SUCCESS STORIES IN NATIONAL INNOVATIONS ON CLIMATE RESILIENT AGRICULTURE

ACHARYA N.G. RANGA AGRICULTURAL UNIVERSITY

ALL INDIA COORDINATED RESEARCH PROJECT FOR DRYLAND AGRICULTURE

AGRICULTURAL RESEARCH STATION

ANANTHAPURAMU - 515 001

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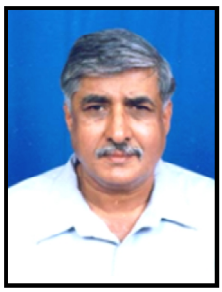

Dr. A.PADMA RAJU
Vice-Chancellor

FOREWORD

In recent years, climate change pertains to significant rise in the frequency of extreme weather events affecting the productivity of crops. Another climate change feature significantly influencing agro eco systems in the change in seasonal rainfall patterns. Enhancing resilience of agriculture to climate risk is of immense importance for protecting livelihoods of farmers.

Rainfed agriculture in India accounts for about 60 per cent of the net cultivated area which supports 40 per cent human and 60 per cent livestock population. The contribution from agricultural sector towards GDP is very crucial as 65 – 70 per cent of the population is mainly dependent on agriculture for their livelihood. The Agricultural growth in dryland areas is determined by the bio-physical and socioeconomic factors and their interactions. Rainfed agriculture is diverse and risk prone mainly depending on rainfall. Location specific technologies are essential to attain sustainability in agriculture in these areas.

The All India Co-ordinated Research Project for Dryland Agriculture (AICRPDA) main centre, Ananthapuramu was started in 1971 and has carried out commendable research work on dryland agriculture for the past four and half decades. This project has been carrying out location specific adaptive research on rain water management, soil and water conservation, crops and cropping system, farming system crop improvement, energy management, integrated nutrient management and alternate land use systems. This publication contains the essence of important technologies developed for profitable rainfed farming including improved crop varieties, soil test based fertilizer application through integrated nutrient management, *insitu* and *exsitu* water conservation methods like rain water harvesting, farm ponds, crops and cropping system, seed to seed mechanization in groundnut, contingency plans for climate exigencies and farming systems approach for enhancing health and income.

I compliment Dr. B. Sahadeva Reddy, Chief Scientist, all other scientists and staff involved in bringing out this publication entitled **"Success Stories in National Innovations on Climate Resilient Agriculture"**. I am sure that this publication would form a valuable source of scientific information for scientists, extension workers, stake holders/farmers and all others engaged in the development of dryland agriculture to improve productivity in rainfed agriculture and enhance the livelihood security of farming.

A. Padma Raju

Date : 26-8-2015 **(A.PADMARAJU)**

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PREFACE

Natural Resource Management has important research agenda in view of the climate change, degradation of land and declining productivity in greenrevolution areas. Efficient methods of soil and rain water conservation and water harvesting become important areas of dryland agriculture research to achieve sustainability. Variation in crop yields is more in dry lands due to non receipt of timely rainfall and prolonged dry spells during crop periods. Adoption of soil and moisture conservation measures and improved management practices will help in getting higher yields.A large number of location specific practices for *insitu* moisture conservation, water harvesting and supplemental irrigation have been developed and tested successfully at All India Co-ordinated Research Project for Dryland Agriculture (AICRPDA), Agricultural Research Station, Ananthapuramu.

Dryland Agriculture occupies a prominent place in rural livelihoods of Andhra Pradesh. In Andhra Pradesh out of 92.04 lakh ha of cultivable land an area of 34.56 lakh ha is under rainfed agriculture, mainly in scarce rainfall and southern agro climatic zones.

NICRA is a multi-institutional, multi-disciplinary network project with an prime objective of enhancing resilience of Indian agriculture to climate change and climate variability. The major climate vulnerabilities are drought, floods, cyclones in Andhra Pradesh. Enhancing resilience is the key to achieve sustainability in agriculture, particularly in the context of climatic vulnerability.

AICRPDA, ARS, Ananthapuramu is continuing efforts to generate location specific technologies in the areas of rain water management, integrated nutrient management, cropping systems, farming systems, alternate land use and energy management.

The booklet entitled **"Success Stories in National Innovations on Climate Resilient Agriculture"** brings out the achievements made by AICRPDA, ARS, Ananthapuramu which will be highly useful for researchers and extension workers. I am confident that this excellent research outcome by AICRPDA, ARS, Ananthapuramu will be useful for farmers, researchers, NGOs and Officials of Department of Agriculture who are involved in Natural Resource Management Programmes and activities. I compliment the efforts of Dr. B. Sahadeva Reddy, Chief Scientist and his staff for compiling the achievements with all details.

K. Raja Reddy

Date : 26-8-2015

(K. RAJA REDDY)
DIRECTOR OF RESEARCH

ACKOWLEDGEMENT

NICRA project came in to existence during drought during crop period influence the crop yield in drylands. Selection of crops, cropping systems, interventions to cope up with the situation with climate change is need of the hour for sustainable production 2010-11 with AICRPDA-ORP to meet the changing climate scenario of Agro climate zone in particular and the country in general to solve the location specific problems. Prolonged dry spells during early and mid-seasons, end season in dryland agriculture.

The achievements of interventions and lessons learnt are documented as "Success stories in National Initiative on Climate Resilient Agriculture (2011-2014)" at Girigetla micro watershed in Kurnool district. The book contains the on farm documentation with appropriate illustrations. The authors express this profound great role to Dr. A. Padma Raju, Hon'ble Vice Chancellor, Dr. K. Raja Reddy, Director of Research, Dr.Y.Padmalatha, Associate Director of Research for encouragement and administrative support to bring out this publication. Team is also great full to Dr.P.K.Misra, Former Project Coordinator AICRPDA-NICRA, Dr.Ch.Sreenivasa Rao, Director, CRIDA, Dr.G.Ravindra Chari, Project Coordinator AICRPDA-NICRA for their encouragement, valuable guidance and financial support through NICRA which helped this publication to see the light of the day.

We acknowledge the cooperation and support received directly or indirectly from the former Chief Scientists and Scientists of AICRPDA and ORP other supporting staff, Mr.V.Venkata Suresh, SRF NICRA for their help in the preparation of this publication.

Principal Investigator

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Introduction:

In India, three fourths of arable land (143mha) is under rainfed. The contribution of rainfed agriculture in India is about 45 per cent of the total food grain, 75 per cent of oil seed, 90 per cent of pulses and about 75 per cent of cotton.

India is located 80^{o} to 36^{o}N of the equator and between 68^{o} to 96^{o}E longitude. It is tropical country. The tropic of cancer which passes through the middle of the country divides it in to two distinct climates; in two tropical climate in the south where all the twelve months of the year have mean daily temperature exceeding 20^{o}C and in the north where sub-tropical climate prevails. India is a monsoonal country in the tropical and sub-tropical regions almost of 80 per cent total annual rainfall is received during the monsoon rainy season at Trivandrum in Kerala state the monsoon breaks around June first and at Andhra Pradesh June 5th .The normal date of onset are just averages, in actual terms they may be a weak or 10 days delay or earliness. These are just guide dates for agricultural operations or crop calendars. The actual dates vary from year to year.

The normal dates of with drawl of South West Monsoon is first fortnight of October. It also shows the average dates of with drawl of second monsoon called North East Monsoon. There normal date of on set is between November 1st to November 15th. The rainy season extended from 2 to 4 months across most of agricultural regions in the country.

Rainfall is the main source of surface water and it conservation is essential for successful crop production on dry lands. As water moves down the slope from ridge to the valley its management also. Should start at the ridge and extend to the valley. *Alfisols* are characterized by moderate

clay (10-20 per cent) and low organic matter content, poor nutrient status, low water retention capacity due to shallow depth, frequently have a compact subsoil are prone to erosion and crusting and produce large volumes of run off.

Both arable and non-arable areas are the apt be considered together as the management of water in one area will influence the other. Forest, pasture lands, crop lands and water waste lands should be treated as inter linked units of hydrological entity. Watershed approach in dryland development is essential to utilize natural resources effectively.

Cropping strategy based on rainfall analysis and moisture availability periods, in-situ moisture conservation technologies for optimum utilization of rainfall, mechanization and rainwater harvesting and use for crops at critical stress periods are the main themes to sustainable crop production in the rainfed areas.

