	16
2014-15	48

Source: Chief Planning Officer, Kadapa

The total Geographical area of the District is 15,379 Sq.Kms. with three Revenue Divisions, 51 mandals, 790 Gram Panchayats, 972 Revenue Villages and 4954 Habitations. The total geographical area is 15,35,900 hectares which constitutes an extent of forest is 5,00,961 hectares, Barren & Uncultivable land is 2,21,834 hectares, Land put to Non-agricultural uses is 1,82,139hectares, Cultivable Waste is 44,889 hectares, permanent pastures and other grazing lands is 8,936 hectares, land under miscellaneous tree crops & groves not included in net area sown is 6,799 hectares, current fallows is 1,41,035 hectares, other fallow land is 89,036 hectares, total cropped area is 3,96,864 hectares and net area sown is 3,40,271 hectares and area sown more than once is 23,959 hectares in the year 2015-16. The details are explained in following table

Table: 7.Land Pattern particulars in Kadapa District (2015-16)

Land Utilization	Area in Hectares
Forests	500961 (32.6)
Barren and Uncultivable Land	221834 (14.4)
Land put to non-agricultural uses	182139 (11.8)
Cultivable waste	44889 (2.9)
Permanent Pastures and other grazing lands	8936 (0.5)
Land under miscellaneous tree crops and groves not included in net area sown	6799 (0.4)
Current fallows	89036 (5.7)
Other fallow Lands	141035 (9.1)
Net area sown	340271 (22.1)
Total Cropped Area	396864 (25.8)
Area sown more than once	56593 (3.6)
Fish and Prawn Culture	0 (0.0)
Total Geographical area	1535900 (100)

SOURCE: Chief Planning Office, Kadapa
Figures insides the parentheses are percentages

The District is drained by the Penneru Basin and its tributaries. This River rises in the Karnataka State and after passing through Anantapur district enters this District at the north-western corner near Tallaproddatur in Kondapuram mandal.

The Soils in the District are of two types i.e., Red Ferruginous and Black Soils. Black Clay is the most superior soil in the District, which occupies 23.7 per cent area in the District.
The year may be divided into four seasons. The period from December to February is the dry and comparatively cool season. The summer seasons starts from March and lasts till May. May is the hottest month of the year. This is followed by the south-west monsoon from June to September, October and December constitute the post monsoon or North East monsoon season.

The average annual rainfall in the District is 696.6 mm. The rainfall generally increases from the North-West to the South-East in the District. The rainy season starts from June and lasts till November. October is the month with the highest normal rainfall. The rainfall in South-west monsoon period is most important for the sowings of dry crops in the District which covers 75 per cent of the total cropped area.

