National Initiative on Climate Resilient Agriculture

Annual Report 2013-14

ICAR-Zonal Project Directorate , Zone-V

CRIDA campus, Santoshnagar, Hyderabad-500 059

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Zonal Project Directorate (Zone-V), Hyderabad.

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Preface

Considering the immense vulner*abi*lity of dryland farming to climate change, there is a need to evolve innovative institutional mechanisms, like Village Level Climate Risk Management Committee, Custom Hiring Centers etc., for successful adoption and up scaling of proven technologies. There has been a significant rise in the frequency of extreme weather events in recent years affecting the productivity and income at the farm level and also impacting the availability of staple food grains at the National level. Therefore, the ICAR has launched National Initiative on Climate Resilient Agriculture (NICRA) Project aimed at enhancing resilience of Indian agriculture to climate change. As a part of this initiative, extensive technology demonstrations of location-specific best-bet practices are being conducted on farmers fields in 13 vulnerable districts of the Zone-V through Krishi Vigyan Kendras. The experiences concerning these technologies demonstrated in Zone V have been compiled in the form of **Annual Report of 2013-14** by Zonal Project Directorate, Zone V, Hyderabad.

I am highly grateful to Dr. S. Ayyappan, Director General, ICAR and Secretary, DARE, Dr. A.K Sikka, DDG (NRM) and DDG (Agril. Extension), Dr. Ch. Srinivasa Rao, Director, CRIDA and Dr. Y.G. Prasad, Coordinator, NICRA, CRIDA for the timely advice and suggestions.

My sincere thanks to Dr. G.Rajender Reddy, Sr. Scientist (Soil Science) & Nodal Officer for NICRA, Zone-V and Dr. G.Subba Reddy, Former Head Crop Science Division & Principal Scientist, CRIDA for their commitment and dedicated efforts. I appreciate the Progrmme Coordinators, Subject Matter Specialists, Research Associates and Senior Research Fellows of Krishi Vigyan Kendras of Zone-V involved in NICRA activities. I appreciate all my colleagues who are directly or indirectly involved in bringing out this Annual Report and for their efforts in programme development, implementation and monitoring the technology demonstrations under NICRA project and documenting the findings for the benefit of the concerned stake holders.

(N. Sudhakar)

Dated the 7th October, 2014
Hyderabad

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कार्यकारी सारांश

राष्ट्रीय जलवायु समुत्थान कृषि पहल (NICRA) एक बहु-संस्थागत, बहु-विषयक नेटवर्क परियोजना है, जिसे वर्ष 2011 में भारतीय कृषि अनुसंधान परिषद द्वारा प्रारंभ किया गया। परियोजना का उद्देश्य अनुकूल अनुसंधान एवं प्रौद्योगिकी के प्रदर्शनों द्वारा जलवायु परिवर्तन एवं जलवायु विविधता से भारतीय कृषि के समुत्थान को बढ़ाना है। प्रौद्योगिकी प्रदर्शन घटक, राष्ट्रीय जलवायु समुत्थान कृषि पहल (NICRA) का जीवनाधार है एवं इसे क्षेत्र-V के अंतर्गत आंध्र प्रदेश, तेलंगाणा एवं महाराष्ट्र के राज्यों में स्थित 13 जलवायु से असुरक्षित जिलों में कृषि विज्ञान केंद्रों द्वारा कार्यान्वित किया जा रहा है। इसमें आंध्र प्रदेश के अनंतपुर, कर्नूल, श्रीकाकुलम एवं पश्चिम गोदावारी; तेलंगाणा के खम्मम; एवं महाराष्ट्र के अहमदनगर, अमरावती, औरंगाबाद, पूणे, गोंड़िया, नंदुराबार एवं रत्नगिरी के कृषि विज्ञान केंद्र शामिल हैं।

क्षेत्र-V, क्षेत्रीय परियोजना निदेशालय ने आंध्र प्रदेश, तेलंगाणा एवं महाराष्ट्र के तीनों राज्यों में, 2950 हेक्टेयर को शामिल करते हुए 3666 किसानों की भागीदारी से कार्यक्रमों का आयोजन किया गया। इस परियोजना के अंतर्गत प्राकृतिक संसाधन प्रबंधन, फसल उत्पादन, पशुधन (Livestock) एवं मात्स्यिकी (fisheries), संस्थागत हस्तक्षेप, क्षमता निर्माण में क्रमशः 1563,1678, 355, 591, 5677 एवं 29868 किसानों को शामिल कर प्रसार गतिविधियों का कार्यन्वयन किया गया। इस परियोजना ने प्राकृतिक संसाधन प्रबंधन के 1021 हेक्टेयर में क्षेत्रीय प्रदर्शन एवं तीन राज्यों के चयनित राष्ट्रीय जलवायु समुत्थान कृषि पहल (NICRA) की गांवों के 635 हेक्टेयरों में फसल उत्पादन गतिविधियों का आयोजन किया गया।

वर्षा पैर्टन

यह देखा गया कि वर्ष 2013 में तेलंगाणा में नलगोंड़ा एवं आंध्र प्रदेश में श्रीकाकुलम के जिलों में साधारण वर्षा की तुलना में क्रमशः 384 मि.मी एवं 349 मि.मी अधिक वर्षा हुई। महाराष्ट्र राज्य के अहमदनगर, अमरावती, औरंगाबाद, पूणे, गोंड़िया, नंदुराबार एवं रत्नगिरी जिलों में साधारण वर्षा की तुलना में क्रमशः 19.67,6.26,10.44,52.76 और 12.02 प्रतिशत अधिक वर्षा हुई। तेलंगाणा में खम्मम, आंध्र प्रदेश के अनंतपुर एवं कर्नूल जिले में क्रमशः 0.86, 45.75, 2.05 प्रतिशत कम वर्षा हुई। जबकि महाराष्ट्र के पूणे और औरंगाबाद जिलों में वर्षा की कमी क्रमशः 10.69 एवं 20.34 रही।

मानसून में देरी के कारण, अनंतपुर के अधिकांश किसानों ने कंगनी (foxtail millet), ज्वार एवं सूरजमुखी जैसी लघु अवधि के आकस्मिक फसलों को उगा रहे हैं एवं कुछ किसान मूंगफली की खेती कर रहे हैं। देर से बाई गई मूंगफली की फसल मुख्य विकास स्तरों के दौरान नमी की कमी का शिकार हुई, जिसके परिणामस्वरूप परिपक्वतापूर्व फसल (90 दिनों में) प्राप्त हुआ, जिससे उत्पादन में काफी कमी आई। मानसून में देरी के परिस्थितियों में अन्य आकस्मिक फसलों से अच्छी उत्पादन प्राप्त हुई। कर्नूल में, सभी रबी फसलें जैसेकि चना के फसल उगाऊ के प्रारंभिक स्तरों में संग्रहित

नमी की कमी से फसल तीर्व नमी दबाव का शिकार हुई। बावग (direct sown) चावल रोपण स्तर पर करीब 5 दिनों तक जलमग्न रही एवं श्रीकाकुलम जिले के अत्यधिक जलप्लावित (inundated) क्षेत्र में फसल नष्ट हो गए। चावल के मध्यम अवधि की किस्म पुष्प गुच्छ निकलने की अवस्था में प्रभावित हुई एवं फसल थोड़ी गिर गई। बूट (boot) पत्ते मुड़ गए एवं फसल पानी में डूब गई। लंबी अवधि के किस्म अधिकतर कल्ला से पुष्प गुच्छ निकलने की अवस्था के दौरान बाढ़ का शिकार हुई। सब्जी की फसल वनस्पतिक स्तर पर जलप्लावित हो गई। नवंबर के पहले सप्ताह के दौरान नीलम तूफान के कारण इस क्षेत्र में भारी वर्षा हुई एवं अधिकतर खेत जलमग्न हो गए तथा फसल नष्ट हो गई।

खम्मम जिले के परियोजना गांव में भारी वर्षा के कारण चावल की फसल की कटाई की अवस्था पर बुरी तरह से प्रभावित हुई। कपास में गलर परिपक्व एवं प्रस्फुटन अवस्थाओं पर क्षति हुई जिसके परिणामस्वरूप गलर गलने लगे एवं खड़ी फसलों पर बीजों से अंकुरण निकलने लगे जिससे रुई की गुणवत्ता खाफी प्रभावित हुई। नलगोंड़ा जिले के चयनित निक्रा (NICRA) गांवों की काली मृदाओं में अगस्त, सितंबर एवं अक्तूबर के महीनों में के दौरान हुई लगातार वर्षा के कारण जलाक्रांत (water stagnation) हुई जिसके परिणामस्वरूप कपास में रुई काफी प्रभावित हुई।

यह वर्षा अमरावती में सोयाबीन जैसी अल्पावधि फसलों के लिए एवं अरहर एवं कपास जैसे दीर्घावधि के फसलों की वनस्पतिक वृद्धि के लिए भी काफी अनुकूल थी। करका पातों (hail stroms) एवं अतिरिक्त वर्षा के कारण गेहूं, कपास एवं चना की फसलें नष्ट हो गई। औरंगाबाद में अक्तूबर 13 से 30 दिसंबर तक संपूर्ण शुष्कदौर रहा जिससे अरहर एवं कपास जैसी लंबी अवधि की फसलें एवं रबी ज्वार की उत्पादकता प्रभावित हुई। गोंड़िया जिले के निक्रा गांवों में 6 दिनों की अतिरिक्त भारी वर्षा (60 मि.मी प्रति दिन से अधिक) से नर्सरी में चावल के पौधों की वृद्धि एवं प्रतिरोपण के बाद खेतों में बाधा उत्पन्न की। पूणे जिले के, बारामती में, उपलब्ध मृदा नमी की परिस्थितियों में जून के दूसरे एवं तीसरे सप्ताह में बाजरा की बोवाई की गई। बाजरा की बोवाई के बाद वाले महीने में अच्छी वर्षा नहीं हुई। रत्नगिरी जिले के निक्रा गांव में जुलाई महीने के दौरान 1727 मि.मी वर्षा हुई जिसके परिणामस्वरूप चावल के पौधे नष्ट हो गए। ऊपरी क्षेत्रों से आने वाला वर्षाजल के बहाव से काफी मात्रा में मृदा हानि हुई एवं खेतों में तैयार किए गए नाले एवं मेढ़ बह गए।

प्राकृतिक संसाधन प्रबंधन

प्राकृतिक संसाधन प्रबंधन प्रयासों के अंतर्गत, अनंतपुर, नलगोंड़ा, अहमदनगर एवं अमरावती के निक्रा गांवों में चेक बांधों से सिल्ट निकालने एवं अंतःस्रवण तालाबों के पुर्ननिर्माण के द्वारा भूमिजल सूची में 2-3 मीटरों की वृद्धि हुई। कर्नूल में रीचार्ज गर्तों से बोर वेलों का रीचार्ज, नंदुरबर में रेत के बैगों से चेक डैम का निर्माण कर वर्षाजल का संग्रहण, अनंतपुर के मूंगफली, कर्नूल एवं नलगोंड़ा के अरंड़, औरंगाबाद के अरहर एवं कपास की खेतों में संरक्षण कूंड़; अमरावती के सोयाबीन में चौड़ी क्यारी कूंड, नंदुरबर के मक्का में मेंढ़ एवं गर्त जैसे स्व-स्थाने नमी संरक्षण प्रौद्योगिकियों द्वारा वर्षाजल संरक्षण अपनाने से, नियंत्रित खेतों की तुलना में 20-30 प्रतिशत अधिक उत्पादन प्राप्त हुआ। कपास में पुष्पण एवं गलर निर्माण पर, अतिरिक्त सिंचाई एवं खम्मम के मल्टीकट चारा, नलगोंड़ा के मिर्च, अमरावती