The villages selected for the project work are Aminabad and Girigetla (ORP village) of Thuggali mandal in Kurnool district (77^0 32^1 E longitude and 15^0 18^1 N Latitude) of Andhra Pradesh. Total cropped area of the mandal is 59.8%, of which net sown area is57.1% and area sown more than once is only 2.7%, clearly indicating the importance of rainfed agriculture. The total cultivated area of both the selected cluster villages (Aminabad and Girigetla) is 1322 ha and waste land occupies 214.4 ha. The most predominant farming situations are rainfed red soils followed by rainfed black soils where groundnut/redgram/castor/rainfed tomato and bengalgram/sunflower/cotton/jowar respectively are cultivated. In both the villages put together, only 18 no. minor irrigation sources (wells and bore wells) are available, covering only 60.4 ha under irrigation.

The average rainfall (1985-2006) of the district is 670 mm, while it is 620 mm (1999-2006) in Tuggali mandal. Out of 22 years of available district rainfall data (1985-2006) 14 years received deficit rainfall of varying from -6.5 to -57.0%.Every alternate year received deficit rainfall in the district. Three consecutive deficit rainfall in the district was received during 1985-1987 and four consecutive deficit rainfall was received during 2001-2004 which clearly explains that agriculture is vulnerable to climate change. The selected mandal receives 69.4% of total rainfall during S-W monsoon period and 24.7% during N-E monsoon period and the remaining during hot weather period. The rainfall in the mandal varies from 329.4 mm to 878.4 mm, indicating high degree of variability. Thus frequent droughts, low and erratic rainfall, prolonged dryspells during the crop season always dictating the productivity from the rainfed crops.

Table .1 Analysis of pre seasonal rainfall in Girigetla Microwatershed, Thuggali (M), Kurnool Dt.

Normal rainfall	**618mm**				
Preseasonal Rainfall	**Year**	**Apr**	**May**	**Jun**	**Total**
	98-07	2.07	38.1	79.2	138.1
	02-11	31.6	42.6	89.5	163.8
	11-12	28.4	35.2	24.0	87.6
	12-13	66.0	20.0	62.0	148.0
	13-14	22.0	--	24.0	46.0
	14-15	26.0	30.0	125.0	181.0
Seasonal rainfall	**11-12**	**459 mm**			
	12-13	**358 mm**			
	13-14	**539mm**			
	14-15	**352 mm**			

Successful NICRA interventions during 2011-12

The rainfall received from April to June is more during 2002 to 2011 *i.e*., 163.8mm compared to the previous decade (1998-2007) *i.e.,* 138.1mm. Due to advancement of the rainfall pattern, farmers are advancing time of sowing of different crops *viz.,* pigeonpea, castor, cotton and tomato during May and June while groundnut can be sown in the month of July. Hence, pigeonpea sowing early in June first week and bajra during July as an intercrop in between pigeonpea rows was suggested.

A.Experienced weather conditions in 2011-12

During south west monsoon period, 279 mm rainfall was received in Girigetla micro watershed area,Thuggali mandal, Kurnool district against the normal rainfall of 149.6 mm. During this period district experienced 81 days dry spell.

- **Normal onset of monsoon :** 7-8th June
- **Onset of monsoon during 2011-12 :** 3^{2d} June
- **Annual mean rainfall (mm):** 618 mm
- **Annual mean rainfall (mm) during 2011-12:** 459 mm
- **Mean Crop seasonal rainfall (mm) during *kharif* and *rabi:*** 239.2 mm and 102.4 mm
- **Crop seasonal rainfall (mm) during 2011-12:** 279 mm

Table 1: Daily rainfall data from January 2011 to December 2011

S. No	Date	Rainfall Received (mm)	S.No	Date	Rainfall Received (mm)
1	23.04.11	17.6	12	22.07.11	11.2
2	29.04.11	10.8	13	24.07.11	9.2
3	26.05.11	26.0	14	26.07.11	39.2
4	28.05.11	7.2	15	27.07.11	7.3
5	31.05.11	2.0	16	30.07.11	4.4
6	02.06.11	6.2	17	31.07.11	27.0
7	03.06.11	4.4	18	16.08.11	11.3
8	13.06.11	3.4	19	21.08.11	12.3
9	28.06.11	10	20	22.08.11	31.0
10	01.07.11	2.4	21	16.09.11	2.3
11	04.07.11	1.4	22	30.09.11	11.3

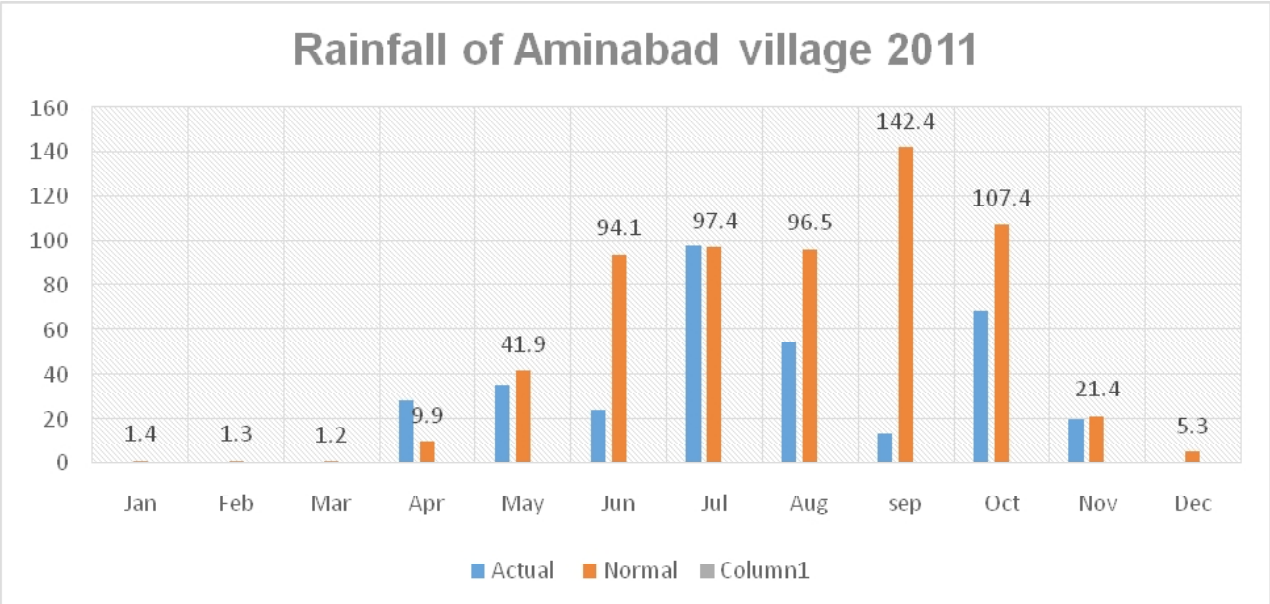


Table:2 Dry spells during crop growing season (2011-12)

S.o	Dry period	Duration (Days)	Stage of crop		
			Groundnut (23.07.2011 to 20.10.2011)	Castor (04.06.2011 to 25.10.2011)	Cotton (03.06.11 to 10.01.11)
1	13.06.11 to 28.06.11	15	----	Vegetative stage	Vegetative stage
2	22.08.11 to 16.09.11	24	Flowering to Pegging stage	Flowering stage to seed development stage	Flowering stage

The sowing of rainfed crops *Viz.,* cotton, castor, rainfed tomato, bajra and setaria was carried out with the receipt of rain on 04.06.2011. Groundnut sowing was taken up from 22.07.2011 to 27.07.2011 with the receipt of rain from 22.07.2011 to 27.07.2011.The castor crop sown during June entered reproductive stage, and pod development suffered due to moisture stress and leading to small seed. While groundnut sown in July crop had suffered with moisture stress from 22.08.11 to 16.09.11at the stage of flowering to pod formation stage.

B.Successful interventions during 2011-12

1.0 Season and year of intervention *Kharif,*2011-12

- **Name of the farmer:** Sri.Vadde Sanjanna
- **Details of the farmer:** Girigetla Village, Thuggali mandal, Kurnool District.
- **Details of the farm**:

Farmer has twelve acres of farming area in Girigetla village. The farmer followed groundnut and redgram intercropping system (15:1) in rainfed red soils and also castor and redgram inter cropping system (5:1).

