Climate Resilient Technologies for Drought Mitigation in Chittoor District, Andhra Pradesh, India

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ABSTRACT

Krishi Vigyan Kendra (KVK) under the administrative control of Rashtriya Seva Samithi (RASS) is implementing the National Innovations on Climate resilient Agriculture (NICRA) project at Chittecherla village, Chinnagottigallu mandal, Chittoor dist, Andhra Pradesh, India. The objective of the project is to enhance the resilience of agriculture and allied sectors to climate vulnerabilities through improved production and risk management technologies. Participatory technology demonstrations in farmers' fields covered natural resource management and production systems (crop and livestock) along with institutional interventions. KVK mobilized farmers for renovation of five irrigation tanks in the village under the project to improve surface water storage, enhance ground water recharge and there by ensure availability of water for raising crops in larger area. About 47 bore wells in the vicinity of tanks were recharged by 3 feet benefitting 96 farmers. Technology demonstrations on polythene mulching in tomato resulted in 31% increase in yield in addition to saving of water. Incorporation of green manure crops like Sunhemp in mango orchards not only improved soil fertility status and also resulted in 13.7% increase in yield. Short duration, blast resistant variety of paddy was demonstrated under direct seeding method resulted in 9% increase in yield and overall saving of Rs.9099/- per ha. Demonstration of drought tolerant variety of groundnut (Dharani) resulted in 13.2% increase in yield over check. Triple disease resistant tomato variety (Arka Samrat) recorded 9.2% increase in yield when compared to existing susceptible hybrids. Farmers adopted diversification of Chrysanthemum cultivation as an alternate option to tomato to overcome glut in the market and realized higher returns. Demonstration of Hybrid Napier CO-4 to overcome green fodder scarcity gave 20.4% increase in yield compared to APBN-1. Foggers were placed in the animal sheds during summer to reduce heat stress in milch animals which increased milk yield by 3.0l per day per animal. Custom Hiring Center was established to supply tools and implements to farmers on nominal rental basis to overcome labour shortage and facilitate timely agricultural operations. An integrated approach is paving the way for development as a model climate resilient village for replication in other villages in the district.

Keywords: *Agriculture technology demonstration, climate, drought, resilience, village*

INTRODUCTION

Enhancing the resilience of agriculture to cope with climate variability and climate change is essential to the livelihood security of small and marginal farmers in the country. Devising appropriate adaptation strategies will enable farmers to cope with various climate risks and promote efficient use of natural resources to bring sustainability to farm production and stability to their incomes.

Agriculture is the major source of livelihood for nearly two thirds of population in India. The impact of climate change and vulnerability on agricultural production in the country is quite evident in the recent years. The weather aberrations like drought, floods, excess rainfall, frost, hail storm, heat waves, cold waves etc are becoming recurring phenomena in most parts of the country in the crop growing seasons. These aberrant situations often lead to poor crop performance or total crop failures in major crops.

Considering the extreme vulnerability to climate change and significant rise in the frequency of extreme weather events the Indian Council of Agricultural Research (ICAR) launched a multi-institutional, multi-disciplinary network project, National Innovations on Climate Resilient Agriculture (NICRA) in 2011 in vulnerable districts to undertake strategic research on adaptation and mitigation, fill critical research gaps, demonstrate technologies on farmers fields to cope with current climatic variability and capacity building of farmers. Technology demonstration component of the project is implemented by Krishi Vigyan

Kendras (KVKs) at district level, regionally coordinated by the Agricultural Technology Application Research Institute's (ATARI's) with overall planning, monitoring and coordination at the National level by the Central Research Institute for Dry land Agriculture (CRIDA), Hyderabad.

Technology Demonstration component is the lifeline of NICRA and is being implemented through Krishi Vigyan Kendras (KVKs) in 121climatically vulnerable districts of the country. The aim is to build the resilience of the farming community to face extreme weather events such as droughts, floods, cyclones, unseasonal rains, heat and cold wave. Demonstration of appropriate practices and technologies with a climate focus evolved by the National Agricultural Research System (NARS) is taken up in farmer participatory mode in NICRA villages. These practices broadly fall into four modules i.e. natural resource management, crop production, livestock and fisheries, and institutional interventions.