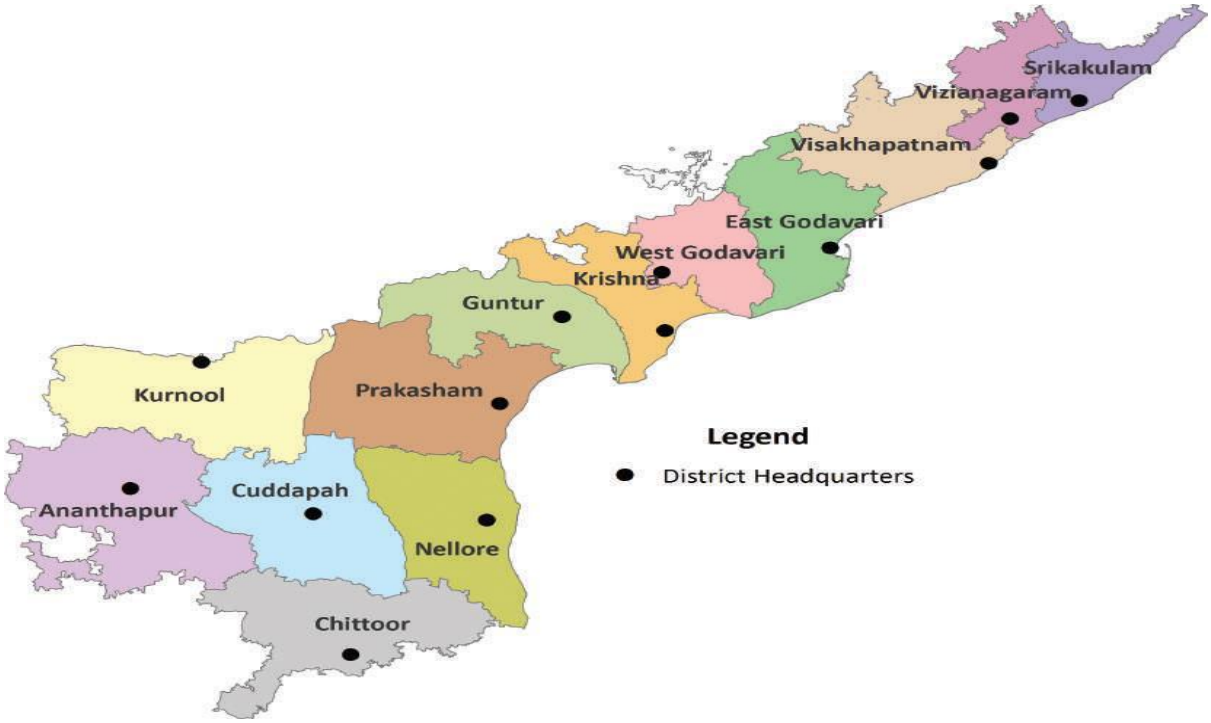
Table 1.7.3 District Average Rainfall Season-Wise and Monthwise (In MMs)