He adopted improved redgram varieties (LRG-41 and PRG-158) and groundnut drought tolerant verities (K-6, Dharani and K-9). The farmer taken up rainfed tomato in red soils.

- **Real-time contingency plan (RTCP) implemented :**

Girigetla village, Thuggali mandal of Kurnool district rainfall received at normal onset of monsoon on 02.06.11.Castor sowing was carried out on 04.06.11 by the received rainfall on 02.06.11 and 03.06.11 and groundnut sowings were taken up on 23.07.11 due to receipt of rainfall of 11.2mm .Twenty four days of dry spell (22.08.11 to 16.09.11) at the stage of flowering to seed development stage was recorded. During this dryspell period the supplemental irrigation from nearest stream was given to castor and groundnut crops which improved yield attributes and yield of castor by 28 % and 46% in groundnut yield.

- **Impact of the intervention compared to traditional practice** :

Sl. No.	Para meter	Intervention (Supplemental irrigation)		Farmers' practice (No irrigation)	
		Castor	groundnut	Castor	groundnut
1	Yield (kg/ha)	410	683	341.5	467
2	Net returns (Rs/ha)	7570	13811	6305	7485
3	BC ratio	1.7	1.9	1.4	1.5
4	RWUE (kg/ha-mm)	1.4	2.5	1.2	1.7

Supplemental irrigation in Castor

Supplemental irrigation in Groundnut

- **Factors contributing to success:**
- Preparatory cultivation with 5-tyned duck foot cultivator improved the soil moisture.
- Practice of conservation furrows at dry spells leads to improve the soil moisture at critical stages of castor and groundnut crops
- Supplemental irrigation to castor and groundnut during dry spell is useful to enhance the crop yields.
- The up scaling of the above interventions to other farmers in the NICRA village and or other villages: Yes
- **Horizontal spread of RTCP** 3ha in 2 farmers.
- **How the upscaling happened (field visit, training, convergence with any state / central government programmes / schemes):**

Field visit was conducted at farmer field and created awareness on water management practices and pest management practices.

- **Any other information:**

Exposure visit was organized at Agricultural Research Station, Anantapuramu on water management, contingent crop planning and mechanization created awareness on different water saving methods of supplemental irrigation techniques.

Season and year of intervention *Kharif,*2011-12

- **Name of the farmer:** P.Govindu
- **Details of the farmer:** Aminabad village, Thuggali mandal, Kurnool district

- **Details of the farm**:

The farmer is having 10 acres of arable land in Aminabad village in which, most of the cultivable area is rainfed red soil. The farmer follow groundnutand redgram intercropping system (15:1) and also castor and redgram cropping system (5:1). He adopted improved varieties in redgram (LRG-41 and PRG-158) and drought tolerant varieties in groundnut (K-6, Dharani and K-9).

- **Real-time contingency plan (RTCP) implemented :**

Farmer takenup sowing of pearl millet and redgram cropping system which was cost effective compared to groundnut + redgram intercropping system and castor + redgram cropping system. Farmer wastaken up sowing on 04.06.11 with the receipt of rainfall on 02.06.11 and 03.06.11. Twenty five days prolonged dry spell prevailed from 22.08.11 to 16.9.11in that dry spell groundnut at pod initiation stage and castor was at seed setting stage. Pearl millet escaped from dry spell because of short crop duration.

Impact of the intervention compared to traditional practice :

Sl. No.	Parameter	RTCP Intervention	Traditional practice
1	Yield kg per ha	625	590
2	Net returns per ha	2250	1925
3	B:C ratio	1.6	1.1
4	RWUE (kg/ha-mm)	3.1	1.9

Factors contributing to success:

- Farmer has good knowledge to adopt technology.
- Farmer under gone for sowing with improved hybrid bajra *i.e.,* ABH-1
- Pearl millet can withstand to moisture stress condition.
- Cost of cultivation is less compared to groundnut+ redgram system.
- Farmer followed soil moisture conservation measures by sowing across the slope and frequently conservation furrows were made for every twelve rows in pearlmillet.

The up scaling of the above interventions to other farmers in the NICRA village and or other villages: Yes

- **Horizontal spread of RTCP** 20 ha in 15 farmers.

How the upscaling happened (field visit, training, convergence with any state / central government programmes / schemes):

Field day was conducted in pearl millet and redgram cropping system and explained the technology to farmers.

Any other information;only farmers who selected short duration bajra those harvested crops.

Successful NICRA interventions during 2012-13

A.Experienced weather conditions in 2012-13

In the year 2012, Kurnool district received 4.5 mm rainfall during cold weather period against normal rainfall of 4.6 mm and this is 2.2% less than normal. During hot weather period, 61.4 mm rainfall is received in 8 rainy days against the normal rainfall of 61.2 mm, which is 0.3 % excess than normal. During the south west monsoon period, 424.4 mm of rainfall is received in 41 rainy days against the normal rainfall of 455.1 mm and this is 6.7 % less than the normal. During this period, 12 mandals received excess, 18 mandals received normal and 24 mandals received deficit rainfall.Kurnool district as a whole experienced two dry spells of 17 days each in June and September months. But at mandal level, 49 mandals out of 54 experienced 2 to 4 dry spells (14 to 46 days) for 41 to 90 days during south west monsoon period.

During north east monsoon period, Kurnool district received 106.6 mm rainfall in 9 rainy days, against the normal rainfall of 149.6 mm. During this period district experienced 81 days dry spell. All the three months experienced dry spell of 23 to 31 days duration. Rainfall received during the first week of November due to NILAM cyclone, which was beneficial for *rabi* crops. The total annual rainfall in Kurnool district is 596.8 mm in 58 rainy days against the normal rainfall of 670.3 mm, which is 11% less than the normal. Based on deficiency in rainfall, reduction in the cropped areas of 50% and above under all principal crops**,** normal reduction in crop yields of 50% and above when compared to the average yields of previous five years, dryspells and its impact on crop damages, Normalized Difference Vegetation Index (NDVI) and Moisture Adequacy Index (MAI), **Government of Andhra Pradesh declared drought in 36 mandals of Kurnool district** during South West Monsoon 2012. Thuggali mandal is one of the drought declared mandals.

The south west monsoon was set in first week of June in Rayalaseema region. It was withdrawn on 7th October as normal withdrawl.

The onset of north east monsoon was delayed and received rain during 2 to 4th November 2012.

Table.3 Onset and withdrawl of monsoon in Andhra Pradesh

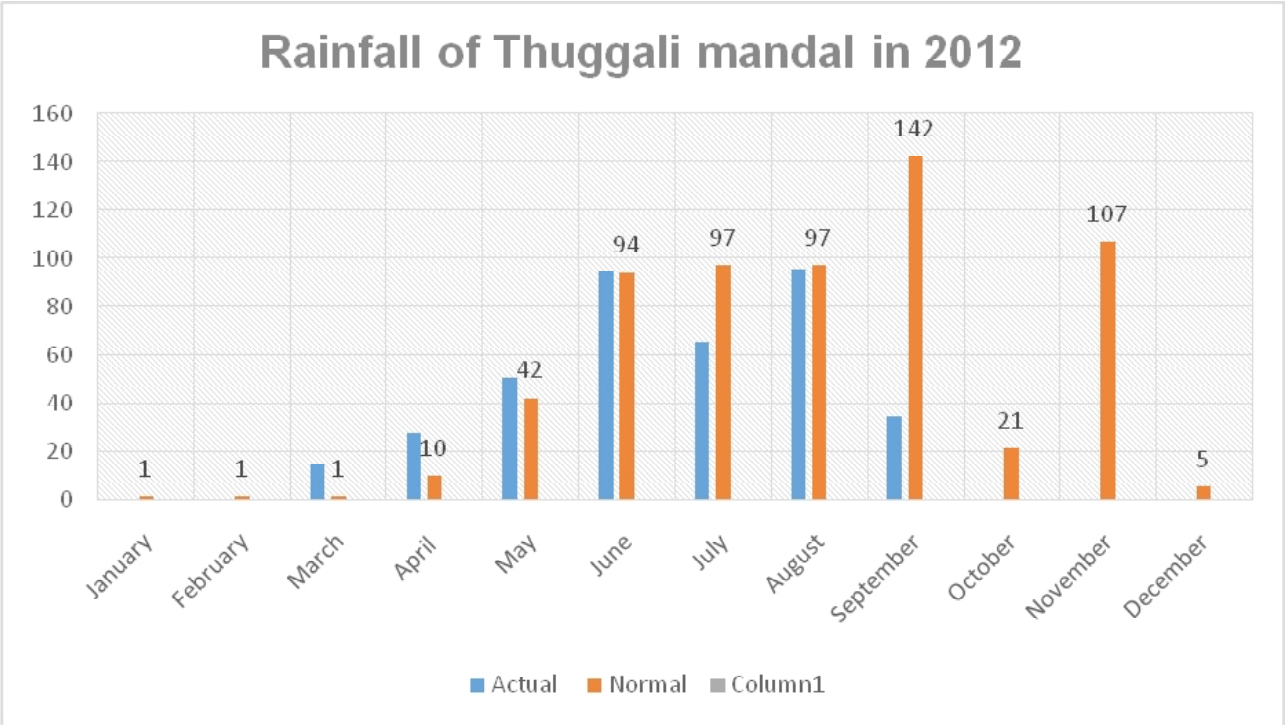
Monsoon	Normal	Actual in 2012
Onset of S-W Monsoon	7-8th June	2nd June
Withdrawl of S-W Monsoon	1st fort night of October	7th October
Onset of N-E Monsoon	1st fort night of October	2nd November