के कपास में संरक्षण सिंचाई से वर्षा आधारित पर्यावरण की तुलना में अधिक उत्पादन एवं 20-25 प्रतिशत अधिक आमदनी प्राप्त हुई।

नलगोंड़ा के नंद्यालगुड़ेम गांव के मिर्च में कंपोस्ट का उपयोग करने, खम्मम जिले के धान में हरी खाद का उपयोग करने एवं कर्नूल के लवण मृदाओं में जिप्सम का प्रयोग करने से मृदा गुणवत्ता में सुधार के अतिरिक्त फसलों के उत्पादन में यथेष्ठ वृद्धि हुई।

फसल उत्पादन

पश्चिम गोदावरी के निक्रा गांवों में, जलप्लावन के विभिन्न स्तरों पर धान की किस्म पीएलए-1100 श्रेष्ठ सिद्ध हुआ इसके बाद एमटीयू-1061 एवं आरजीएल-2357 का स्थान रहा। निचले जलप्लावन क्षेत्रों में पीएलए-1100 एवं एमटीयू-1061 ने बेहतर निष्पादन दिया। एमटीयू-1140 में जलप्लावन से फसल गिरने का लक्षण नहीं है एवं 5 दिन अधिक जलप्लावन को सह सकता है। अनंतपुर के लिए पीआरजी-158 (अरहर), जेएकेआई-9218, दिगविजय, NBeG-1 (चना); कर्नूल के लिए नंद्याल संगा-1 (चना); नलगोंड़ा के लिए एलजीजी-460 (चना), धान में लवण सहीष्णु किस्म सिद्दी एवं शीतलता सहीष्णु किस्म शीतल, पीआरजी-158 (अरहर); अमरावती के लिए दिगविजच(चना), जेएस-9305 (सोयाबीन); नंदुरबार के लिए जीएम-26 (मक्का); औरंगाबाद के लिए बीडीएन-711 (अरहर), आकाश(चना), नेत्रावती (एनएआईडब्ल्यु-1415) (गेहूं), परभनी मोती (रबी ज्वार), एमएयूएस-71 (सोयाबीन); गोंड़िया के लिए फुले रेवती (ज्वार), पीकेवी-तारा (अरहर) की उन्नत किस्में वर्षा आधारित क्षेत्रों में स्थिरता लाती हैं।

सस्ययन प्रणालियों में, कर्नूल के लिए कंगनी (foxtail millet) (सेटारिया)अअरहर (5:1) एवं अरंड़अअरहर (1:1); श्रीकाकुलम के लिए कपासअअरहर ; औरंगाबाद जिले के निक्रा गांवों के लिए सोयाबीनअअरहर (4:2), बाजराअअरहर (3:3), कपासअमूंग (1:1); महाराष्ट्र के नंदुरबर के लिए सोयाबीनअअरहर (3:1), मूंगफलीअसोयाबीन (4:1) एवं रबी ज्वारअकुसुंभ (3:3) की अंतरासस्ययन प्रणालियों ने विभिन्न निक्रा गांवों को स्थिर आय प्रदान किया।

अनंतपुर में एमटीयू-1010 के रोपण के 20-25 दिनों के बाद 500 किलोग्राम प्रति हेक्टेयर की दर से जिप्सम का ऊपरी छिड़काव; श्रीकाकुलम के बाढ़ग्रस्त क्षेत्रों में अधिकतम कल्ला (tillering) स्तरों पर 19:19:19 द्रव उर्वरकों का छिड़काव, मल्टी पोटाश (13:0:45); पश्चिम गोदावरी जिले के धान में पोषक प्रबंधन आधारित मृदा जांच; अहमदनगर में सोयाबीन के क्रांतिक उगाऊ स्तरों पर पर्ण पोषक प्रयोग; अमरावती के सोयाबीन में पोषक प्रबंधन (10-15 टन प्रति हेक्टेयर अहाता खाद) एवं पीएसबी से बीजोपचारअसिफारिश किया गया रासायनिक उर्वरक (30:75:0); औरंगाबाद के बीटी कपास में समेकित पोषक प्रबंधन, कपास में पर्ण पोषक (19:19:19 या 12:61:00 का सूक्ष्मपोषक एवं घुलनशील उर्वरक) प्रयोग; बारामती के प्याज एवं मक्का में समेकित पोषक प्रबंधन ने किसानों की प्रक्रिया की तुलना में अधिक आर्थिक लाभ प्रदान किया।

अनंतपुर में उन्नत प्लांटर से मूंगफली की बोवाई; कर्नूल में अरहर के लिए, खम्मम में मक्का के लिए एवं अमरावती में सोयाबीन के लिए उन्नत बीज ड्रिल का उपयोग; पश्चिम गोदावरी में खरीफ के दौरान धान का मशीनी रोपण; खम्मम एवं नलगोंड़ा जिलों में धान के लिए ड्रम सीड़र के उपयोग ने पारंपरिक प्रक्रिया की तुलना में न केवल श्रम (40-50 प्रतिशत) बल्कि 100 प्रतिशत इकाई समय द्वारा प्रचालन के क्षेत्र में भी वृद्धि की।

देर से बोई गई परिस्थितियों के अंतर्गत, वर्षा आधारित परिस्थितियों में कर्नूल के देसी कपास एवं अनंतपुर के मूंगफली की तुलना में कंगनी (foxtail millet) बेहतर विकल्प एवं लाभदायक हो सकता है। अनंतपुर एवं गोंड़िया के धान की खेती में एसआरआई पद्धत्ति, औरंगाबाद के बीटी कपास में ड्रिप प्रणाली, महाराष्ट्र के गोंडिया में रबी ज्वार के लिए छिड़काव प्रणाली जल के बेहतर उपयोग में सफल सिद्ध हुआ।

अनंतपुर के मूंगफली में फली विकास स्तर पर कार्बेनड़िज़म (Carbendazim) अ मेनकोज़ेब (Mancozeb) का उपयोग, कर्नूल के अरंड़ में 2.5 एमएल की दर से क्लोरोपाइरिफास (Chloropyriphos) एवं एक ग्राम प्रति लीटर की दर से कार्बेनड़िज़म (Carbendazim) का छिड़काव एवं अरहर में मौसम आधारित समेकित नाशीजीव प्रबंधन, अमरावती के कपास में समेकित फसल प्रबंधन (ICM), नंदुरबर के ज्वार में 2,4-डी खरपतवारनाशी का उपयोग लाभदायक फसल संरक्षण सिद्ध हुआ।

पशुधन एवं मात्स्यिकी

पशुधन आधारित हस्तक्षेपों में, अनंतपुर में उन्नत चारा ज्वार किस्म एसएसजी-एस-93, खम्मम में मल्ट ीकट तनजानिआ, नलगोंड़ा में मल्टीकट एपीबीएन-1, अहमदनगर में मल्टीकट चारा देवगन रसीला एवं नंदुरबर के लिए मल्टीकट लेर्सेन आरएल-88 चारा उत्पादन के क्षेत्र में आशाजनक परिणाम के रूप में दर्ज हुए। दुधारू पशुओं में किसानों की प्रक्रिया की तुलना में अनंतपुर में अज़ोला, चावल की भूसी (50 किलोग्राम प्रति 90 दिनों की अवधि)अखनिज मिश्रण (50 किलोग्राम प्रति 90 दिनअ ½ किलोग्राम अज़ोला प्रति पशु प्रति दिन की दर से); कर्नूल में एक किलोग्राम प्रति पशु की दर से खनिज मिश्रण का उपयोगअएक किलोग्राम प्रति पशु की दर से चारा सांद्रता, अहमदनगर में साइलेज के निर्माण ने 25-30 प्रतिशत अधिक दुग्ध उत्पादन दिया। स्थानीय नस्लों की तुलना में कुक्कट-पालन पक्षियों की उन्नत नस्लों राजश्री एवं वनराज से 20-25 प्रतिशत अधिक अतिरिक्त आय प्राप्त करने में उपयोगी सिद्ध हुए। औरंगाबाद में स्थानीय नस्लों से एक वर्ष में 26 भेड़ों की तुलना में उन्नत प्रजनन भेड़ के समावेश से 40 भेड़ों के उत्पादन में सहायता मिली। खम्मम के स्थानीय नस्लों की तुलना में उन्नत नस्ल वाले भेड़ों के मृत्युदर में 2 प्रतिशत की कमी थी। आंध्र प्रदेश के श्रीकाकुलम, नलगोंड़ा एवं पश्चिम गोदावरी जिलों में कटला, रोहू, ग्रास कार्प के उन्नत प्रजातियों से चेक डेमों में पशु पालन की गतिविधि से किसानों के जीविकोपार्जन में वृद्धि हुई। विभिन्न निक्रा गांवों में व्यापक स्तर पर ट ीकाकरण कार्यक्रमों से पशुधन में मृत्युदर एवं अस्वस्थता से होने वाली हानि में कमी आई।

संस्थागत हस्तक्षेप

संस्थागत हस्तक्षेपों के रूप में, तेलंगाना, आंध्र प्रदेश एवं महाराष्ट्र के सभी निक्रा गांवों में कस्टम हायरिंग एवं बीज तथा चारा बैंक प्रारंभ किए गए। नलगोंड़ा एवं खम्मम(तेलंगाना); अनंतपुर, कर्नूल, पश्चिम गोदावरी एवं श्रीकाकुलम (आंध्र प्रदेश), महाराष्ट्र के अहमदनगर, अमरावती, गोंड़िया, पूणे, नंदुरबर एवं रत्नगिरी जिलों में इन केंद्रों ने न केवल सही समय पर कृषि प्रचालों को प्रारंभ करने में किसानों की सहायता की बल्कि 3000/- रुपए से 64100/- रुपए तक प्रति केंद्र प्रति वर्ष का अतिरिक्त निवल आय प्राप्त करने भी सहायता की। आंध्र प्रदेश के अनंतपुर जिले के निक्रा गांवों में उन्नत धान की किस्म एनएलआर 34449 सहित मूंगफली के उन्नत बीजों के-6 (200 किलोग्राम), के-9 (90 किलोग्राम) एवं धरणी (120 किलोग्राम) तथा चारा ज्वार किस्मों (500 किलोग्राम) का उत्पादन किया गया।