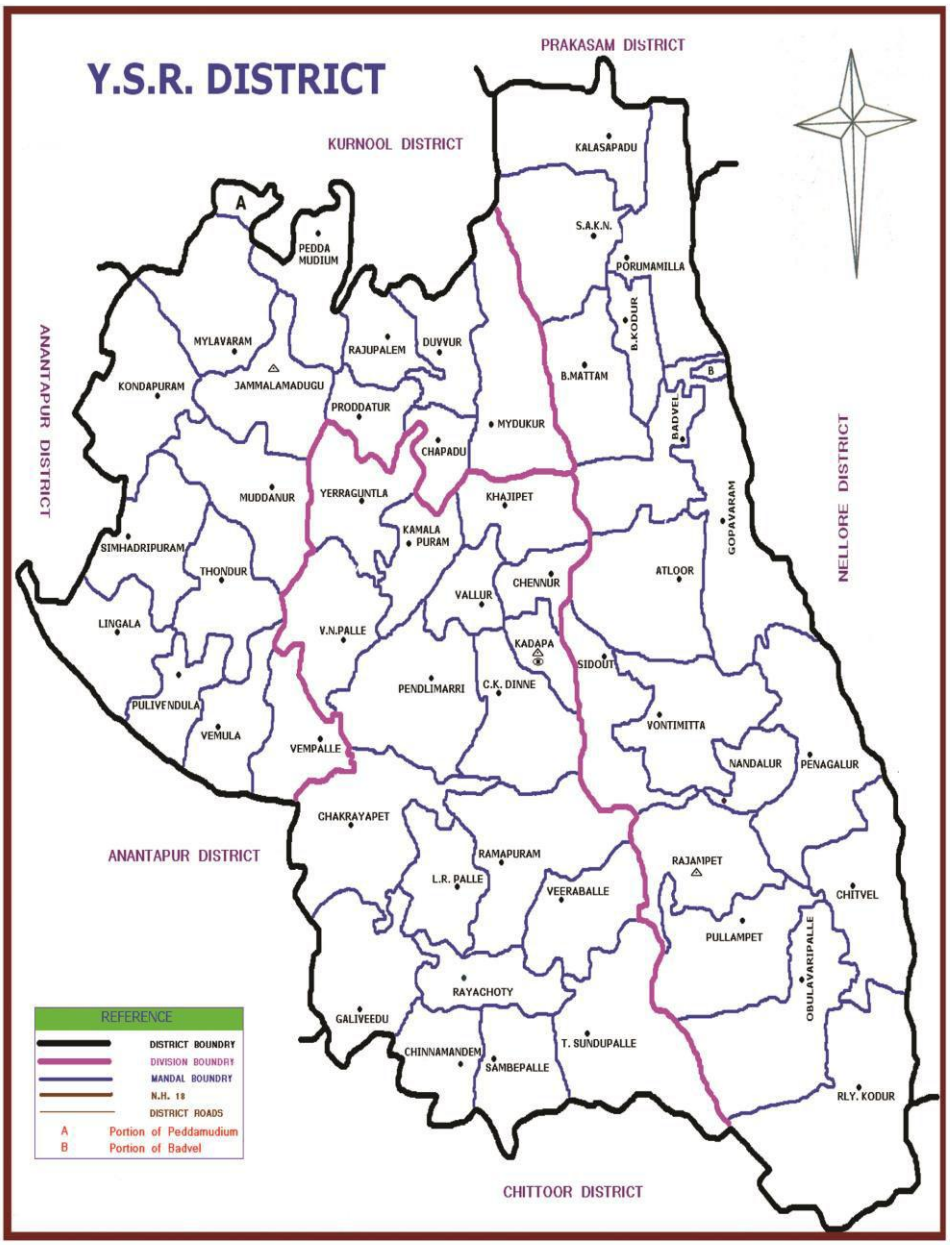
Year	SOUTH - WEST MONSOON					NORTH - EAST MONSOON			
	June	July	August	September	Total	October	November	December	Total
Normal	69.2	96.7	114.0	113.7	393.6	131.9	93.4	25.7	251.0
2009-10	46.5	28.9	144.9	136.9	357.2	22.6	141.2	28.1	191.9
2010-11	119.4	165.1	136.6	101.2	522.3	76.9	198.8	45.4	321.1
2011-12	37.6	117.3	167.7	52.0	374.6	113.8	92.0	23.8	229.6
2012-13	41.8	125.0	88.2	37.1	292.1	76.5	75.4	60.1	209.6
2013-14	62.1	85.2	122.7	177.7	446.5	208.4	27.5	1.5	237.4
2014-15	42.1	33.8	69.4	65.7	211.0	64.9	32.2	13.7	110.8
2015-16	62.3	31.6	128.4	124.0	346.3	78.1	323.5	27.0	428.6

Source: District Hand Book

Andhra Pradesh

District / Mandal / Boundaries





The District is rich in Minerals value. The Major Minerals in the District are Barites, Lime Stone and Asbestos. Apart from Major Minerals, Minor minerals are Napa Slabs, Road Metal, Building Stone, Marble, Mosaic Chips and Rehmatti are also in the District.

The Major Source of Irrigation is under K.C. Cannal. There is a Major Irrigation Project on Penna at Mylavaram. Pincha Project, Lower Sagileru Project, Upper Sagileru Project, Annamay Project, Brahma Sagar Project and Pulivendula Branch Canal are Medium Irrigation Projects in the District.

Table 1.7.4 Revenue Division wise Area Irrigated by Sprinklers and Drip Irrigation 2015-16

S.No.	Division	No.of Sprinklers working	Area Irrigated (in Hect.)	No.of Drip working	Area Irrigated (in Hect.)
1	Kadapa Division	2267 (58.3)	2727.91 (56.7)	1784 (21.5)	1724.29 (20.83)
2	Rajampet Division	279 (7.18)	327.24 (6.8)	3502 (42.3)	3736.34 (45.14)
3	Jammalamadugu Division	1339 (34.4)	1750.99 (36.43)	2976 (36.0)	2815.18 (34.04)
TOTAL		3885 (100)	4806.14 (100)	8262 (100)	8275.81 (100)

Source: District Handbook, 2015-16
Figures insides the parentheses are percentages