Analysis of Rainfall during 2012-13 in Thuggali Mandal, Kurnool Dt:-

The rainfall received during south west monsoon period is 288.8mm against the normal of 537.8mm.No rainfall event noticed during north east monsoon period against normal of 26.7mm. The total rainfall was less during all seasons in the year 2012. The actual annual rainfall in 2012 (Jan to Dec) recorded as 380.8 mm against 620.2 mm with deviation of 65.2% deficit.

Table4.Annual Rainfall data of Thuggali mandal, Kurnool dt.

Month	Actual (mm)	Normal (mm)
January	0.0	1.0
February	0.0	1.0
March	14.2	1.0
April	27.6	10.0
May	50.2	42.0
June	94.2	94.0
July	65.2	97.0
August	95.4	97.0
September	34.0	142.0
October	0.0	21.0
November	0.0	107.0
December	0.0	5.0
Total during crop period (Jun to Oct)	**288.8**	**451.0**
Total Annual Rain fall	**380.8**	**618.0**



Preseasonal rainfall data in Thuggali mandal revealed that April 2nd fort night 27.6 mm (78% higher) rainfall received as against normal 9.9 mm. During May, actual received rainfall is 19.8% higher than normal rainfall. Rainfall was normal during June.

Analysis of Rainfall during 2012-13 in Girigetla Watershed area, Thuggali Mandal, Kurnool Dt:-

The total annual rainfall in 2012 (Jan to Dec) is recorded as 526 mm against 618 mm with deviation of 14.8% deficit only. During crop growth period, the rainfall received was 391 mm in 12 rainy days.

Table-5.Annual Rainfall data of Girigetla micro Watershed, Thuggali mandal, Kurnool dt.

S.No	Dry period	Duration (Days)	Stage of crop		
			Groundnut (20.06.12 to 22.07.12)	Castor (08.07.12 to 20.07.12)	Bengalgram (27.09.12 to 10.10.12)
1	10.05.12 to 13.6.12	34	Vegetative stage	Vegetative stage	--
2	21.06.12 to 07.07.12	17	Vegetative stage	Vegetative stage	--
3	09.07.12 to 19.07.12	11	Pegging stage	Flowering stage	--
4	04.08.12 to 17.08.12	11	Pegging stage	Flowering stage to seed development stage	---
5	24.08.12 to 02.09.12	10	Pod development stage	Seed development stage	--
6	04.09.12 to 27.09.12	24	Pod development stage	Seed development stage	--
7	28.09.12 to 06.10.12	9	Maturity stage	First picking stage	Vegetative stage
8	08.10.12 to 01.11.12	25	Maturity stage	First picking/harvested castor and gone for	Vegetative stage
9	05.11.12 to31.01.13	56	Pigeonpea is intercrop is at flowering stage to pod formation stage	Vegetative stage of jowar	Flowering stage

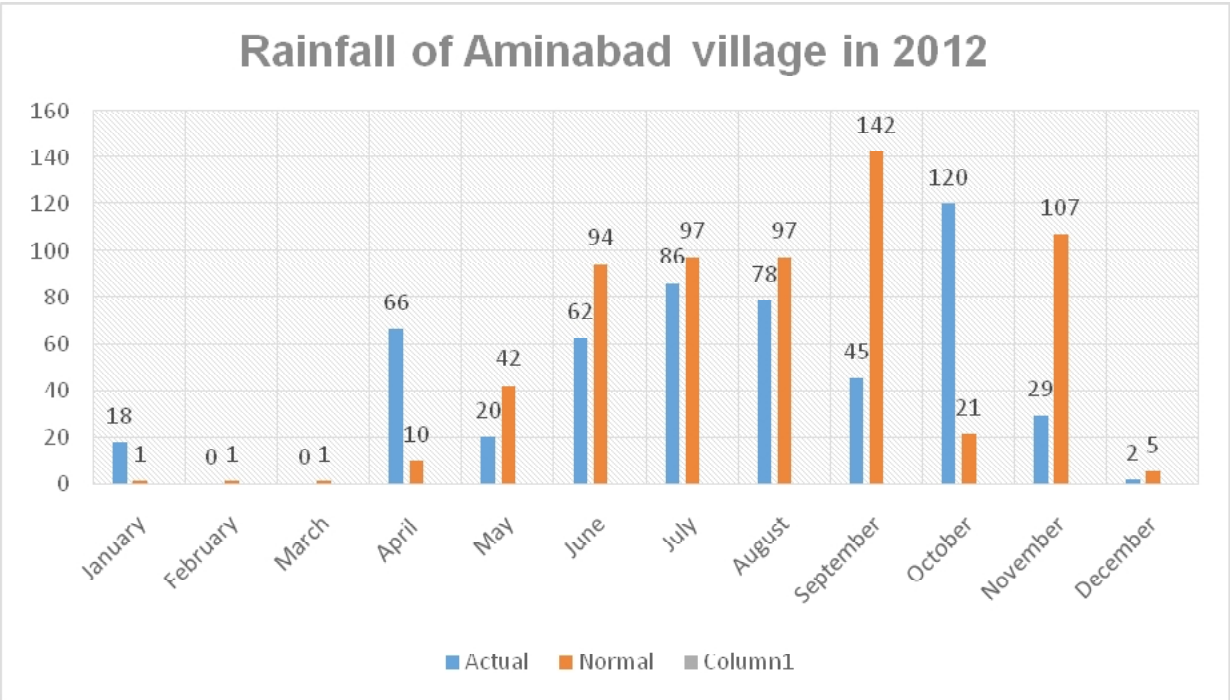


Table.5. Rainfall (mm) and rainy days in preseason and during crop growth period

Particulars	April	May	June	Crop Period	Total rainfall
Girigetla micro watershed area	66	20	62	391	526
Rainy days	2	1	2	12	18

Table.6. Dry spells during 2012-13

S.No	Dry period	Duration (Days)	Stage of crop		
			Groundnut (20.06.12 to 22.07.12)	Castor (08.07.12 to 20.07.12)	Bengalgram (27.09.12 to 10.10.12)
1	10.05.12 to 13.6.12	34	Vegetative stage	Vegetative stage	--
2	21.06.12 to 07.07.12	17	Vegetative stage	Vegetative stage	--
3	09.07.12 to 19.07.12	11	Pegging stage	Flowering stage	--
4	04.08.12 to 17.08.12	11	Pegging stage	Flowering stage to seed development stage	---
5	24.08.12 to 02.09.12	10	Pod development stage	Seed development stage	--
6	04.09.12 to 27.09.12	24	Pod development stage	Seed development stage	--
7	28.09.12 to 06.10.12	9	Maturity stage	First picking stage	Vegetative stage
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9	05.11.12 to31.01.13	56	Pigeonpea is intercrop is at flowering stage to pod formation stage	Vegetative stage of jowar	Flowering stage

Groundnut and castor crops were sown during June, but pod development stage suffered due to lack of moisture in soil during September leading to small seed. While groundnut sown in July crop had luxurious vegetative stage from July-August (Table.3). But dry spells prevailed from 04.09.12 to 17.09.12 resulted in low moisture in soil in pod development stage influenced drastic reduction in crop yield in Thuggali mandal. Castor crop suffered from moisture stress resulted in poor seed formation and registered low yield from castor in Girigetla micro watershed area. With the incidence of rainfall on 07.10.12 farmers are able to plough back castor crop and sowing of Jowar was taken up. Some farmers harvested groundnut crop and sowing of Jowar as second crop was taken up so that they could get fodder at least. Fortunately farmers harvested grain and fodder from jowar crop on receipt of rains in November.