क्षमता निर्माण

वर्ष 2013-14 के दौरान विभिन्न निक्रा गांवों में 5677 किसानों की भागीदारी से क्षेत्र-V के अंतर्गत निक्रा परियोजना केंद्रों में 199 आवश्यकता आधारित प्रशिक्षण कार्यक्रमों का आयोजन किया गया। तेलंगाणा राज्य में, किसानों को 13 प्रशिक्षण कार्यक्रमों के द्वारा किसानों को कृषि संबंधि कौशल सिखाया गया। जबकि महाराष्ट्र में, 2652 पुरूष एवं 636 महिला किसानों की सक्रिय भागीदारी से निक्रा गांवों के किसानों ने 101 प्रशिक्षण कार्यक्रमों में प्रशिक्षण प्राप्त किया। आयोजित किए गए प्रशिक्षण कार्यक्रमों की सूची में प्राकृतिक संसाधन प्रबंधन, सिफारिश की गई अंतरासस्यन प्रणालियों की प्रौद्योगिकियां, आकस्मिक फसल योजना, मृदा उत्पादकता सुधार, फसल विविधिकरण, समेकित नाशीजीव प्रबंधन, मृदा जांच आधारित उर्वरकों की आवश्यकता, बीज बैंक एवं समेकित पशुधन प्रबंधन उद्यम आदि शामिल हैं।

29686 किसानों की भागीदारी से 455 प्रसार गतिविधियों का आयोजन किया गया। इनमें, आंध्र प्रदेश के राज्य में 23889 पुरूषों एवं 559 महिलाओं से 188 प्रसार गतिविधियों का आयोजन किया गया। जबकि तेलंगाणा राज्य में, 325 पुरूष एवं महिलाओं की भागीदारी से 23 प्रसार कार्यक्रमों का आयोजन किया गया। वर्ष 2013-14 के दौरान महाराष्ट्र राज्य में करीब 5095 महिलाएं एवं पुरूषों की भागीदारी से 201 प्रसार गतिविधियों का आयोजन किया गया।

Executive Summary

The National Initiative on Climate Resilient Agriculture (NICRA) is a multi-institutional, multi-disciplinary network project launched by ICAR in 2011. The project aims to enhance resilience of Indian agriculture to climate change and climate variability through strategic research and technology demonstrations. Technology Demonstration component is the lifeline of NICRA and is being implemented through Krishi Vigyan Kendras (KVKs) in 13 climatically vulnerable districts located in the states of Andhra Pradesh, Telangana and Maharashtra under Zone - V. These include KVKs of Anantapur, Kurnool, Srikakulam and West Godavari of Andhra Pradesh. Khammam and Nalgonda of Telangana and Ahmednagar, Amravati, Aurangabad, Pune, Gondia, Nandurabar and Ratnagiri in Maharashtra.

Zonal Project Directorate, Zone - V, facilitated in organizing programmes with participation of 3666 farmers covering 2950 ha in three states of Andhra Pradesh, Telangana and Maharashtra. The project implemented NRM, Crop production, Livestock and Fisheries, Institutional Interventions, Capacity building and Extension activities with involvement of 1563, 1678, 355, 591, 5677 and 29868 farmers respectively. The project organized field demonstrations in 1021 ha of NRM and Crop production activities in 635 ha in selected NICRA villages of three states.

Rainfall Pattern

It was observed that the rainfall received in 2013 was excess by 384 and 349 mm compared to respective normal rainfalls in districts of Nalgonda in Telangana and Srikakulam in Andhra Pradesh respectively. The rainfall was higher by 19.67, 6.26, 10.44, 52.76 and 12.02 percent than respective normal rainfall in the districts of Ahmednagar, Amravati, Gondia, Nandurbar and Ratnagiri districts of Maharashtra state. The rainfall was deficient by 0.86, 45.75, 2.05 percent in districts of Khammam in Telanagna, Anantapur and Kurnool districts of Andhra Pradesh respectively. While in Maharashtra, the rainfall was less by 10.69 and 20.34 in the districts of Pune and Aurangabad respectively.

Due to delayed monsoon, most of the farmers in Anantapur have taken up short duration contingent crops such as setaria, (Foxtail millet), sorghum and sunflower and few farmers cultivated groundnut. Late sown groundnut crop was subjected to moisture stress during key developmental stages resulting in prematurity of the crop (90 days) and resulted in drastic reduction in yield. Other contingent crops performed better under delayed monsoon conditions. In Kurnool, all *rabi* crops like chickpea suffered with acute moisture stress as there was dearth of stored soil moisture in the early stages of crop growth. Direct sown paddy at seedling stage was inundated nearly for 5 days and the crop was failed in high inundated area of Srikakulam district. Medium duration varieties of paddy were affected at panicle initiation stage and the crop was slightly lodged. Boot leaf was twisted and crop was submerged in water. Long duration varieties suffered at maximum tillering to panicle initiation stage during floods. Vegetables crops were submerged while they were at

vegetative stage. During the first week of November heavy rains occurred in this area due to Neelam cyclone and most of the fields were submerged and crops were damaged.

The paddy crop was seriously affected during the harvesting stage due to heavy rains in project village in Khammam district. In cotton damage occurred at boll ripening and bursting stages as a result boll rotting and germination of seeds on standing crop took place and the quality of lint was badly affected. Continuous wet spells received during the months of August, September and October created water stagnation in black soils in selected NICRA villages of Nalgonda district resulting in damage of lint in cotton.

The rainfall was much favorable for short duration crops like soybean and also for vegetative growth of long duration crops like pigeon pea and cotton in Amravati. Hailstorms and excess rainfall caused lodging of wheat, cotton and chickpea. The complete dry spell experienced from October 13th to 30th December affected the productivity of long duration crops like pigeon pea and cotton and *rabi* sorghum in Aurangabad. The occurrence of excessive heavy rains (more than 60 mm/day) in 6 rainy days in NICRA village of Gondia district hampered the growth of paddy seedlings in nurseries and also in main field after transplanting. In Baramati of Pune district, sowing of pearl millet was done in the second and third week of June at available soil moisture condition. After sowing of pearl millet there was no effective rainfall in the succeeding month. The NICRA village of Ratnagiri district received 1727 mm of rainfall during the month of July resulting in loss of transplanted paddy seedlings. The rainwater flow from upper regions caused severe soil loss and the nalas and bunds constructed in the fields were washed away.

Natural Resource Management

Under Natural Resource Management interventions, 2-3 meters increase in ground water table was achieved by desilting check dams and renovation of percolation tanks in NICRA villages at Anantapur, Nalgonda, Ahmednagar and Amravati. Recharge of bore wells with recharge pits at Kurnool, harvesting of rainwater by constructing check dam with sand bags at Nandurbar, conservation of rainwater through in-situ moisture conservation technologies like conservation furrows in groundnut at Anantapur, castor at Kurnool and Nalgonda, pigeonpea and cotton at Aurangabad, broad bed furrows in soybean at Amravati, ridges and furrows in Maize at Nandurbar helped in realizing the yields from 20-30 percent over respective control plots. Supplemental irrigation at flowering and boll formation stages in cotton, protective irrigation in multicut fodders at Khammam, chillies in Nalgonda, cotton in Amravati enhanced the yields and income by 20-25% over rain fed environment.

Use of compost in chillies in Nandyalagudem village of Nalgonda district, green manuring in paddy (Khammam district) and gypsum application in saline soils of Kurnool helped in improving the soil quality besides considerable increment in yields of crops.

Crop Production

In NICRA village of West Godavari, PLA-1100 of paddy performed best followed by MTU-1061 and RGL-2357 at different levels of inundation. In low inundated areas PLA-1100 and MTU-1061 performed better. MTU-1140 is having non-lodging characters and has 5 days more duration. Improved varieties PRG-158 (Pigeon pea), JAKI-9218, Digvijay, NBeG-1 (Chickpea) at Anantapur, Nandyala Sanaga-1 (Chickpea) at Kurnool, LGG-460 (Green gram) and salt tolerant variety Siddi and cold tolerant variety Sheetal in Paddy, PRG-158 (Pigeonpea) at Nalgonda, Digvijay (Chickpea), JS-9305 (Soybean) in Amravati, GM-26 (Maize) at Nandurbar, BDN-711 (Pigeon pea), Akash (Chickpea), Netravati (NAIW-1415) in Wheat, Parbhani moti (*rabi* sorghum), MAUS-71 (Soybean) in Aurangabad, Phule Revati (Sorghum), PKV-Tara (Pigeonpea) in Gondia gave stable yields in rain fed environment.

Among cropping systems, intercropping systems of foxtail millet (Setaria) + pigeon pea (5:1) and castor + pigeonpea (1:1) at Kurnool, cotton + pigeonpea in Srikakulam, soybean + pigeonpea (4:2), pearlmillet + pigeonpea (3:3), cotton+green gram (1:1) in NICRA village of Aurangabad district, soybean + pigeon pea (3:1), groundnut + soybean (4:1) and *rabi* sorghum + safflower (3:3) at Nandurbar in Maharashtra, imparted stable income in different NICRA villages.

Top dressing of Gypsum @ 500 kg/ha at 20-25 days after transplanting (MTU-1010) at Anantapur, spraying of liquid fertilizer 19:19:19, Multi K (13:0:45) at maximum tillering stage in flood prone areas at Srikakulam and soil test based nutrient management in paddy of West Godavari district, foliar nutrient application at critical growth stages of soybean at Ahmednagar, nutrient management (FYM 10-15 tons/ha and seed treatment with PSB + recommended dose of chemical fertilizer (30:75:0) in soybean at Amravati, INM in Bt. Cotton, foliar nutrient application (micronutrients and soluble fertilizer i.e., 19:19:19 or 12:61:00) in cotton at Aurangabad, INM in onion and maize at Baramati gave higher economic benefits than corresponding farmers practices.

Sowing of groundnut with improved planter in Anantapur, Use of improved seed drill in pigeonpea at Kurnool and in maize at Khammam and soybean at Amravati, Machine transplanting of paddy during *kharif* in West Godavari, use of drum seeder in paddy at Khammam and Nalgonda districts, not only saved the cost of labour (40-50%) but also increased area of operation by 100% per unit time over their traditional practices.

Under delayed sowings, short duration variety Suryanandi of foxtail millet can be better alternative profitable than desi cotton at Kurnool and groundnut in Anantapur under rain fed situation. SRI method of cultivation in paddy in Anantapur and Gondia, drip system in Bt cotton at Aurangabad, Sprinkler system in *rabi* sorghum at Gondia in Maharashtra were useful in efficient use of water.

Use of Carbendazim + Mancozeb at pod development stage in groundnut at Anantapur, spray of Chloropyriphos @ 2.5 ml and Carbendazim @1gm/lit in castor and weather

based IPM in pigeonpea at Kurnool, ICM in cotton at Amravati, use of weedicide 2,4-D in sorghum at Nandurbar, were found as profitable crop protection measures.

Livestock and Fisheries

In livestock based interventions, improved fodder sorghum var (SSG-S-93) in Anantapur, multicut Tanjania at Khammam, multicut APBN-1 at Nalgonda, multicut fodder Devgan rasila at Ahmednagar and multicut lucern (RL-88) at Nadurbar, recorded promising results in terms of fodder yields. Improvement of nutrition through azolla, ricebran (50 kg/90 days duration) + mineral mixture (50kg/90days + azolla @ 1/2kg /animal/day) at Anantapur, use of mineral mixture @1kg/animal along + feeding concentrates @ 1kg/animal at Kurnool, silage making at Ahmednagar registered higher milk productivity by 25-30% than farmers practice in dairy animals. Improved breeds of poultry birds (Rajasree and Vanaraja) were useful to get higher supplementary income by 20-25% than local breeds. Introduction of superior breeding ram helped to produce 40 lambs as against local (26 no) in a year at Aurangabad. Mortality of sheep was decreased by 2% in upgraded breed over local breeding at Khammam.