The major objectives of the NICRA project are

- To enhance the resilience of Indian agriculture covering crops, livestock and fisheries to climatic variability and climate change through development and application of improved production and risk management technologies;
- To demonstrate site specific technology packages on farmers fields for adapting to current climate risks; and to enhance the capacity building of farmers, scientists and other stakeholders in climate resilient agricultural research and its application.
- The overall expected outcome is to enhance resilience of farms and the farming community to climate risks so as to ensure sustainability over a period of time.

RASS (Rashtriya Seva Samithi) - Krishi Vigyan Kendra (KVK) is implementing NICRA in Chittecherla village, Chinnagottigallu mandal, Chittoor district since 2015. The village is located between 130 37' - 130 41' N latitude and 790 04' - 790 43' E longitude. The climate of the Mandal is hot at the time of summer season and moderate for winter season. The majority of the soils are red loam and red sands. About 200 farm families were in the village and most of them are small and marginal farmers. The agriculture is mainly depending on rains and irrigation under tanks and bore wells. There are 10 tanks and 16 small kuntas (ponds) present in the village and half of the tanks got silted up due to soil erosion and kuntas become defunct due to neglect and non maintenance. The cultivated area is 466ha and major area is rainfed. The major crops grown are paddy, groundnut, tomato and mango and farmers depend mainly on dairy activity. Since last ten years the village received less than normal rainfall i.e. 770mm and facing drought situations. KVK facilitated preparation of an action plan for the village by Village Climate Risk Management Committee (VCRMC) and farmers. The main objective is to motivate the farming community to utilize the available resources effectively and efficiently through conservation of soil and water by physical structures and improving vegetation in the area besides imparting technical skills to improve productivity and livestock management to reduce the rate of migration, even in the off season. Technological interventions related to water, soil, crop, livestock and institutional mechanisms were implemented by KVK in the village under NICRA project.

Natural Resource Management (NRM)

A. Renovation of irrigation tanks

Due to non maintenance and silting up of the irrigations tanks viz Nannapacheruvu, Gounicheruvu, Nayanicheruvu, Rayavarapukunta, Errakunta and Chinnakothacheruvu located in the village, excess rainfall received during the monsoon season was not fully stored and utilized for crops. It reflects on crop production because of prolonged dry spells at critical stages of crop growth and sometimes leads to crop failures.

Clearing of unwanted vegetation and deepening of the tanks and strengthening bunds of

tanks were taken up under NRM activity. Desilting was also carried out in Gouni Cheruvu and Nannapa Cheruvu and the same was applied to the fields of farmers to improve the physical and chemical properties of the soil. Feeder channels were also cleared of vegetation and deepened to improve flow of water to the tanks.

Table 1
Performance of renovated irrigation tanks

Particulars	Irrigation tanks					
	Nannapucheruvu	Gounicheruvu	Nayanicheruvu	Rayavarapukunta	Errakunta	Chinnakothacheruvu
Area of the tank	2.08 ha	1.84 ha	1.6 ha	1.0 ha	0.8 ha	1.28 ha
Water holding capacity before renovation	6375cu.m. (63.75lakh lt)	9213cu.m. (92.13lakh lt)	4620cu.m. (46.20 lakh lt)	2532cu.m. (25.32lakh lt)	359.28cu.m. (3.59 lakh lt)	2040cu.m. (20.40 lakh lt)
Water holding capacity after renovation	7524cu.m. (75.24lakh lt)	10635cu.m.(106.35lakk lt)	5808cu.m. (58.08lakh lt)	3280cu.m. (32.80 lakh lt)	924cu.m. (9.24lakh lt)	2720 cu.m. (27.20 lakh lt)
Area covered	6.48 ha	10.45 ha	14 ha	4.45 ha	7.2 ha	8.04 ha
Bore wells supported	8	13	15	6	5	5
Farmers benefited	23	31	30	13	12	20

Renovation of tanks helped in recharging of 52bore wells in the vicinity in addition to increase in storage capacity; as a result crops were cultivated in an area of 50.62 ha and benefited 129 farmers in the village (Table 1).

B. Conservation of soil moisture with polythene mulching in tomato

KVK conducted demonstrations on polythene mulching in tomato for two years (2015-16 & 2016-17) with an objective of soil moisture conservation, weed control at critical stages of crop growth and to improve yields. Polythene mulch of 25 micron thickness was spread over a raised bed on which holes of 4-5cm diameter were punched with recommended spacing of 90x30cm of tomato (Sweekar 448 variety).