B. Successful interventions during 2012-13

- **Name of the farmer:** Sri.T.Rangaswamy
- **Details of the farmer:** Aminabad,Thuggali mandal, Kurnool district
- **Details of the farm**:

6 acres farming area in Aminabad of the farmer is rainfed red soil. The farmer followed groundnut and redgram intercropping system (15:1) He has taken up sowing of castor on 20.6.12 with the receipt of 49 mm of rain in the month of June.The performance of castor is not satisfactory.Hence he is advised to go for crop like sorghum.

- **Real-time contingency plan (RTCP) implemented and on what situation:**

With the receipt of 120mm of rainfall on 7-10-12 he could sow sorghum(NTJ-4).The farmer got first picking yield of castor .(390 kg/ha)

- **Impact of the intervention compared to traditional practice:**

Groundnut wet pod thresher is useful to harvest the fresh pods.

Sl. No.	Para meter	castor	sorghum
1	Yield per ha	390 kg/ha	756 kg/ha
2	Net returns per ha	2480 Rs./ha	5876 Rs./ha
3	B:C ratio	1.4	1.5
4	RWUE (kg/ha-mm)	1.0	5.07

Factors contributing to success:

Timely decision helped the farmer to go for double cropping when the first crop castor suffered and yield was poor due to moisture stress conditions prevailed during *kharif* season, 2012.

The up scaling of the above interventions to other farmers in the NICRA village and or other villages: Yes

Horizontal spread of RTCP

How the upscaling happened (field visit, training, convergence with any state / central government programmes / schemes): Frequent interaction meetings were conducted to cope up with the drought situations in dryland agriculture.

Field day conducted in castor followed by sorghum cropping system and explained the technology to farmers.

Any other information: Training programmes were conducted regarding improved dryland technologies practiced to cope up the drought situations to reap higher yields of crops.

Successful NICRA interventions during 2013-14

A.Weather conditions in the year 2013 in Girigetla micro watershed area, Thuggali mandal, Kurnool Dt.

Analysis of Rainfall during 2013 in Girigetla Watershed area, Thuggali Mandal, Kurnool Dt:-

The total annual rainfall in 2013 (Jan to Dec) is recorded as 596 mm against 618 mm with deviation of 3.5% deficit only. During crop growth period the rainfall received was 539 mm in 21 rainy days.

Table-6.Annual Rainfall data of Girigetla micro Watershed, Thuggali mandal, Kurnool dt.

Month	Actual (mm)	Normal (mm)
January	0	1.0
February	35	1.0
March	0	1.0
April	22	10.0
May	0	42.0
June	23	94.0
July	69	97.0
August	22	97.0
September	368	142.0
October	57	21.0
November	0	107.0
December	0	5.0
Total during crop period (Jun to Oct)	**539**	**451.0**
Total Annual Rain fall	**596**	**618.0**

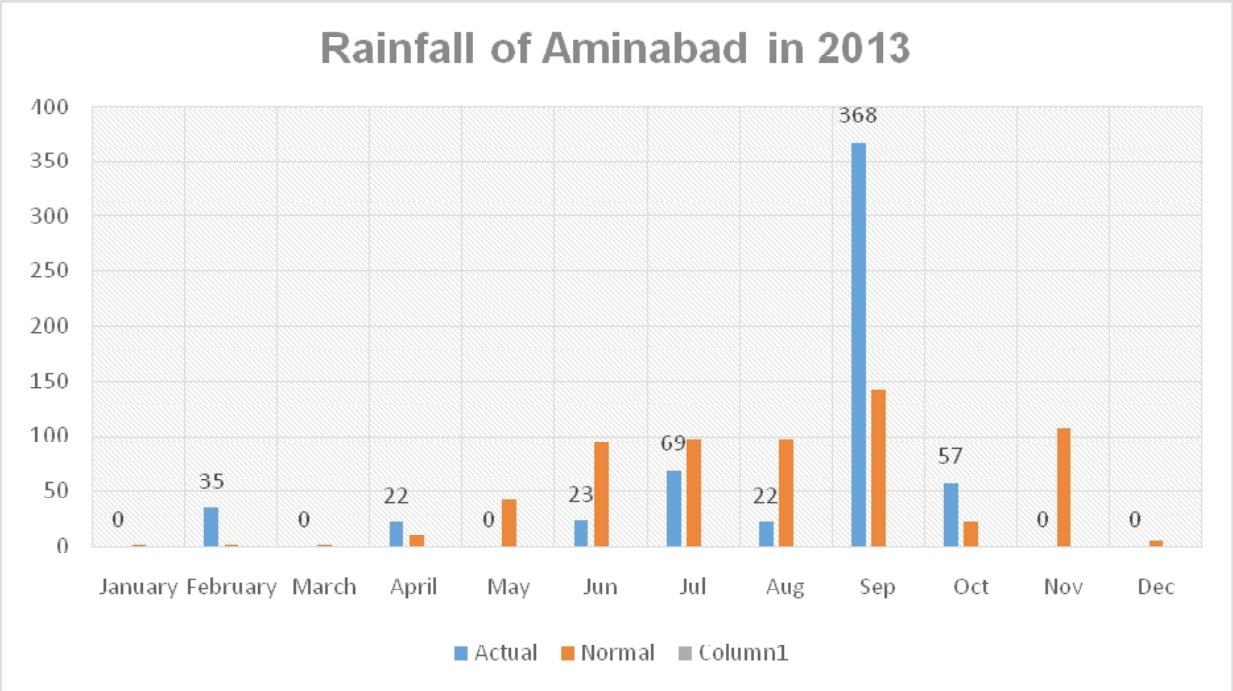


Table.7 Rainfall (mm) and rainy days in preseason and during crop growth period

Particulars	April	May	June	Crop Period	Total rainfall
Girigetla micro watershed area	22	--	22	539	596
Rainy days	1	--	1	21	23

Table.8. Dry spells during 2013

S.N	Dry period	Duration (Days)	Stage of crop		
			Groundnut (15.07.13 to 17.10.13)	Castor (23.06.13 to 20.10.13)	Bengalgram (05.09.13 to 10.12.13)
1	02.06.13 to 09.07.13	15	---	Vegetative stage	--
2	19.07.13 to 13.08.13	26	Vegetative stage	Flowering stage	--
3	20.09.13 to 13.10.13	23	Pod development stage	Flowering stage to seed development stage	Vegetative stage
4	13.10.13 to 31.12.13	59	Maturity stage	seed development stage	Flowering stage

Groundnut and castor crops were sown during June, but pod development stage suffered due to lack of moisture in soil during September leading to small seed. While groundnut sown in July crop had luxurious vegetative stage from July-August . But dry spells prevailed from 20.09.2013to 13.10.2013 resulted in low moisture in soil in pod development stage influenced drastical reduction in crop yield in Thuggali mandal. Castor crop suffered from moisture stress resulted in poor seed formation and registered low yield from castor in Girigetla micro watershed area. With the incidence of rainfall on 02.09.2013 farmers are able to plough back castor crop and sowing of Jowar was taken up. Some farmers harvested groundnut crop and sowing of Jowar as second crop was taken up so that they could get fodder at least.

B.Successful interventions during 2013-14

Tomato is remunerative under rain fed conditions in red soils at Girigetla micro watershed area-a success story

Sri. Diwakar Chowdaryin Aminabad village and Sri Vadde Ganganna in Girigetla village, Girigetla post, Thuggalimandal, Kurnool District transplanted tomato on different dates as per the advice ofscientists of ORP team.

The farmers repeatedly cultivated across the slope two times and made ridges and furrows. The land has undulating topography and hence advised them to go for transplanting first on upper point and then middle followed by bottom land based on moisture storage capacity of land. On receipt of rainfall they brought tomato seedlings of 3-4 weeks from private nursery and transplanted 1.0 acre at each time. First transplanting was done during last week of June, second was on 16thJuly followed by third transplantation on 7th August. The fruits were harvested after 45 days to

60 days after each transplantation. The ORP team advised them to go for micro nutrient spray in rainfed tomato. The spraying of ZnSo4 2% and Boron 2% twice viz., before flowering and during fruit setting stages in tomato was advised.