Fish rearing activity in check dam with improved species of Catla, Rohu, Grass carp increased the livelihoods of farmers in Srikakulam, Nalgonda and west Godavari districts of Andhra Pradesh. Mortality and morbidity losses in live stock were reduced with mass vaccination programmes in different NICRA villages

Institutional Interventions

As a part of Institutional Interventions, custom hiring centers and seed and fodder banks were started in all NICRA villages in Telangana, Andhra Pradesh and Maharashtra, These centers not only helped the farmers for timely agricultural operations but also generated additional net income ranging from Rs 3000 to Rs. 64100/center/year in Nalgonda and Khammam (Telangana), Anantapur, Kurnool, West Godavari and Srikakulam (Andhra Pradesh) and Ahmednagar, Amravati, Gondia and Pune, Nandubar and Ratnagiri districts in Maharashtra. Improved seeds of K-6 (200 kg) and K-9 (90 kg) and Dharani (120 kg) of groundnut, Fodder sorghum varieties (500 kg) were produced along with improved Paddy seed (NLR 34449) in NICRA village in Anantapur district of Andhra Pradesh.

Capacity Building

NICRA Project centers under Zone -V organized 199 need based training programmes with participation of 5677 farmers in different NICRA villages during 2013-14. The farmers in NICRA villages of Andhra Pradesh underwent 85 training programmes with participation of 1831 farmers. In Telangana State, farmers were imparted skills through 13 training programmes with participation of 523 farmers. While in Maharashtra, the farmers of NICRA villages experienced 101 training programmes with active participation of 2652 male and 636 female farmers. The list of training programmes organized includes: Natural

Resource Management, technologies of recommended intercropping systems, contingency crop planning, soil productivity improvement, crop diversification, Integrated Pest Management, Soil test based fertilizer requirements, Seed Banks and integrated livestock Management enterprises etc.

Extension Activities

Conducted 455 extension activities with participation of 29868 farmers. Among these, 188 extension activities were organized with 23889 men and 559 women in the state of Andhra Pradesh. While in Telangana state, 23 extension programmes were organized with participation of 325 men and women. About 5095 women and men were participated in 201 extension activities in the state of Maharashtra during 2013-14.

1. INTRODUCTION

Indian agriculture today faces a myriad of challenges pressured simultaneously by several sectoral and non-sectoral demands. These challenges become all the more daunting by the extreme weather vagaries that have become a regular feature over the years. Rainfed agriculture is considered to be relatively vulnerable to climate variability and change in view of its heavy dependence on rainfall. People dependent on rainfed agriculture are also less endowed in terms of financial, physical, human and social capital limiting their capacity to adapt to the changing climate. Experience over the past five years shows that climate variability is already impacting Indian Agriculture. Heat wave during February-March in North India caused an estimated reduction in yield of wheat (6 million tons) in 2002-03. Similarly, delayed onsets of monsoon, mid-season and terminal droughts in rainfed areas are causing huge losses to agriculture and livestock production. Climate change/variability has been affecting the livelihood of farmers leading to the decline in productivity and profitability of farming enterprise.

The majority of farmers are small and marginal landowners who are resource-poor. They are most affected due to their low adaptive capacity and risk-bearing ability. By incorporating various adaptation measures in the agriculture system one can increase the resilience and adaptive capacity of the small land holders. Evolving climate resilient agricultural technologies that would increase farm production and productivity *vis-à-vis* continuous management of natural and manmade resources constitute an integral part of sustaining agriculture in the era of climate change. Keeping this information in view, iNational Initiative on Climate Resilient Agriculture (NICRA) is implemented as a network project of the Indian Council of Agricultural Research (ICAR) and is launched in February, 2011. The project aims to enhance resilience of Indian agriculture to climate change and climate variability through strategic research and technology demonstration. The project consists of four components viz. Strategic Research, Technology Demonstration, Capacity Building and Sponsored/Competitive Grants.

Technology Demonstration under NICRA

The technology demonstration component of NICRA is being implemented in 130 (100 KVKs in eight zones: 23 AICRPDA centers of dryland agriculture, technology transfer divisions of ICAR (7 core institutes) districts involving one lakh farmers with an aim to demonstrate integrated package of proven technologies for adaptation in crop-livestock production systems to mitigate adverse affects of climatic variability. In order to deal with climatic change under technology demonstration component of NICRA, extensive demonstration of location-specific best bet practices contributing to climate resilience was organized in 13 districts in Andhra Pradesh and Maharashtra. The project is implemented in selected districts by respective Krishi Vigyan Kendra (KVK).

Objectives:

- 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
- To enhance the capacity building of scientists and other stakeholders in climate resilient agricultural research and its application

Under this component, an integrated package of proven technologies would be demonstrated in one village panchayat in each district for adaptation with an aim to mitigate the ill-effects of climate variability in crop and livestock production systems.

Process of Project Implementation

As a part of the process each KVK has developed action plans by adopting following steps:

1. Formation of inter-disciplinary team consisting of specialists from plant breeding, Natural Resource Management (NRM), Agronomy, Horticulture, Plant protection, Livestock, Fisheries, Agricultural Economics, Extension and Home Science etc., The inter-disciplinary team formed in each KVK gave input in selection of an appropriate village, identification of climatic vulnerabilities with regards to agriculture and finalization of climate resilient technology package. The composition of the team varied depending upon the type of climatic vulnerability faced in selected village.
2. The target village was selected based on degree of vulnerability in the district by using secondary/published data like prolonged drought, dry-spells, extreme rainfall events, hailstorms, extreme temperatures, cold and heat waves, frost and flood ,etc.,

3. The village selected for the project activities represented the dominant cropping system of the district. The proportion of the rainfed area in the chosen village was supposed to be more than district average. A higher portion of small and marginal farmers were considered. It was made sure that majority of the farmers in selected village derived major portion of income from agriculture and allied activities. The climatic vulnerability of the village (Intensity of droughts, floods, Heat wave, cold wave etc.) represented that of the district.

4. Climatic characteristics of selected village in terms of quantum and distribution of rainfall, number of rainy days, intensity of rain-spells, number of dry spells over the last 10 years, length of growing season, number of floods that severely damage crops and livestock and other extreme events like frost, heat, cold waves, hail storms, sea inundation of agricultural fields was documented.

5. Participatory Rural Appraisal in selected villages was organized to understand major farming systems, resource situation and assessment of natural resource status, socio-economic, institutional and infrastructural status.

6. The multidisciplinary team in each KVK analyzed the constraints related to climatic variability and indentified the point of interventions focusing larger resource poor groups addressing resource conservation which give long term and sustainable benefits. The modules that were implemented in selected villages focused on building resilience in soil, adapted cultivars and cropping systems to climatic variability, rainwater harvesting and recycling, water saving technologies, community managed custom hiring centers, crop contingency plans, livestock and fishery interventions and institutional interventions for community owner ship of the programme.

The technological interventions were implemented on participatory mode. The team in each KVK documented the impact of modules with measurable indicators. The progress of the project activities in all NICRA villages was monitored by the Zonal Project Directorate and monitoring cell at CRIDA.

The interventions at each NICRA center cover the following four modules:

Module I: Natural Resource Management

This module consists of interventions related to in-situ moisture conservation, water harvesting and recycling for supplemental irrigation, improved drainage in flood prone areas, conservation tillage where appropriate, artificial ground water recharge and water saving irrigation methods.

Module II: Crop Production

This module consists of introducing drought/temperature tolerant varieties, advancement of planting dates of *rabi* crops in areas with terminal heat stress, water saving paddy cultivation methods (SRI, aerobic, direct seeding), frost management in horticulture through fumigation, community nurseries for delayed monsoon, custom hiring centers for timely planting, location specific intercropping systems with high sustainable yield index.

Module III: Livestock and Fisheries

This module consists of use of community lands for fodder production during droughts/ floods, improved fodder/feed storage methods, preventive vaccination, improved shelters for reducing heat stress in livestock, management of fish ponds/tanks during water scarcity and excess water, etc.

Module IV: Institutional Interventions

This module consists of institutional interventions either by strengthening the existing ones or initiating new ones relating to seed bank, fodder bank, commodity groups, custom hiring centre, collective marketing and introduction of weather index based insurance and climate literacy through a village level weather station.

2. Basic resources of selected NICRA villages

Andhra Pradesh

Anantapur

Anantapur is the second most drought-affected district of India. It falls under scarce rainfall zone of Andhra Pradesh. It is in the arid agro ecological zone and is marked by dry summers and mild winters. The NICRA programme is implemented in three clusters of the villages namely chamaluru, chakrayapeta and peravali. The cluster of chamaluru receives an average rainfall of 311 mm from June to September, 147 mm from October to December and 61mm from April to May. The village chamaluru has the population of 2790 with 519 total households. This cluster has the cultivated area of 2167 ha. The mean annual rainfall of the cluster is 522 mm. The village has 280 bore wells and 40 open wells. The predominant crops grown in this village are : *kharif* groundnut, castor, pigeonpea, maize, paddy, tomato and brinjal. The major *rabi* crops grown in this village are groundnut, paddy, brinjal , tomato and fodder crops. The live stock is an important component in the village. The village has 60 cattle, 200 buffaloes, 150 goat, 900 sheep, 10 pairs of bullocks and 300 poultry birds.

The chakrayapeta village has a population 180, 36 households and 104 ha of cultivated area. It receives an annual rainfall of 498 mm. The village has 5 bore wells. The major crops grown in this village are groundnut, castor, pigeonpea and fodder crops. Cattle (10), buffaloes (100), goat (50), sheep (2200), bullocks (5 pairs) and poultry birds (200) constitute important components of livestock grown in this village.

The village peravali has a cultivated area of 714 ha with 431 households. It receives 498 mm of annual rainfall. Groundnut, castor, tomato, pigeon pea and fodder crops are mainly cultivated in this village. The village has 62 bore wells and 66 open wells. It has 25 cattle, 200 buffaloes, 50 goats, 2250 sheep and 50 poultry birds. The cluster has both red and black soils. The range of ground water depletion in both black and red soils is 0.13-5.3m and 2.3-13.34 m respectively. The area experiences frequent droughts and water scarcity. Frequent dry spells, occurrence of late leaf spot (LLS), poor soil health and labour scarcity are few major constraints affecting the productivity in groundnut. Increased cost of cultivation due

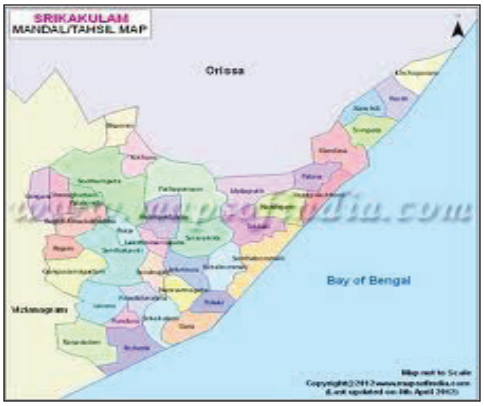
to high fertilizer application, high seed cost and poor LLS management are main reasons for low net returns. Horticultural crops (Mango, Citrus, Tamarind, Guava, Ber and Vegetables) are grown under irrigation. The important livestock in this village are dairy animals and poultry. Mortality and morbidity losses due to biotic and a biotic stress, fodder scarcity and poor access to live stock services are major livestock problems in this village.