Table 2
Effect of polythene mulching on soil conservation, weed control and yield in tomato

Particulars	2015-16		2016-17		Average	
	Farmers practice	Improved practice	Farmers practice	Improved practice	Farmers practice	Improved practice
Yield (kg/ha)	54380	78750	63580	75870	**58980**	**77310**
Cost of cultivation (Rs/ha)	68250	104250	155400	172900	**111825**	**138575**
Gross income (Rs/ha)	217500	315000	370666	442322	**294083**	**378661**
Net income (Rs/ha)	149250	210750	215266	269422	**182258**	**240086**
B.C. Ratio	2.02	2.19	2.39	2.56	**2.20**	**2.38**
No of irrigations	29	20	25	15	**27**	**17**
Weed density (N umber per m^2)	56.3	34.5	62.6	41.2	**59.4**	**37.9**

Weed density was low (37.9/m^2) with polythene mulching in tomato than without mulch (59.4/m^2). About 31 per cent increase in yield was recorded under polythene mulching when compared to without mulching. It was due to polythene mulch which acts as barrier and prevents light to enter the soil, as a result weed density was low in demonstration and also effective soil

moisture conservation at critical stages of crop growth when compared to farmers practice. Number of irrigations used in farmers practice was 27 during entire crop period and it was only 17 in case of demonstration. Cost of cultivation was more in the demonstration (Rs.26750/- per ha) due to use of polythene mulching and it was compensated by achieving higher productivity. The studies with drip irrigation at 80% evapo-transpiration (ET) with polyethylene mulch resulted in significantly highest yield (57.87t/ha), water use efficiency (t/ha-cm) and maximum benefit cost ratio (2.03) in tomato (Rajbir Singh *et al*., 2009). Black polythene mulch recorded 13.08 per cent higher soil moisture conservation and 50.66 per cent increase in tomato yield (Sunil, 2018).

C. Effect of green manuring on soil fertility status and yield improvement in mango

Mango is an important horticultural crop grown in an area of 25ha in NICRA village. Indiscriminate use of chemical fertilizers, pesticides and weedicides adversely affected soil fertility, yield and quality of the produce. Green manures are a gift from nature, being a suitable alternative to increase the nutrient content of the soil. Green manuring is a practice of ploughing in situ or turning into soil undecomposed green plant material for the purpose of improving physical structure as well as fertility of the soil. It increases the availability of plant nutrients that contribute to the yield of the crop. Amongst the green manure crops, sun hemp (Crotolaria juncea) is outstanding in biomass production. Traditionally there was no practice of adopting green manuring by the farmers in mango orchards in the village. The existing practice is to keep orchard interspaces vacant, which resulted in more weed growth, loss of nutrients and fertile soil due to erosion. Hence, KVK motivated farmers to adopt green manuring in mango orchards by conducting demonstrations in the village. KVK conducted demonstrations in 50farmers' fields. Sunhemp seed was supplied to the farmers and the same was sown @ 50 kg per ha in the orchards. The crop was ploughed into soil at the time of flowering, which resulted in improved physical and chemical properties of the soil there by contributing to yield increase.

Table 2
Effect of polythene mulching on soil conservation, weed control and yield in tomato

Particulars	2015-16		2016-17		Average	
	Without green manuring	With green manuring	Without green manuring	With green manuring	Without green manuring	With green manuring
Yield (kg/ha)	6580	7570	8560	9640	**7570**	**8605**
Cost of cultivation (Rs/ha)	34875	36875	43300	41800	**39088**	**39338**
Gross income (Rs/ha)	210560	242240	162640	183160	**186600**	**212700**
Net income (Rs/ha)	175685	205365	119340	141360	**147513**	**173363**
B.C. Ratio	5.03	5.56	2.76	3.35	**3.89**	**4.46**

Green manuring resulted in 13.6 per cent increase in mango yield (8605kg/ha) when compared to farmers practice (7570kg/ha).

D. Productivity improvement in groundnut with supplemental micro-irrigation

Groundnut is the major oilseed crop in the village grown in an area of 50ha under rainfed conditions with low productivity and farmers often experience crop failures due to erratic rainfall at critical crop growth stages. This adverse effect of drought can be overcome by harvesting water in farm ponds and providing supplemental irrigation using sprinklers. Supplemental irrigation of 10mm

water to groundnut at pod filling stage results in significant increase in pod yield (Yellamanda Reddy and Sulochanamma, 2008). KVK conducted demonstrations on yield improvement in groundnut by giving supplemental irrigation using sprinklers during kharif 2016.