Both the farmers adopted the technology and the fruits were harvested after 45 days to 60 days after each transplantation. They recorded 11% higher yields in rainfed tomato with micronutrient spray compared to no spray. The fruit quality and size was higher with spraying of micro nutrients viz., zinc and boron.

Table 9.Yield and economics of rainfed tomato during 13-14 (Mean of two locations)

S.No	DOS of nursery	DOT	DOH	Tomato Yield (Kg/ha)	Rate (RS/Kg)	Gross Returns (Rs/ha)	Net Returns (Rs/ha)	BCR
1	25.05.13	24.06.13	22.08.13 to30.10.13	14500	7.50	108750	45125	0.71
2	17.06.13	16.07.13	10.09.13 to 31.11.13	19050	12.00	228600	164975	2.60
3	18.07.13	07.08.13	15.10.13 to 31.11.13	19100	16.00	305600	241975	3.80
				17550	**11.8**	**214316**	**150692**	**2.3**

- Rainfall (23mm) received in 23.06.2013 and transplanted on24.06.2013. Rain fed tomato experienced 15 days dry period. The crop recovered with the rainfall received during July (69 mm in 5 rainy days). The harvesting started during last week of August with the wet spells of 160mm on 02.09.2013 the flower and fruit drop was observed.

Table10.Annual Rainfall data of Girigetla micro Watershed, Thuggali mandal, during 2013-14

Month	Actual (mm)	Normal (mm)
January	0	1.0
February	35	1.0
March	0	1.0
April	22	10.0
May	0	42.0
June	23	94.0
July	69	97.0
August	22	97.0
September	368	142.0
October	57	21.0
November	0	107.0
December	0	5.0
Total during crop period (Jun to Oct)	**539**	**451.0**
Total Annual Rain fall	**596**	**618.0**

- Rainfall (17mm) received from 10.07.2013(5mm) to 11.07.2013 (12mm), hence tomato crop was transplanted on 12.07.2013.The crop established with the rainfall received on 15.07.2013 to 18.07.2013 (52mm). The crop experienced dry spells from 19.07.2013 to 13.08.2013 (26 days) but the soil moisture was sufficient for the growth of rainfed tomato with the wet spell of 160mm on 02.09.2013 when the crop was at flower to small fruit formation stage. Though flower and small fruit drop was observed, the plant recovered with successive rains in the same month.

- Rainfall (17mm) received from 10.07.2013(5mm) to 11.07.2013 (12mm) and transplanted on 12.07.2013.The crop established with the rainfall received on 15.07.2013 to 18.07.2013 (52mm). The crop

experienced servere moisture stress from 19.07.2013 to 13.08.2013 (26 days) but the soil moisture was sufficient for the growth of rainfed tomato with the wet spell of 160mm on 02.09.2013 when the crop was at flower to small fruit formation stage. Though flower and small fruit drop was observed, the plant recovered with successive rains in the same month.

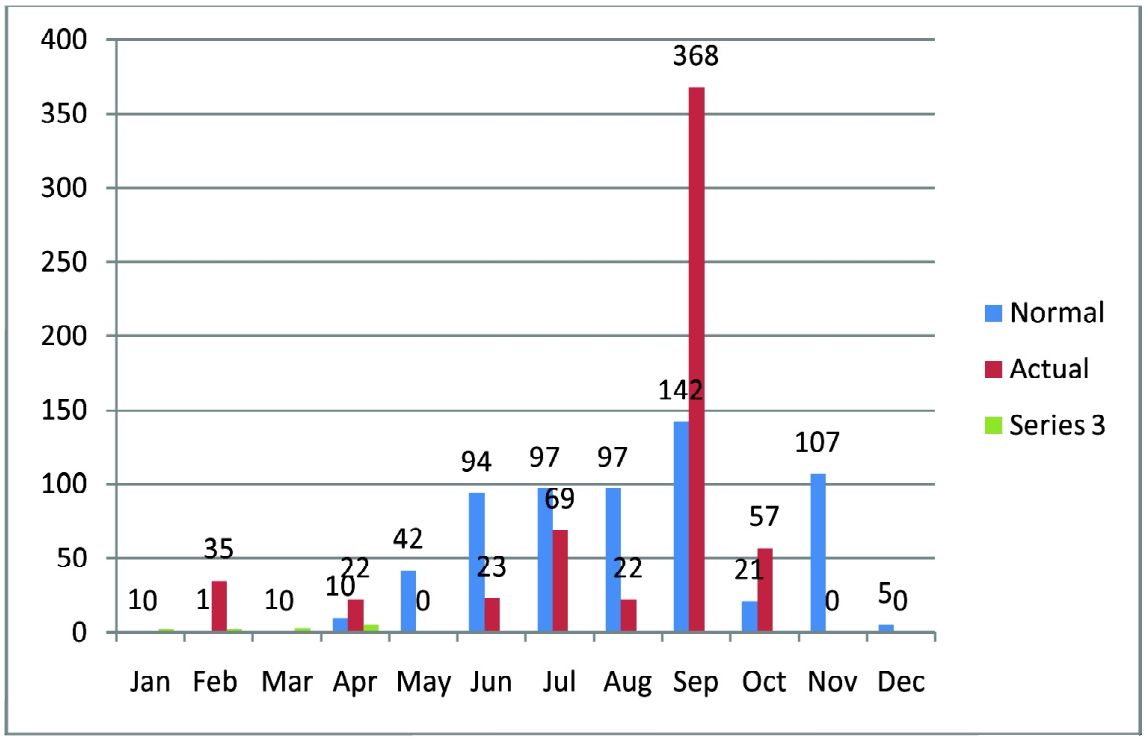
- Rainfall received from 14 to 17 August .2013 (22mm) transplanted on 17-08-13. The tomato seedlings were established with rainfall received successively during August and September. The flower and fruit formation was good and with September rain on 02.09.2013, higher yield was recorded with this date of transplanting.

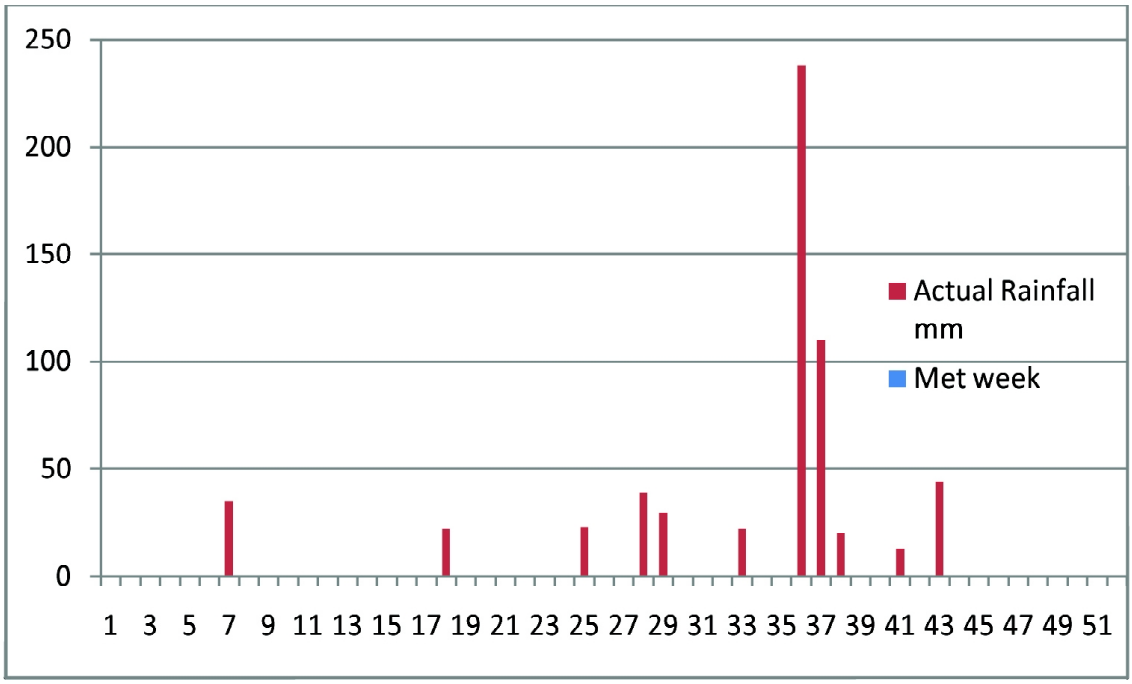
The farmers harvested the produce and graded the produce as big, medium and small size tomato and sold. The big size and medium size tomato fetched more price than small sized tomato. In a basket he placed medium small tomato in lower side and big size tomatos on the upper side so that they could get more price per basket. The market intelligence fetched them more price for their produce.