Kurnool

Kurnool is one of the drought prone districts of Andhra Pradesh. Yagantipalle village which is located at a distance of 4 km from Banaganapalle Panchayat of Banaganapalle mandal with 70% of rainfed agriculture was selected for implementing NICRA project. The village has 361 households with 640 ha of cultivated area. The major soil types are sandy clay loam to clay loam. The village has 176 cattle, 976 buffaloes and 300 sheep and Goat. Desi cotton and pigeonpea are the main crops grown during *kharif* and sorghum, sunflower and chickpea in *rabi*. The village Meerapuram has1835 population with 381 households and 200 ha of cultivated area. The major livestock in this village are cattle (12), buffaloes (1154), sheep and goat (570). Sorghum and pigeonpea are important crops grown in this village. The major source of irrigation is bore wells. Most of the crops are affected by late onset of monsoons followed by dry spells during critical crop growth periods, which in turn is severely affecting the yield of these crops . The villages on an average receive a rainfall of 633 mm annually. Water scarcity, poor soil health, frequent droughts and losses due to pest and diseases are major climatic vulnerabilities faced by the farming community. Mortality and morbidity losses due to a biotic and biotic stresses, fodder scarcity and poor access to livestock services are major constraints for increased profitability in livestock.

Srikakulam

Srikakulam district of Andhra Pradesh is one of the flood prone districts in Andhra Pradesh. Heavy floods occur generally during September and occasionally in October and November due to heavy rain fall and depressions formed in Bay of Bengal. Sometimes, the crops at early stage are also prone to inundation due to heavy rain fall received in July. The normal annual rainfall received in the district is 1162 mm. But, the rainfall distribution is quite erratic. The Annampeta, Thimadam and Adduripeta villages in Burja mandal were selected for implementing the project activities during first year. These villages are mostly



rain fed. The rainfall distribution in these villages is irregular and the crops are mostly rain fed. During second year (2011-12), to cover the flood prone area, Sirisuwada village of Kothuru mandal was selected in *rabi* 2011-12 to make technological interventions in flood prone areas. The village is situated 3 km away from Kothuru mandal Head-Quarters. It has 250 village households with total cultivated area of 600 ha. The major existing soil types are red sandy and red sandy loams with clay base. The mean annual rainfall received is about 982 mm. The major existing cropping systems in this selected village are paddy/cotton/vegetables/ pulses/groundnut. Mid seasonal drought is most frequent due to erratic distribution of rainfall. The village is prone to floods due to excess rainfall received during monsoon season in low lying areas of around 150 acres lying near to Jagannathanaidu tank either due to overflow of hill stream in Marripadu gedda or water from Vamsadhara river.

West Godavari

Floods and cyclones are the major climatic constraints in the Godavari districts of Andhra Pradesh state. Rice is the major crop in this district and most of the crop gets damaged by heavy rains during August to September months. Matsyapuri village was selected to implement the activities of NICRA. The village has 1602 households. Rice is the major crop grown in 616 ha area. The village has 150 ha fish and prawn ponds. It receives a mean annual rainfall of 1185 mm. The major soil types are alluvial soils. The major existing cropping systems are paddy-paddy-pulses. Floods and cyclones are major climatic vulnerabilities limiting the productivity of crops. Water logging, mid season drought, poor soil health are major limitations that affect the crop productivity in this village. The major livestock in this village are small ruminants (62). Large ruminants in this village are 1041. The village has 1179 poultry birds. Mortality and morbidity during and post flood, loss of fish during floods and fodder scarcity are major constraints for livestock in this village.

Telangana

Khammam

Khammam district is situated in Northern Telangana State. The district comprises of 46 mandals under four revenue divisions namely, Khammam, Kothagudem, Palvoncha and Bhadrachalam. It is one of the agriculturally important districts in the state with a total geographical area of 16, 02,900 ha and net sown area of 4, 69,710 ha (29%). Nearly 47% area is under forests.

The village of Nacharam situated in Enkoor mandal of Khammam district is selected for implementing the project activities.

General Information of the NICRA Village

Name of the village	:	Nacharam and Cluster villages; Gangulanacharam, colony nacharam, Ramatanda, Bhadrutanda, Muniya tanda and Bheemlatanda
Population	:	3246
No. of households	:	749
Cultivated area	:	1382 ha.
Major crops	:	Paddy, Cotton, Chilli & Sugarcane
Soil type	:	Heavy and Light soils
Source of irrigation	:	Streams & Bore wells
Major climate challenges	:	Uneven distribution of rainfall, Seasonal drought and heat waves
Average rainfall	:	1053.5 mm
Water streams	:	4
Animal population	:	4352 (White cattle-897, Black cattle-928, Sheep-913, Goat-1614)

Nalgonda

Nalgonda district falls under Southern Telangana region. The village Nandyalagudem and Boring Thanda of Atmakoor (S) Mandal is selected for NICRA project activities. The village is having 50 ha total cropped area with 155 households. Sandy loams, loamy sands and light black to medium black soils exist in this village. The average rainfall is 750-850 mm. But the distribution of rainfall is erratic. The major crops grown in these villages are cotton, pigeon pea, green gram, paddy and vegetables. Late onset of monsoon, mid and terminal dry spells and poor soil health are most common climatic vulnerabilities of this village. Wells and bore wells are major sources of irrigation water. Heat wave affects the yield of Mango and sweet orange crops. Mortality and morbidity losses due to biotic and a biotic stresses and fodder scarcity are major causes for low productivity of livestock. Low seed replacement rate, poor access to improved seeds and farm machinery and poor livestock services are major Institutional limitations for enhanced livelihoods in this village.

Maharashtra

Ahmednagar

The village Shekta was selected to implement the NICRA activities in Ahmednagar district. The village has a total population of 1268 with 319 households. The major soil types in the village are black soils. The village receives mean annual rainfall of 537 mm. The main source of the irrigation is open wells. Pearl millet, *rabi* sorghum, maize, wheat and onion are the main crops grown in the village. Drought is the major climatic vulnerability of the village. The village has 859 cows, 454 goats, 6 buffaloes and 53 bullocks. The soils in the selected village are medium in nitrogen, low in phosphorus and high in potassium. The average EC and pH of soil: EC-1 to 2 and pH-8.3 to 9.0.The average EC and pH of water: EC-1 to 4 and pH-8.0 to 9.0. The average EC and pH of silt: EC-0.26 and pH 7.97. The soils in the village have 1-3m soil depth. These soils have low infiltration capacity. Hence water stagnation and soil erosion are major problems in the village. The soils show micro nutrient deficiencies like Fe and Mn. Low rainfall, frequent droughts, and fodder scarcity during summer are major constraints that limit the living standards of farmers in the village.

Amravati

NICRA village Takali (Bk), Nanggaon Kh (Taluk) is selected for implementing the project activities in Amravati district. The village has 424 village households. It has total cultivated area of 880 ha. Medium black cotton soils are the major soils in this selected village. The village receives an annual normal rainfall of 650 mm. Cotton, soybean, pigeon pea, chickpea and wheat are major crops grown in this village. Drought, water stress and heat waves are major climatic vulnerabilities faced by the farming community.

Aurangabad

The shektha village in Gangapur tehsil is selected for implementing the NICRA activities in Aurangabad district of Maharashtra. The farmers in selected village are cultivating 120 ha of cereals, 36 ha of pulses, 15 ha of oil seeds and 226 ha of cotton. The village has 380 ha of cultivated area out of which 75.5% area is rain dependent. The village on an average receives mean annual rainfall of 625 mm. It is predominated with black soils (Shallow to light). Water scarcity, poor soil health, intermittent dry spells are limiting the productivity of crops. Mortality losses due to abiotic and biotic stresses, scarcity of fodder resources are main constraints for stepping up milk productivity of live stock. Low seed replacement, poor access to improved seeds, farm machinery and livestock services are limiting the standards of living of the farmers

Gondia

The Krishi Vigyan Kendra, Hiwara of District Gondia is implementing the NICRA project in selected village Katangtola, The village has 862 households and has total cultivated area of 572 ha. The major soil types are loamy, sand and sand loamy. The village receives annual normal rainfall of 1400 mm. Rice is an important crop grown in this village. Drought is an important climatic vulnerability in this village.

Nandurbar

Umarani (NICRA village) is situated in the Satpura ranges of Nandubar district. It receives an annual normal rainfall of 813 mm. The frequency of intense rainfall is 2.5 as decadal average in that area. It has 257 households and also has total cultivated area of 539 ha. The main source of irrigation in the village is bore wells and natural drains. The existing soil types are red and black. The soils are having shallow rooting depth, prone to soil erosion (moderate to severe). Soil erosion is a serious problem faced by the farmers. Major cropping systems in the village are

soybean, sorghum, maize and pigeon pea. The village on an average receives 813 mm of rainfall. The major crops grown in the village are *kharif* sorghum, soybean, chickpea and mango. The major climatic risks in this village are drought and heat stress. Most of the tribal farmers have 7-8 mango trees in their fields. Preparation of mango slices from raw mango (Amchur) is the main activity in summer season which is very important monitory source for upcoming *kharif* season.

Pune

The village Jalgoan KP, located in Baramati tehsil was selected to implement the NICRA programme in Pune district of Maharashtra. It comes under western Maharashtra zone. The village has 398 households and has the population of 1268. The village on an average receives an annual rainfall of 537 mm. The major soil types existing in the village are medium black soils and are calcareous in nature. The village has total cultivated area of 1094 ha, out of which 980 ha are rainfed. It has livestock population of 869 cows, 454 goats, 6 buffalos and 53 bullocks. The major crops grown in the village are pearl millet, *rabi* sorghum, maize, onion and wheat. Drought is the major climatic vulnerability in this area.

Ratnagiri

Ratnagiri district of Maharashtra is high rainfall area with scarcity of water. The village selected under NICRA is Haral, Tehsil-Rajapur. The village has 353 households with a cultivated area of about 139 ha. Major existing soil types are red lateritic soils. It receives mean annual rainfall of 3594 mm. The major cropping systems in the village are rice and small millets. Farmers are cultivating crops like horse gram which can be grown on residual moisture. Cashew and mango are important fruit crops in this village. Sheep, goat, and dairy are important livestock enterprises in this village. Farmers are dependent only on agriculture for their livelihood and very few are engaged in agro enterprises. High rainfall with scarcity of water as a result of runoff is a major climatic vulnerability in this village.