Groundnut crop was sown during last week of June 2016 and the crop suffered due to dry spells. Two dry spells were observed from 1st to 29th August (29 days) and from 30th August to 30th September (32 days) during the cropping season. KVK supplied sprinklers to farmers through Custom Hiring Center to provide supplemental irrigation to groundnut crop to overcome drought situation. Two supplemental irrigations were given i.e. one at peg penetration and another at pod maturation stages. Two irrigations at 65 and 85 days after sowing using sprinklers recorded 116 per cent increase in yield.

Table 4
Effect of sprinkles on yield and economic returns in groundnut

Particulars	Rainfed condition (No supplemental irrigation)	Rainfed condition (Supplemental irrigation with sprinklers)
Yield (kg/ha)	750	1620
Cost of cultivation (Rs/ha)	29125	36495
Gross income (Rs/ha)	33750	77900
Net income (Rs/ha)	4625	36495
B.C. Ratio	1.16	1.88

Crop Production Interventions

A. Drought tolerant groundnut variety (Dharani): Groundnut was one of the major crops in the village and farmers generally grown Kadiri 6 variety which is of low yielding and susceptible to bud necrosis. Hence, 30 demonstrations were conducted on improved, drought and bud necrosis tolerant Dharani groundnut variety in the year's kharif 2015, 2016 and 2017.

Table 5
Performance of Dharani groundnut variety

Particulars	2015		2016		2017		Average	
	Kadiri-6	Dharani	Kadiri-6	Dharani	Kadiri-6	Dharani	Kadiri-6	Dharani
Yield (kg/ha)	1396	1630	1665	1850	1715	1930	**1592**	**1803**
Cost of cultivation (Rs/ha)	38225	39947	43020	44370	48135	49575	**43126**	**44630**
Gross inco me (Rs/ha)	56367	65828	86580	96200	73745	82990	**72230**	**81672**
Net income (Rs/ha)	18142	25881	43560	51830	25610	33415	**29104**	**37042**
B.C. Ratio	1.47	1.65	2.01	2.16	1.53	1.67	**1.67**	**1.83**
Plant height (cm)	44.3	41.2	42.8	39.6	46.5	42.3	**44.5**	**41.0**
No of pods / plant	14.2	15.1	15.3	17.4	16.1	18.5	**15.2**	**17.0**
Haulm yield (kg/ha)	3675	2650	4382	3007	4513	3137	**4190**	**2931**

Dharani groundnut variety performed better than Kadiri-6 variety. About 13.2% increase in yield was observed with Dharani over Kadiri-6 and it was due to more number of pods, uniform pod maturity and high shelling percentage which in turn led to increased pod yield. Bhagavatha Priya *et al* (2016) also reported that highest pod yield was recorded by Dharani variety followed by TAG-24, Kadiri-6

and Greshma during early kharif season.

B. Demonstration of triple disease resistant Arka Samrat tomato hybrid

Generally farmers cultivate private hybrids in tomato crop which are susceptible to many diseases. Farmers spent additional cost to control the diseases and they use chemicals indiscriminately. Hence KVK introduced and demonstrated triple resistant tomato hybrid, Arka Smarat in the year 2017-18. It is resistant to bacterial wilt, early blight and leaf curl diseases.

Table 6
Performance of Arka Samrat Tomato hybrid

Treatments	Fruit yield (kg/ha)	Cost of cultivation (Rs/ha)	Gross income (Rs/ha)	Net income (Rs/ha)	B:C ratio	Disease scale
Sweekar448	59500	196344	594999	398655	2.03	2(11-25%)
Arka Samrat	65000	190344	649650	459306	2.41	Free from disease

Arka Samrat recorded about 9.2 per cent increase in yield when compared to Sweekar448 variety. With improved hybrid, farmers recorded an additional net income of Rs. 60651/-. Disease incidence was not observed in Arka Samrat, whereas about 11-25 per cent incidence of bacterial wilt, early blight and leaf curl was observed in Sweekar448 hybrid (Table 6).

C. Direct seeding in rice using drum seeder

Manual transplanting is the most popular method of crop establishment in rice growing areas in Chittoor district, as it requires more number of labour and hence increases the cost of cultivation and also often results in delay in transplanting because of shortage of labour. Increasing water scarcity is becoming real threat for rice cultivation. Hence, water saving technology which also maintains soil health and sustainability and as well as economically beneficial needs to be developed. Hence, KVK conducted demonstrations in NICRA village on direct seeding in rice using drum seeder during 2015 to 2017. Demonstrations were conducted during rabi season using the variety RNR-15048, which is a fine grain variety of 125 days duration and blast tolerant.