The market rate during August was Rs. 7.50 per kg as there was good tomato yield harvest from rainfed areas, while it was Rs. 12/- during September-October. While the late transplanted tomato came to harvesting in the month of October to November and fetched high rate of Rs 16/Kg where tomato transplanted during July was dried due to prolonged dry spells and heavy fruit fall. Hence farmers got more income from staggered transplanting of tomato during 2013-14 with vagaries of monsoon and market risk of higher or lower rates of tomato prevailed during the monsoon.

Dr.Ch.Srinivasa Rao, Project Coordinator visited staggered planting in tomato field at Girigetla Micro Watershed

Rainfall in Girigetlamicrowatershed area during 2013-14





- **Name of the farmer:** Sri.V.Ganganna
- **Details of the farmer:** Girigetla village, Thuggali mandal, Kurnool district
- **Details of the farm**:

6 acres farming area in Girigetla village most of the farming area of the farmer is rainfed red soil. The farmer followed groundnut and redgram intercropping system (15:1) in rainfed red soils. He adopted improved redgram varieties (LRG-41 and PRG-158) and groundnut drought tolerant verities (K-6, Dharani and K-9). The farmer was small farmer, he leased in 5 acres of land. He has taken up sowing of groundnut (K-6) with tractor drawn ananta automatic planter.

- **Real-time contingency plan (RTCP) implemented and on what situation:**

With the receipt of 12mm rainfall of 11.07.13 he could sow groundnut with tractor drawn ananta automatic seed Planter not only saved time but

also 15 kg of seed. Uniform plant population in a row resulted in higher yields due to low competition among the plants.

- **Impact of the intervention compared to traditional practice**

Sl. No.	Para meter	RTCP Intervention	Traditional practice
1	Yield per ha	532kg/ha	404 kg/ha
2	Net returns per ha	6405 Rs./ha	1285 Rs./ha
3	B:C ratio	1.4	1.1
4	RWUE (kg/ha-mm)	0.9	0.9

Factors contributing to success:

Groundnut sowing with tractor drawn Ananta seed planter in suitable soil moisture improved germination there by optimum plant stand resulted to reap higher yield. Sowing with tractor drawn Ananta seed planter could sow larger area with in short time.

The up scaling of the above interventions to other farmers in the NICRA village and or other villages: Yes

Horizontal spread of RTCP:20 ha for 20 farmers

How the upscaling happened (field visit, training, convergence with any state / central government programmes / schemes: Farmers visited the field sown with tractor drawn seed planter and witnessed the advantage of sowing with tractor drawn implements.

Any other information: Training programmes were conducted regarding improved dryland technologies practiced to cope up the drought situations to reap higher yields of crops.

Tractor Drawn Anantha Groundnut Planter

Traditional method of sowing

- **Name of the farmer:** Sri.K.Basavaraj
- **Details of the farmer:** Girigetla village, Thuggali mandal, Kurnool district
- **Details of the farm**:

5acres farming area in Girigetla village most of the farming area of the farmer is rainfed red soil. The farmer followed groundnut and redgram intercropping system (15:1) He has taken up sowing of groundnut K-6 in the month of June.

- **Real-time contingency plan (RTCP) implemented and on what situation:**

With the receipt of 40mm of rainfall on 20.7.12 the farmer sown groundnut crop. The crop was at its maturity and received 20,7,2 mm of rainfall from 2-11-12 to4-11-12.At this situation he advised to go for wet pod thresher. This saved the groundnut pods from germination and discolouration .Otherwise the entire produce might have germinated and discouration might have affected the quality and cost of the produce.

- **Impact of the intervention compared to traditional practice:**

Groundnut wet pod thresher is usefulto harvest the fresh pods .

Sl. No.	Para meter	Wet pod thresher
1	Yield per ha	418 kg/ha
2	Net returns per ha	6025 Rs./ha
3	B:C ratio	1.4
4	RWUE (kg/ha-mm)	1.0

Factors contributing to success: Groundnut harvesting manually and threshing immediately with tractor operated wet pod thresher is useful for groundnut during continuous rains at the time of harvest.

- **The up scaling of the above interventions to other farmers in the NICRA village and or other villages: Yes**
- **Horizontal spread of RTCP:** 19 no.farmers in 20 ha

Groundnut wet pod thresher

- **How the up scaling happened (field visit, training, convergence with any state / central government programmes / schemes):**Farmers visited the field harvested manually and threshing with tractor operated wet pod thresher .The farmers from other village also used wet pod thresher during this season.
- **Any other information:**very useful machinery to be placed at mandal headquarters whenever required the farmers in situation of continuous rains occurs they can utilize the services and protect the crop without damage.

Successful NICRA interventions during 2014-15

A.Weather experienced during 2014-15 in Aminabad village

Normal onset of monsoon : 7-8th June

Onset of monsoon during 2014-15 : 3rd June

Annual mean rainfall (mm) : 618 mm

Annual mean rainfall (mm) during 2014-15 : 408 mm

Mean Crop seasonal rainfall (mm) during *kharif* and *rabi:*

289mm and 63mm

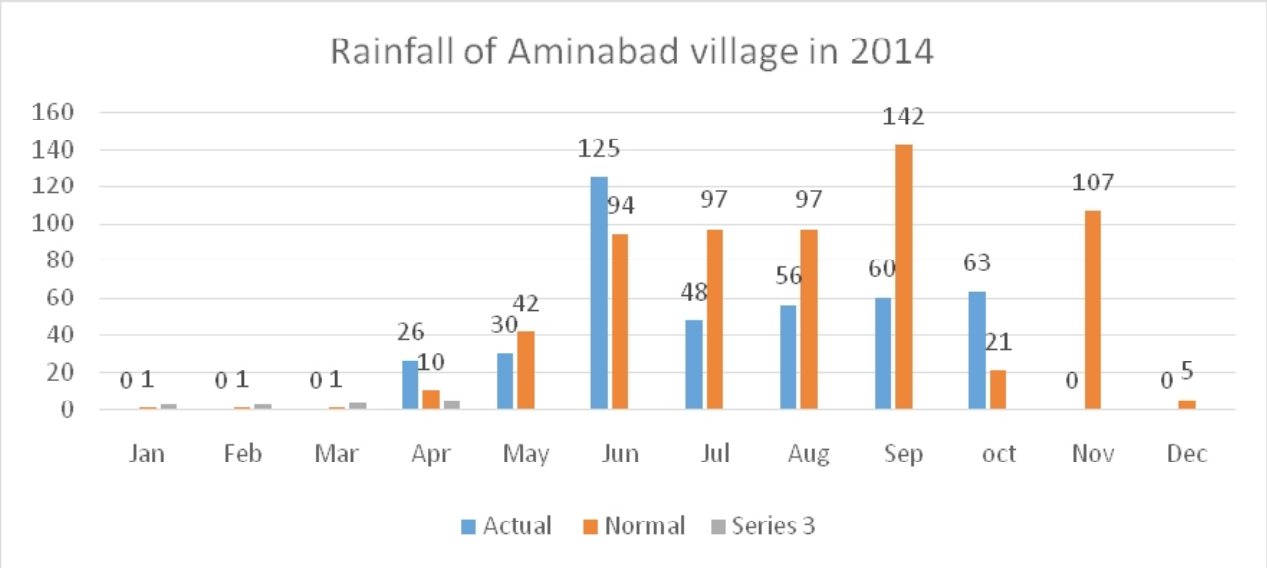
Crop seasonal rainfall (mm) during 2014-15 : 352 mm

Table: 11 Dry spells during crop growing season (2014-15)

S.No	Dry period	Duration (Days)	Stage of crop		
			Groundnut (02.07.2014 to 15.10.2014)	Castor (03.06.2014 to 20.10.2014)	Cotton (03.06.14 to till date)
1	10.06.14 to 02.07.14	22	----	Vegetative stage	Vegetative stage
2	10.07.14 to 19.08.14	40	Vegetative stage	Flowering stage	Vegetative stage
3	27.08.14 to 15.09.14	18	Flowering to Pegging stage	Flowering stage to seed development stage	Flowering stage
4	17.09.14 to 06.10.14	18	Pod development stage	Seed development stage	Flowering to boll developing stage