Table 1: Details of various NICRA centers of Zone-V

Selected District	Name of NICRA village/villages	Actual rainfall (mm) 2013	Soil types	Major climatic variability
Andhra Pradesh				
Anantapur	Chamaluru and Chakrayapeta	268	Red soils	Drought
Kurnool	Yagantipalle	620	Black soils	Drought
Srikakulam	Sirusuwada	1613	Red sandy soils	Floods
West Godavari	Matsyapuri and Veera Varsam	842.3	Alluvial soils	Floods
Telangana				
Khammam	Nacharam	1151	Black red soils	Drought, Heat stress
Nalgonda	Nandyalagudem and Boring Thanda	1188	Black soils	Drought, Heat stress
Maharashtra				
Ahmednagar	Nirmal Pimpri	511	Black soils	Drought
Amravati	Takali BK	1002	Black soils	Drought, floods
Aurangabad	Shekta	513	Black soils	Drought
Gondia	Katangtola and Chandinitola	1418	Sandy loams	Drought
Nandurbar	Umarani	1242	Red&Black soils	Heat stress, drought
Pune	Jalgoan KP	469.2	Black soils	Drought
Ratnagiri	Haral	3781	Red &Lateritic solis	Floods

2.1 Rainfall pattern in different NICRA centers

It was observed that the rainfall received in 2013 was excess by 384 and 349 mm compared to the normal rainfall in districts of Nalgonda in Telangana, Srikakulam in Andhra Pradesh respectively. The rainfall was higher by 19.67, 6.26, 10.44, 52.76 and 12.02 percent than respective normal rainfall in the districts of Ahmednagar, Amravati, Gondia, Nandurbar and Ratnagiri districts of Maharashtra state. The rainfall was deficient by 0.86, 45.75 and 2.05 percent in districts of Khammam in Telanagna and Anantapur and Kurnool districts of Andhra Pradesh respectively. While in Maharashtra, the rainfall was less by 7.0 and 20.34 in the districts of Pune and Aurangabad respectively.

Table 2: Total rainfall of NICRA villages in Andhra Pradesh, Telangana and Maharashtra

State	District where NICRA centre is located	Normal Rainfall (mm)	Rainfall During 2013 (mm)	Rainfall excess/ deficit (mm)	Deviation of rain fall from the normal i.e., $\frac{\text{Actual-Normal}}{\text{Normal}} \times 100$
Andhra Pradesh	Anantapur	494	268	-226	-45.75
	Kurnool	633	620	-13	-2.05
	Srikakulam	1264	1613	+349	+27.61
	West Godavari	1077	842.3	-235	-21.81
Telangana	Khammam	1161	1151	-10	-0.86
	Nalgonda	804	1188	+384	+47.76
Maharashtra	Ahmednagar	427	511	+84	+19.67
	Amravati	943	1002	+59	+6.26
	Aurangabad	644	513	-131	-20.34
	Gondia	1284	1418	+134	+10.44
	Nandubar	813	1242	+429	+52.76
	Pune	505	469.2	-54	-7.00
	Ratnagiri	3375	3781	+406	+12.02

Table 3: Distribution of the rainfall of different NICRA centers during cropping season of 2013.

Centre	June		July		Aug		Sep		Oct		Nov		Dec		Total	
	N	2013	N	2013	N	2013	N	2013	N	2013	N	2013	N	2013	N	2013
Andhra Pradesh																
Anantapur	64	39	67	19	89	12	118	174	111	24	35	0	10	0	494	268
Kurnool	65	72.2	107	95.3	115.0	106.6	120.0	186	117.0	44.6	26.0	4.2	8.0	0	558	508.9
Srikakaulam	146.0	206	239	293.2	205.0	232.2	188	287.9	177	430.2	60.0	11.2	1.0	0	1016.0	1460.7
West Godavari	115	121.4	265	185.5	190	23	178	0	190	355.2	65	25	15	40.6	1018	750.7
Telangana																
Khammam	131	186.6	304	283.2	300	240	151	175.2	114	190.4	25	2.6	3.0	12.4	1028	1090.4
Nalgonda	102.5	68	185.2	241	194.7	234	151.1	239	114.1	225	26.7	111	1.7	0	776	1118
Maharashtra																
Ahmednagar	95.4	104.8	69.4	71.4	56.9	34.6	133.1	173.0	58.1	85.3	9.1	31.0	5.3	0	427.3	500.1
Amravati	146	332	276.5	337.5	219.8	32.3	172.2	202.2	46.4	0	20.5	19.3	8.6	0	890	923.3
Aurangabad	131.8	125	101.0	127	133.3	59.0	172.2	151.0	69.0	48.0	22.8	0	11.1	0	641.2	510.0
Pune	78.5	115.2	56.7	76.8	67.4	39.4	150.1	203.4	72.2	34.4	32.1	0	5.3	0	462.3	469.2
Gondia	184.8	235.8	410.7	593.5	417.0	404.3	205.2	111.3	66.6	79.5	0	0	0	0	1284.3	1424.4
Nandurbar	120.1	181	256	305	198	249	187.6	448	51.8	59	0	0	0	0	813.5	1242.0
Ratnagiri	817.9	944	1239.8	1727.2	829	620	359.7	343	128.4	146.8	0	0	0	0	3374.8	3781.0

2.2 Distribution of rainfall in different NICRA centers

Andhra Pradesh

Anantapur

In NICRA village i.e. chamaluru during 2013, total rainfall received was 268 mm in 15 rainy days. Rainfall received in the month of June was useful for land preparation. But rainfall received in the months of July and August was not sufficient to take up sowing of crops. Hence farmers of NICRA village could not take up sowings. But in the month of September, heavy receipt of rainfall (174 mm) occurred within 6 rainy days. Due to delayed monsoon, most of the farmers have taken up short duration contingent crops such as setaria, sorghum and sunflower and few farmers cultivated groundnut. Distribution of rainfall was not uniform in NICRA villages due to temporal and spatial variability. Late sown groundnut crop was subjected to moisture stress during key developmental stages resulting in prematurity of the crop (90 days) and drastic reduction in yield. Other contingent crops performed better under delayed monsoon conditions.

Kurnool

During 2013 total rainfall received was 620 mm as against normal rainfall of 633.0 mm. *Kharif* sowings were taken up with the rain fall received during last week of July. Among the *kharif* crops seteria, pigeonpea and castor performed well with reasonable yields. The rainfall was excess by 7.2 and 66 mm during the months of June and September respectively compared to the normal rainfall of corresponding months in 2013. The total rainfall was deficient by 11.8, 8, 72, 22 and 8 mm than normal rainfall received during the months of July, August, October, November and December respectively. Sowing of chickpea was taken up during *rabi* with the rainfall received during 2nd week of October. All *rabi* crops suffered acute moisture stress as there was dearth of stored soil moisture in the early stages of crop growth and subsequent prolonged drought conditions. Only during fag end of November scanty rain was received which could not boost crop growth. Ultimately these aberrant weather conditions reflected badly on the crop yields.

Srikakulam

The NICRA center in Srikakulam district of Andhra Pradesh received excess rainfall of 60, 54, 27, 100 and 72.4 mm during the months of June, July, August, September and October respectively than normal rainfall. Direct sown paddy at seedling stage was inundated nearly for 5 days and the crop failed in high inundated area. Medium duration varieties of paddy were affected at panicle initiation stage and the crop was slightly lodged. Boot leaf was twisted and crop was submerged in water. Long duration varieties were at maximum tillering to panicle initiation stage when the flooding took place. Vegetables crops were submerged while they were at vegetative stage.

West Godavari

The rainfall received during the months of July, August, September and November was deficient by 80,167,178 and 40 mm as against the normal rainfall received in the respective months. But higher rainfall of 6.4,165 and 26 mm was received in the months of June, October and December than corresponding normal rainfall. The rainfall of 355 mm received in the month of October and occurrence of Helen cyclone in the months of November and December caused water stagnation for paddy crop. During the first week of November heavy rains occurred in this area due to Neelam cyclone and most of the fields were submerged and crops were damaged. During this period the rainfall in Matsyapuri village was up to 162.4 mm.

Telangana

Khammam

In NICRA village of Khammam district, the rainfall received was excess in the months of June, September, October and December by 56, 24, 76.4 and 9.4 mm as compared to the normal rainfall of corresponding months during this year. The rain fall was deficient by 21, 60 and 22.4 mm as against normal rainfall received in July, August and November months during 2013. The rainfall was deficient by 20% in the month of August and 90% during the month of November. Normally the sowing of paddy was taken up in third week of June and transplanting was done in 3rd week of July. The other crops grown in this village were cotton and pulses. A total of 190.4 mm rain fall was received compared to normal rainfall of 114 mm which was 67% excess than the normal rainfall received in the month of October, 2013 due to the attack of Phailin cyclone. The paddy crop was seriously affected during the harvesting stage due to heavy rains. In cotton which was at boll ripening and bursting stage damage occurred due to boll rotting and some of the seeds germinated on standing crop and the quality of lint was badly affected.

Nalgonda

Cotton, paddy, pigeonpea, greengram, chilles and vegetables are predominant crops grown in the selected villages of Nalgonda district. The NICRA village in Nalgonda district received higher rainfall by 56, 40, 88, 111, 85 mm during the months of July, August, September, October and November respectively compared to the normal rainfall received during corresponding months.

During this year (2013) the rainfall was less by 35, 111.7 mm during the months of June, Dcember.. The rainfall of 17 mm received in second fortnight of June facilitated land preparation for sowing crops of cotton, pigeon pea, greengarm and chillies. Sowing of rain fed crops was done during first fortnight of July. The crops experienced dry spells during first and second fortnights of August. However the crops recovered from the dry

spells with the receipt of 218 mm of rainfall from 14th to 16th August 2013. Fifteen days of dry spell from 1st to 15th September affected flowering and boll formation of cotton and reproductive phase of green gram. The continuous dry spell from October and November severely affected the yield of cotton, chillies and pigeon pea. Thus erratic distribution of rainfall was not favorable to get normal yields of rain fed crops. The continuous wet spells received during the months of August, September and October created water stagnation in black soils resulting in damage of lint in cotton.

Maharashtra

Ahmednagar

The rainfall in NICRA village of Ahmednagar was excess in the months of June, July, September, October and November by 9.4, 2, 40, 27, 22 mm compared to the normal rainfall received in respective months in 2013. The rainfall was deficient by 22 mm in the month of August. This year onset of rainfall was in time i.e. in second week of June. Sowing of *kharif* crops was completed in the second and third weeks of June. After sowing there was a dry spell of 23 days during 4th week of June to 3rd week of July. Initial vegetative growth of the crop was adversely affected. Crop reached reproductive stage without sufficient vegetative growth. During flowering and pod filling stage there were again continuous dry spells of 11 and 26 days, which affected pod filling badly. Grain size was smaller than average and farmers who could not give protective irrigation suffered losses due to reduced yields.

Amravati

The rainfall in selected NICRA village was deficient by 188, 46, 1 and 11 mm in the months of August, October, November and December as against the normal rainfall received in corresponding months respectively. The rainfall of 332 mm received in the month of June facilitated the farmers for land preparation and also timely sowing of *kharif* crops. The rainfall was much favourable for short duration crops like soybean and also for vegetative growth of long duration crops like pigeon pea and cotton. Long duration crops like cotton and pigeon pea experienced moisture stress at reproductive phases due to long dry spells in the months of November and December. The excess rainfall received in the month of September created the problem of water stagnation and also resulted in sprouting of seed in the standing crop of soybean. Hailstorms and excess rainfall caused lodging of wheat, cotton and chickpea.