Table 7
Performance of direct seeded rice

Particulars	2015		2016		2017		Average	
	Manual transplanting	Drum seeder	Manual transplanting	Drum seeder	Manual transplanting	Drum seeder	Manual transplanting	Drum seeder
Grain yield (kg/ha)	6093	6637	5855	6469	5506	6269	**5918**	**6458**
Cost of cultivation (Rs/ha)	50035	40312	56413	46350	59062	51550	**55170**	**46071**
Gross income (Rs/ha)	85312	92925	85866	94875	84425	100312	**85201**	**96037**
Net income (Rs/ha)	35277	52613	29453	48525	25363	48762	**30031**	**49967**
B.C. Ratio	1.70	2.30	1.52	2.04	1.63	1.95	**1.62**	**2.09**
Plant height (cm)	98.2	97.5	98.8	99.2	99.5	98.6	**98.8**	**98.4**
No of productive tillers/hill	15.3	17.2	14.8	16.8	14.1	16.3	**14.7**	**16.7**
No of grains/panicle	211	267	193	241	182	228	**195**	**243**

Direct seeded rice using drum seeder performed better than manual method of transplanting. About 9% increase in grain yield was observed in direct seeding method than manual transplanting method. An amount of Rs.9099/- was saved in direct seeding method when compared to manual method of transplanting (Table 7). It is mainly due to ease in operation without raising of nursery, pulling and transport of seedlings to main field for transplanting. Crop duration was also reduced by 10 days in direct seeding method than manual method. Sreenivasulu *et al* (2013) also reported that adoption of direct seeding in rice using drum seeder resulted in more productive tillers m-2, more grains per panicle, higher gain yield, low cost of cultivation, higher gross and net returns when compared to manual method of transplanting.

D. Demonstration of Chrysanthemum as an alternative to tomato to overcome price fluctuation

Tomato is the major horticultural crop in the village grown in an area of 40ha during kharif and rabi seasons. Many times price fluctuations leading to low returns despite good harvest is a major issue faced by tomato farmers. To overcome market glut, KVK introduced Chrysanthemum as an alternate to tomato crop. Demonstrations were conducted on Chrysanthemum during the year 2016-17 and farmers realized good returns when compared to tomato.

Table 8
Performance of Chrysanthemum

Crop	Yield (kg/ha)	Cost of cultivation (Rs/ha)	Gross income (Rs/ha)	Net income (Rs/ha)	B:C ratio
Tomato	55100	65125	201000	135875	1.99
Chrysanthemum	9850	145907	357073	211166	2.44

Chrysanthemum cultivation brought in additional returns of Rs. 75291/- when compared to tomato (Table 8). Hence, farmers can choose to diversify to Chrysanthemum as an alternate crop to tomato to realize higher net returns.

Livestock Interventions

A. Demonstration of Hybrid Napier Co-4 variety

Chittoor district stands first in milk production in the state. Dairy is economically viable enterprise that provides quick and regular income to the farmers from the sale of milk and by products. Beside, supplementing income it also supports the livelihood in the event of crop failure during drought conditions. The success of dairy depends on availability of green fodder of good quality at various times during the year. Dairy animals require balanced diet for optimal production. Green fodder is an important constituent of livestock ration. Green fodder keeps the animal in good health and improves reproductive efficiency, it is palatable and easily digestible, it is mild laxative, hence prevents constipation, provides fresh nutrients in their natural form and green fodder is economical.

Hybrid Napier is also known as Bajra-Napier hybrid, Napier Bajra hybrid, King Grass, Elephant millet, Cumbu-napier hybrid. It is tall growing (400-500 cm), erect, stout, deep rooted, perennial grass derived from inter specific cross between Pennisetum glaucum and P. purpureum. The hybrid is a triploid and hence sterile and does not produce seed. Hybrid Napier is a multi cut perennial grass with profuse tillering (30-40 tiller per clump) and very good tonnage (375-400 tonnes per ha per year) throughout year. It can be grown saline soils, wastelands, bund and terraces. It is palatable, having high nutritive value and suitable to varying climatic and soil conditions. Besides, it also supplies green fodder at least for five years once established. Green fodder scarcity during summer and drought periods significantly affects the milk production in milch animals. Hence, demonstrations were conducted in the village on Hybrid Napier CO-4 fodder variety during 2015 and 2016.