Table 12.Daily rainfall data from January 2014 to March 2015 (on-farm)

S.No	Date	Rainfall Received (mm)	S.No	Date	Rainfall Received (mm)
1	02.04.14	17	13	20.08.14	20
2	09.04.14	09	14	21.08.14	16
3	09.05.14	10	15	24.08.14	05
4	21.05.14	20	16	26.08.14	05
5	03.06.14	100	17	27.08.14	05
6	10.06.14	25	18	15.09.14	20
7	02.07.14	16	19	16.09.14	05
8	07.07.14	10	20	17.09.14	35
9	08.07.14	05	21	16.10.14	10
10	10.07.14	15	22	20.10.14	05
11	30.07.14	02	23	25.10.14	40
12	19.08.14	05	24	26.10.14	08



- The sowing of rainfed crops Viz., cotton, castor, rainfed tomato, bajra and sateria was carried out with the receipt of rain on 03.06.2014 .Groundnut sowing was taken up from 10.07.2014 to 15.07.2014 with the receipt of rain from 02.07.2014 to 10.07.2014.

- The crops viz., bajra, sateria received 289 mm during crop period and harvested during second fortnight of September.

- The castor crop sown during June entered reproductive stage, and pod development suffered due to moisture stress and leading to small seed.

- While groundnut sown in July crop had suffered with moisture stress from July - August and dry spells prevailed from 11.07.2014 to 18.08.2014 and 28.08.2014 to 14.09.2014 resulted in low moisture in soil at flowering to pegging stage affected pod formation. Dry spell from 18.09.2014 to 06.10.2014 affected crop growth during pod development stage.

B.Successful interventions during 2014-15

Year of intervention : 2014-15

Name of the farmer : Sri.Kunduri Venkatesh

Details of the farmer : S/O K.Rangaiah, Aminabad Village, Thuggali mandal, Kurnool District.

Details of the farm:

15 acres farming area in Aminabad village most of the farming area of the farmer is rainfed red soils followed by black soils. The farmer followed groundnut and redgram intercropping system (15:1) in rainfed red soils and also castor and redgram cropping system (5:1). He adopted improved redgram varieties (LRG-41 and PRG-158) and groundnut drought tolerant verities (K-6, Dharani and K-9). In case of black soils in

rainfed condition he cultivated cotton in 5 acres with the receipt of rain of 100mm on 09.05.14 and 20mm on 21.05.14 preparatory cultivation was done with tractor drawn duck foot 5 row cultivator criss cross in the field followed by spring tyned tiller cultivation and blade harrowing.

Real-time contingency plan (RTCP) implemented : Aminabad village, Thuggali mandal Kurnool district rainfall received with at normal onset of monsoon on 03.06.14. The farmer taken up preparatory cultivation with duck foot 5 row cultivator it improved moisture levels at dry spells in different stages of crop. He went for sowing of cotton on 13.06.14 in rainfed black soils. Cotton crop was under gone 38 days long dryspell (11.07.14 to 18.08.14) at vegetative stage at that stage he went for conservation furrows after receiving of rainfall of 20mm on 20.08.14 and 16mm on 21.08.14 which improved the moisture level and the crop was able to tackle moisture stress. Continues drizzling helped the crop to enter into reproductive stage which experienced 18 days of dryspell from 28.08.14 to 14.09.14. Twenty eight days of dry spell from18.09.14 to 15.10.14 was prevailed during boll formation stage. Micronutrient spraying (19:19:19 1%, Zn SO4 2%, Mg So4 1% and Boron 0.15 %) at flowering and 20 Days after flowering stage reduced the reddening of cotton improved the yield attributes and yield of cotton.

Impact of the intervention compared to traditional practice :

Sl. No.	Para meter	RTCP Intervention	Traditional practice
I.	Yield per ha	875	800
II.	Net returns per ha	25,438	22,400
III.	B:C ratio	3.5	3.2
IV.	RWUE (kg/ha-mm)	2.4	2.2


Impact of moisture conservation and micro nutrient sprays in rainfed *Bt.* Cotton

Factors contributing to success:

- Preparatory cultivation with 5-tyned duck foot cultivator improved the soil moisture.
- Practice of conservation furrows at dry spells lead to improve the soil moisture at critical stages of crop.
- Micronutrient spraying (19:19:19 1%, Zn SO4 2%, Mg So4 1% and Boron 0.15 %) at flowering and 20 Days after flowering stage reduced the reddening of cotton improved the yield attributes and yield of cotton.
- Farmer has good knowledge in crop management in different aspects like pest management, water management and marketing management.
- Farmer has enthusiasm adopting nature to learn new crop management techniques and advising the other farmers to follow.

The up scaling of the above interventions to other farmers in the NICRA village and or other villages: Yes

.**Horizontal spread of RTCP** 20 ha in 20 farmers.

How the up scaling happened (field visit, training, convergence with any state / central government programmes / schemes):

Field visit was conducted at farmer field and created awareness on rain water management practices, pest and micro nutrient management and conducted training programme on pest management practices in cotton against the sucking pest.

Any other information:

Organized exposure visit to AICRPDA centre GKVK Bangalore on 21.11.14 creating awareness on rain water management through conservation furrows, farm pond technology and dry sowing technology.

Details of Village Climate Risk Management Committee (VCRMC)

The committee is formed with the following farmers from Aminabad and Girigetla villages of Thuggali mandal, Kurnool district on 07.02.2012

S.No	Name of the farmer	Village
1	Sri.B.DiwakarChowdary	**Aminabad**
2	Sri.Y.Ekambaram - **Treasurer**	Girigetla
3	Sri.V.Venkata Reddy	**Aminabad**
4	Sri.P.Narayana Swamy	,,
5	Sri.Kunduri Ramesh S/O Rangaiah	,,
6	Sri.J.Umapati	,,
7	Sri.JaragalaSaratBabu S/O Vivekananda Chowdary	,,
8	Sri.G.Siddaiah S/O Anjanaiah	,,
9	Sri.B.Omkarappa S/O Bajarappa	,,
10	Sri.M.Venkateswarlu	,,
11	Sri.T.Gopal S/O Timmappa	,,
12	Sri.GoseBalaram S/O Parasuramudu	**Girigetla**
13	Sri.Karanji Chandrasekhar S/O Veerabhadrappa	,,
14	Sri.BalachandraKaladar Reddy S/O Seetarami Reddy	,,
15	Sri.AravaBasappa S/O ChinnaBasappa	,,
16	Sri.SolaRangaswamy	,,
17	Sri.M.Gangadaraiah	,,
18	Sri.BolaVenkatesh S/O Ranganna	,,
19	Sri.G.Ramakrishna S/O Anjaneyulu	,,

Details of Custom hiring management committee

The committee is formed with the following farmers from Aminabad and Girigetla villages of Thuggali mandal, Kurnool district on 07.02.2012

S.No	Name of the farmer	Village
1	Sri.B.Diwakar Chowdary	**Aminabad**
2	Sri.V.Venkata Reddy	,,
3	Sri.P.Narayana Swamy	,,
4	Sri.Kunduri Ramesh S/O Rangaiah	,,
5	Sri.J.Umapati	,,
6	Sri.JaragalaSaratBabu S/O Vivekananda Chowdary	,,
7	Sri.G.Siddaiah S/O Anjanaiah	,,
8	Sri.B.Omkarappa S/O Bajarappa	,,
9	Sri.M.Venkateswarlu	,,
10	Sri.T.Gopal S/O Timmappa	,,
11	Sri.GoseBalaram S/O Parasuramudu	**Girigetla**
12	Sri.Karanji Chandrasekhar S/O Veerabhadrappa	,,
13	Sri.BalachandraKaladar Reddy S/O Seetarami Reddy	,,
14	Sri.AravaBasappa S/O ChinnaBasappa	,,
15	Sri.SolaRangaswamy	,,
16	Sri.M.Gangadaraiah	,,
17	Sri.BolaVenkatesh S/O Ranganna	,,
18	Sri.G.Ramakrishna S/O Anjaneyulu	,,

From these studies it is evident that there is every scope to increase the productivity through real time contingency plans, rainwater conservation technology, enhancing fodder production and popularizing the improved tools and implements in drylands.

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