In Kadapa there are three revenue divisions, namely Kadapa, Rajampet and Jammalamadugu. In Kadapa division, 56.7 percent area irrigated by Sprinklers (58.3 per cent) and the drip cover by 21.5 per cent of area irrigated. In the case of Rajampet, most of the area irrigated by Drip i.e. 42.3 per cent. Jammalamadu division, 34.04 percent area is covered by 36.0 per cent of drip. Therefore, new irrigation techniques should be good alternative for water-starved regions. One of the innovative strategies is deficit irrigation by drip system for dry areas **(Aacar et al 2006: Geerts and Raes, 2009)**

Drip irrigation in general also facilitates higher and qualified yield due to uniform water distribution through the root zone **(Acar et al, 2008).**

Majority of the people in Kadapa are depending on Agriculture only. The major crops in the District are Paddy, Groundnut, Sunflower, Cotton, Betel leaves and Horticultural crops like Mango, Papaya, Banana, Lemon and Oranges. The gross cropped area in the District is 3,96,864 hectares, out of this, gross irrigated area is 1,85,292 hectares.

7. CONCLUSION:

Nearly two third of a total of 169.65 million ha land under arable area and permanent crops in India is rainfed. The productivity of horticultural crops in dry land is, however, very low, extremely irregular, and variable depending upon the extent and pattern of rainfall. Besides water scarcity, the other productions constraints in the dry lands are: i. Abiotic stresses due to extremes of temperature and atmospheric humidity, ii. Biotic stresses due to damage caused by wild animals rodents, birds, insects, and diseases, iii. Poor, degrades, and marginal soil conditions, iv. Difficult conditions to execute agro techniques, and v. difficulty in postharvest handling and marketing (**Pareek. O.P, 1999).**

The average rainfall of the district is 700 mm. 65 per cent of the rainfall is contributed by south-west monsoon, 30 per cent of the rainfall is from north-east monsoon and the rest as summer showers. 67 per cent of the cultivable land is under rain fed conditions and 33 per cent of the area is under irrigation, mainly by K.C.Canal, Bramham Sagar, Pincha, Mylavaram, Upper and Lower Sagileru, Annamaiah, Buggavanka and Chitravathi balancing reservoir, tanks, kuntas and wells and bore wells and filter points (CDAP, Kadapa).

Recurring drought is the most common phenomenon in Kadapa district, particularly in the rainfed areas. Farmers are sustaining crop losses leading to distress conditions. In rainfed situation, recurring losses are very common during the recent past. Therefore, it is felt that there is a need to encourage Micro irrigation methods for sustainability of horticultural crops in this area. The Govt. with a view to save the available irrigation water (30% to 40%) and to bring additional area under cultivation, supply of sprinklers and drip irrigation units are proposed on 90 per cent subsidy instead of 70 per cent subsidy.

The cropping pattern also varies with the effect of temperature, soil and other irrigation facilities. The food crops occupy a significant place, among them paddy, jowar and other millets are main. Among the commercial crops, groundnut is the most predominant crops followed by sugarcane and cotton. There would have been no Horticulture in Micro Irrigation without Rayalaseema Region. Therefore, water, can significantly improve and stabilize the

productivity of horticultural crops in the drylands. Agriculture is the highest water use sector but in drought prone areas the rainfall status is not sufficient for cultivation. Farmers have choose an alternative irrigation methods for an alternative crops like Horticultural crops. Drip system has both advantages and disadvantages. The most notable thing is water-labor-saving, efficient fertilizer use, and resulting higher yield under well management. The drip irrigation is suited for the deficit irrigation circumstances. It is recommended especially the areas where water scarcity for the cultivation. In another aspect ie., disadvantage perspective, farmers do not have enough budget to meet installation cost of drip system. Now a days the Government is to providing subsidies to the farmers for adopts micro irrigation system.

Therefore, micro irrigation techniques like Drip and Sprinkler methods of irrigation should be good alternative for water-starved regions.

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