Table 9
Performance of Hybrid Napier CO-4 variety

Particulars	2015-16		2016-17		Average	
	APBN-1	Hybrid Napier CO-4	APBN-1	Hybrid Napier CO-4	APBN-1	Hybrid Napier CO-4
Plant height (cm)	174.2	179.8	175.6	182.4	**174.9**	**181.1**
No of tillers per clump	13	19	15	18	**14**	**18.5**
Fodder yield (t/ha)	79.5	90.3	81.6	93.4	**80.55**	**91.85**

Hybrid Napier CO-4 performed better than APBN-1 fodder variety (Table 9). About 14% increase in yield was observed in CO-4 when compared to APBN-1. It was due to more plant height and more no of tillers per hill in Hybrid Napier CO-4. Milk yield also increased by 1.0-2.0l per animal due to feeding of Hybrid Napier CO-4 fodder. Hybrid Napier produces more nutritious fodder with good palatability, taste and succulence, which is relished by animals and fulfils the nutritional needs of the animals, reduces expenditure on feed, increases the milk productivity and hence, makes the dairy farming more feasible and profitable (Kadam *et al*., 2017).

B. Demonstration of foggers in the animal shed to reduce heat stress in milch animals

Heat stress is the major problem in milch animals faced by the dairy farmers in the village during summer season due to high temperatures which leads to decreased milk production. Adverse effects of heat stress are reduced milk yield (15-40%), lower milk fat, and greater susceptibility to diseases and environmental stress in bovines. To overcome this situation, foggers were installed in animal sheds to spray minute droplets of water so as to reduce heat stress in summer.

It was noticed that installing foggers in the animal shed led to an average increase of 3.0l per animal by when compared to farmers practice. It was due to congenial temperature in the animal sheds due to installation of foggers. An additional amount of Rs.31050/- was achieved by farmers using improved technology when compared to farmers practice. Foggers were very useful as a microclimate alteration in buffalo sheds for reducing heat stress thereby improving the dry matter intake and favors increase in milk yield in Murrah buffaloes during summer season (Santhosh Kumar *et al*., 2018).

Table 10
Effect of installation of foggers in animal sheds on milk improvement in milch animals

Treatments	Milk yield (litre/day/ animal)	Milk production (litres/ 3 months)	Total Milk yield / 5 animals	Expenditure (Rs.)	Total Income (Rs.)	B: C Ratio
Farmers practice (without foggers)	9.0	810	4050	36000	93150	2.58
Improved technology (with foggers)	12.0	1080	5400	41800	124200	2.97

Institutional Interventions

A. Performance of custom hiring center for farm machinery

Mechanization brings in timeliness and precision to agricultural operations, greater field coverage over a short period, cost effectiveness, efficiency in use of resources and applied inputs, conservation of available moisture under stress conditions. But the farm power availability of for

small and marginal land holders is very low. Hence Custom Hiring Center for farm machinery was established in Chittecherla village and required farm implements and equipment were purchased and kept available to farmers in the center. The center is operated by Village Climate Risk Management Committee (VCRMC) comprising of villagers as members formed at the beginning of the NICRA project. Hiring charges for different implements are decided by the committee and displayed at the centre. Farmers utilize the centre for hiring of implements by paying nominal charges. The equipment available in the center include sub soiler, disc plough, tarpaulins, drum seeders, power weeder, Taiwan sprayers, power sprayers, knapsack sprayers, brush cutter, pole pruner, tractor mounted sprayer, star weeders, sprinkler system, mini rice mill, secateurs, loppers and pruning saws. Farmers hired implements from the centre in about 140 ha, 144ha and 107ha area under different crops for agricultural operations during 2015, 2016 and 2017, respectively in the NICRA village. Through custom hiring center an amount of Rs. 75791/- was generated as revenue for utilizing it for maintenance of the machinery and the center.

CONCLUSION

Technology demonstrations implemented in drought prone village of Chittoor district in Andhra Pradesh, India enabled farmers to cope with and enhance their resilience to climate variability. An integrated participatory approach through natural resource management, productivity enhancement in crops and livestock production systems, risk management through diversification and enabling farmer managed village level institutions paved dividends in transforming this drought prone village into a climate resilient village. The successful model can be replicated in other climatically vulnerable villages in the district.

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