Aurangabad

The NICRA village of Aurangabad district received excess rainfall of 26 mm during the months of July against the normal rainfall received, but the rainfall was deficient by 6.8, 74.3, 21.2 and 21 mm during the months of June, August, September and October than the normal rainfall received during respective months. The rainfall of 125 mm received

in the month of June facilitated land preparation for *kharif* crops. The complete dry spell experienced from october13th to 30th December affected the productivity of long duration crops like pigeonpea and cotton and *rabi* sorghum.

Gondia

The NICRA village in Gondia district received excess rainfall by 51,183 and 13 mm during the months of June, July and October as compared to the respective normal rainfall received during this cropping season. The rainfall in the selected village was less in the months of August and September by 13 and 94 mm as against the normal rainfall received in corresponding months. During the year 2013-14, rainy season started on 4th June at proper time. Land preparation completed in the summer season. Timely commencement of rains helped the farmers for sowing paddy seed in nurseries. The growth of seedlings was satisfactory. However the occurrence of excessive heavy rains (more than 60 mm/day) in 6 rainy days hampered the growth of paddy seedlings in nurseries and after transplanting, thereby reducing the number of tillers per plant, root establishment, photo-synthetic activities etc. The plants were also submerged affecting the growth adversely. Pest attack was also observed on the crop. All the above conditions drastically reduced the paddy yield, as the tillering and flowering stages were affected.

Nandurbar

The rainfall in the selected village for NICRA programme was excess in June, July, August, September and October by 60.9, 49, 51, 260.4 and 7.2 mm respectively compared to the normal rainfall received in corresponding months. The important crops raised in this village are maize, groundnut, pigeon pea, soybean and chickpea. The rainfall of 181mm received in the month of June was helpful for land preparation and sowing of *kharif* crops. The excess rainfall received in the months of July, August and September created water stagnation in the village fields.

Pune

The rainfall during the year 2013 was characterized by 3 dry spells ranging from 10 to 28 days and annual rainfall of 469.2 mm. The annual effective rainfall was only 351.3 mm. (Calculated from USDA S.C. Method). There was 62 mm rainfall on June 2, 2013 which was effective for the sowing of pearl millet crop in the village. Farmers in the village undertook tillage practices in the month of April and May prior to the onset of monsoon. Sowing of pearl millet was done in the second and third week of June at available soil moisture condition. After sowing of pearl millet there was no effective rainfall in the succeeding month and therefore no water harvesting took place in the village and in turn no ground water recharge. Farmers were not able to give protective irrigations to pearl millet. Farmers have chosen cultivation of onion, maize and sunflower as contingency crops. These crops

were sown during last week of July and first week of August when there were showers of rain ranging from 2 to 16 mm. In the second week of September there was good rainfall which was necessary for sowing of *rabi* sorghum. The *rabi* sorghum was sown during the last week of September and in the first week of October. It was observed that June and September months received much of the annual rainfall which was 115.2 and 203.4 mm respectively. Though the monsoon was earlier than its regular arrival during *kharif* and *rabi* seasons, there was yield reduction in the crops grown in *kharif* due to long dry spell. The offseason rainfall and hailstorm in the month of February and March 2014 was detrimental to the quality of *rabi* sorghum (dry fodder). It was observed that there was increase in disease incidence in *rabi* Sorghum in the month of December 2013 and January 2014.

Ratnagiri

At the selected village of Ratnagiri district, the rainfall received was excess by 126, 487 and 18.6 mm during the months of June, July and October respectively than respective normal rainfall received in corresponding months during this rainy season. The amount of 1727 mm rainfall received during the month of July resulted in loss of paddy seedlings transplanted in the field. The rainwater flow from upper regions caused severe soil loss and the nala's and bunds constructed in the fields were washed away. Under this situation cow pea became alternative crop in place of rice.

Fig 1: Distribution of rainfall in different NICRA centres of Andhra Pradesh

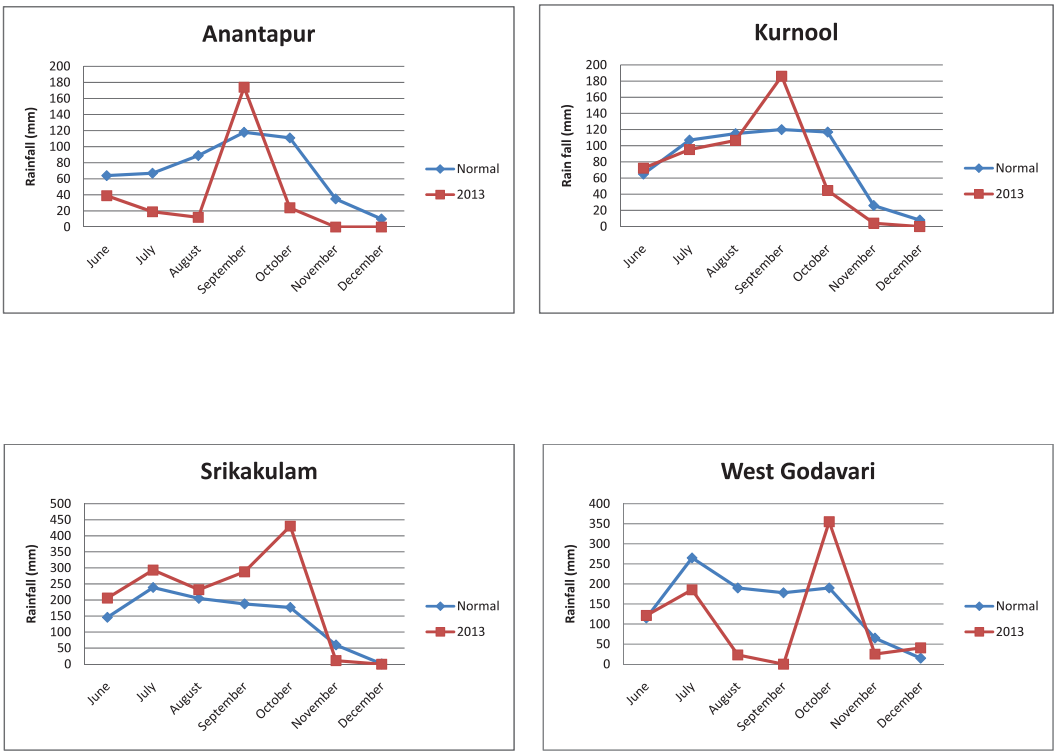
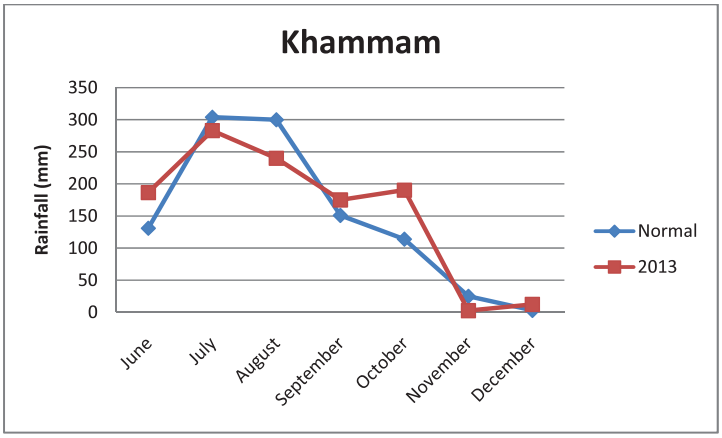


Fig 2: Distribution of rainfall in different NICRA centres of Telangana



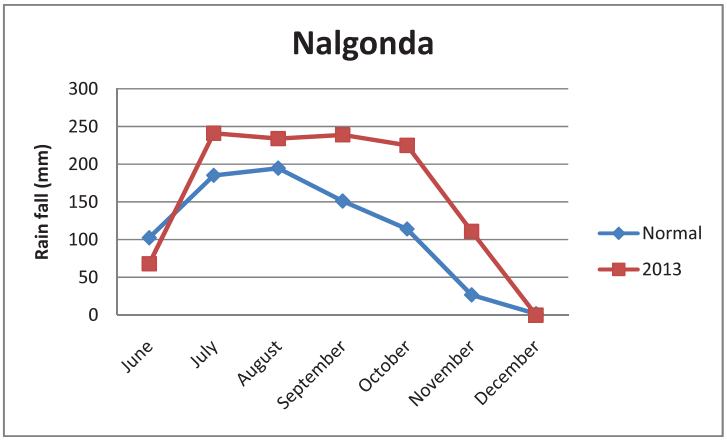
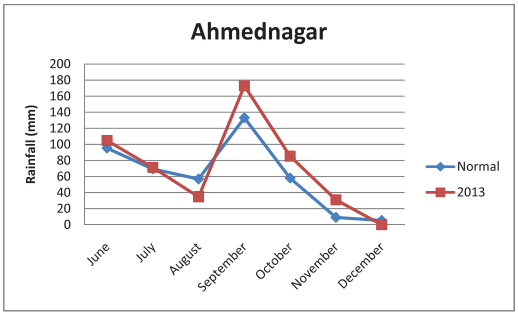
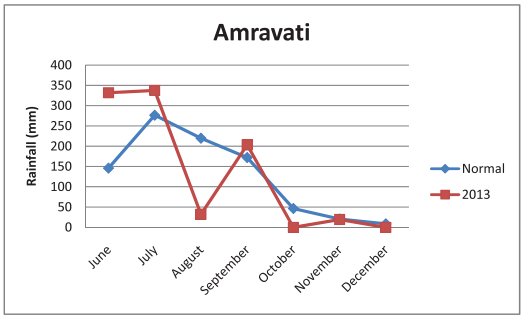
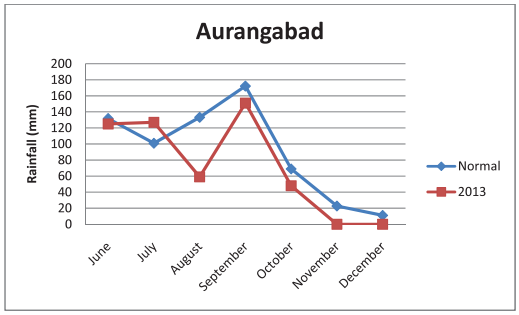
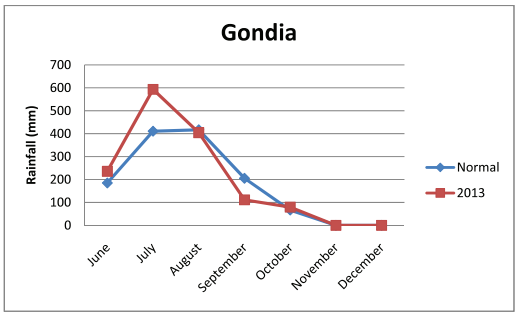


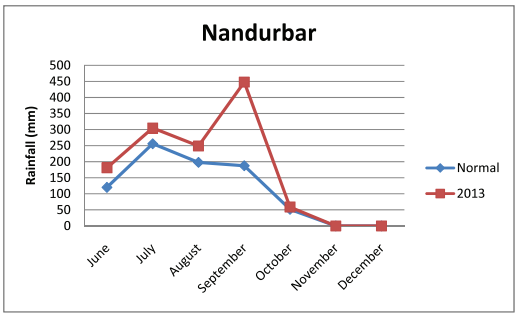
Fig 3: Distribution of rainfall in different NICRA centres of Maharashtra

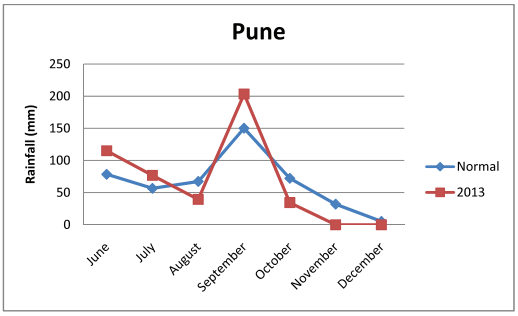












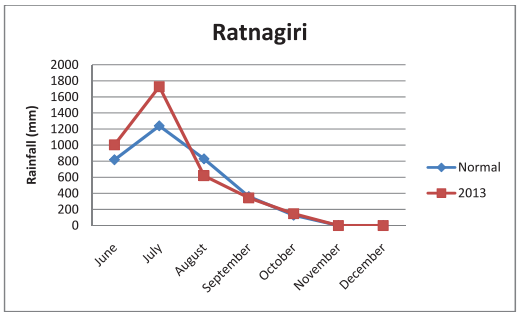


Table 4: Incidence of dry spells and continuous wet spells in different NICRA centres during 2013.

Centre	Rainfall (mm) during the cropping season	Dry spells (More than 10-15 days)	Continuous wet spells (More than 100 mm)
Andhra Pradesh			
Ananatpur	268.0	10th June-16th July (27 days), 8th July-15th August (39 days), 17-31st August, 18th September-23 October (45 days) 27th October-30th December	No wet spells
Kurnool	508.9	18th July-1st September (15 days), 9th-20th October (12 days), 25th Ocotober-30th December (67 days)	4th-14th July (10 days)
West Godavari	754.5	July 24-August 2 (10 days), August 8-October 21 (72 days), October 30th -20 (22 days), November 23-December 30th (39 days)	July 15-23 (94.4 mm), October 22-27 (345.2 mm)
Srikakulam	1016.0	July 27-August 5th (10 days), August 22-31 (10 days), October 29th - November 22nd (24 days)	June 12-15th (162 mm), July 12-13th (111.8 mm), October 22-28th (328.8 mm)
Telangana			
Khammam	1090.4	From 29 October-30th December (63 days)	From July 10th-20th (134 mm), 13-19th August (167.6 mm), 23-27th October (101.8 mm) due to phailine cyclone
Nalgonda	1118.0	23rd July- 13th August (21 days), 17-30th August (14 days), 3-21st November (18 days), 23 November-30th December (380days)	14-16th August (218 mm), 15-16th September (125 mm), 22-25th October (108 mm)

Maharashtra			
Ahmednagar	511.1	25th June-14th July (21 days), 14th August-7th September (23 days), 20th -30th September (10 days), 15th -30th October	15-19th August (151 mm)
Amravati	924.4	13-17th June (191 mm), 30&31st July (106 mm)	14-31st August (17 days), 10-31st September (20 days), 1-31st October (31 days), 1-24 November (24 days), 1-30th December (30 days)
Aurangabad	641.2	19th August-9th September (22 days), 30th August-13th September (10 days), 17-30th December (83 days)	No wet spell
Pune	469.2	3-28th August (25 days), 1-17th October (17 days), November (30 days)	9-15th September (124.6 mm)
Gondia	1418.0	7-14th July (269.5 mm), 29 July-1st August (142.25mm), 16-24th August (258.75 mm)	November-December (60 days)
Nandurbar	1455.0	20-29th July (10 days), 27 August- 7th September, 10-31st October, (20 days), November-December (60 days)	14-19th June (127 mm), 4-5th July (96 mm), 12th July-4th August (223 mm), 22nd – 25th September (547 mm)
Ratnagiri	3781.0	From October 18-31st October	From 7th June to 31st August 3288mm

3. Natural Resource Management

Soil and water are basic resources that sustain productivity not only in rain dependent crops but also in irrigated agriculture. Drought, floods and temperature are major climatic variabilities that encountered the productivity of various crops in different districts of Andhra Pradesh and Maharashtra. Many technologies that are generated in the NARS system in addition to innovations of the farming communities were assessed to protect the natural resources against climatic risks.

Rainwater harvesting and water management

3.1 *Ex situ* water harvesting and efficient use

Andhra Pradesh

Anantapur

Anantapur is one of the Drought-prone districts in the rain shadow area of Andhra Pradesh particularly in southern India. The average rainfall is around 550 mm per year; some parts of the district have recorded as low as 200 mm in bad years and as high as 900 mm in good years of rainfall. Anantapur is the second most drought-affected district of India. Over the years, the process of desertification has been taking place in large tracts of the district because of soil erosion and sand casting on one hand and Monocropping, deforestation, and excessive use of ground water on the other.

Desilting of Check dams

The activity of desilting the check dams (5) was initiated in NICRA villages of Chamaluru and chakrayapeta in Anantapur district. The capacity of check dam before and after desilting was 1150 and 2922 cu.m respectively. About 6 bore wells were located in the premises of check dam. The ground water table in the bore wells was increased by 2-3 meters and discharge of wells was increased by ½ inch. The check dam was filled with the receipt of rainfall on 4th September 2013.

Table 5: The Dimensions of check dams before and after desilting are as follows:

S. No.	Name of Village	Dimensions of Checkdam before de-silting	Dimensions of Checkdam after de-silting
1.	Chamaluru	17x13x1m	25x13x2 m
2.	Chamaluru	30x15x1.5m	30x22x2.5 m
3.	Chamaluru	33x3x1.5m	33x7x2 m
4.	Chakrayapeta	10x7x1.5m	10x8x2 m

Renovation of percolation ponds

The renovation of existing percolation ponds (3) was done in NICRA village of Chakrayapeta during 2013. The capacity of the structure before renovation was 396 cu.m while it increased to 1012.5 cu.m after renovation. About 10,12,500 liters of rain water was collected from runoff water from rain received on 4th sept.2013. The stored water fulfilled the drinking water needs of the livestock. About 4-6 bore wells were located in the premises of percolation ponds. The groundwater table in these wells was increased by 2-3 meters. The discharge from these wells was increased by ½ inch.

Table 6: Dimensions of percolation pond before and after renovation

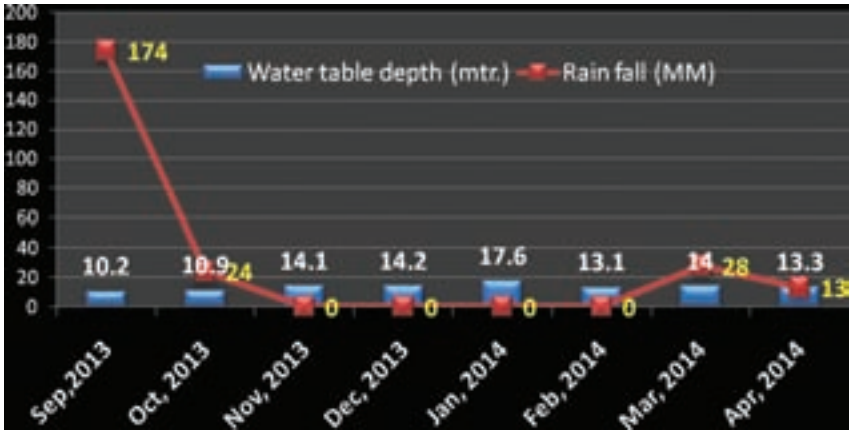
S. No.	Name of the Village	Type of pond	Dimensions of percolation pond	
			Before renovation	After renovation
1.	Chakrayapeta	Individual	9x9x1 m	10x10x2 m
2.		Community farm pond	10x9x1 m	10x10x2.5 m
3.			15x15x1 m	15x15x2.5 m

Measuring water table depth in bore wells by using water level indicator

Edification of new farm ponds -1

A new farm pond with a water storage capacity of 7, 26,000 liters was constructed. This farm pond was filled two times with runoff water. Five bore wells located in the vicinity of farm pond were recharged. One defunct bore well became functional and irrigated area increased to 2 ha.

Farm pond (22x22x1.5 m) filled with runoff water at chamaluru village

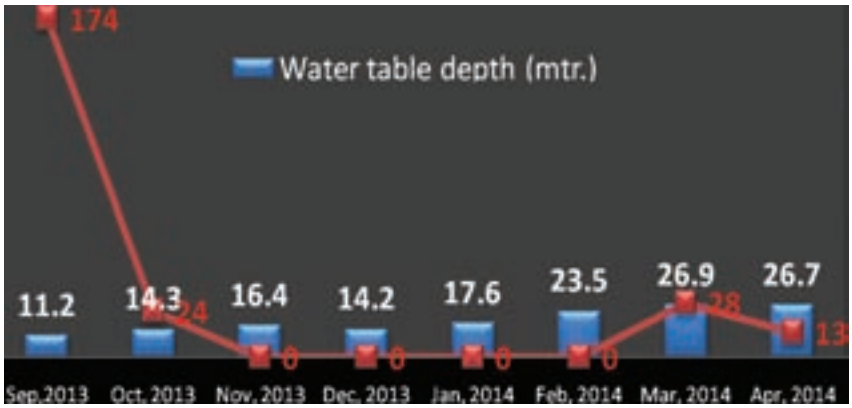


Water table depth in the farm pond before and after edification

Edification of new farm ponds -2

Size of another farm pond was extended from 12x8x2.5 m to15x11x2.5 m as a result of edification. Two bore wells were located around the farm pond. One defunct bore well become functional and the runoff water was useful for drinking purpose of the livestock.

Farm pond filled with runoff water Zonal Monitoring Team, NICRA visited farm pond at chakrayapeta



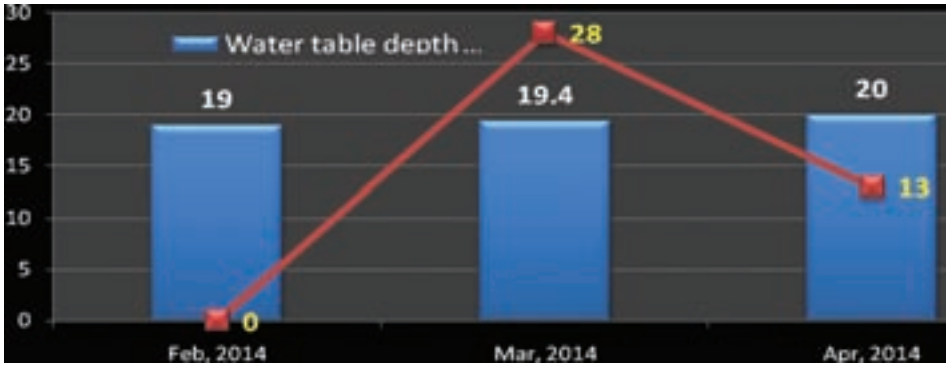
Water table depth in the farm pond before and after edification

Edification of new farm ponds -3

A farm pond with a size of **25x15x2 m** and water storage capacity of **6, 60,000 liters** was constructed. About 5-6 bore wells located in the premises of farm pond were recharged. Runoff water was also useful for drinking water purpose of livestock.

New farm pond (25x15x2m) at Peravali

Farm pond filled with runoff rain water



Water table depth in the farm pond from February to April

Desilting and recharge of open wells

One open well was desilted and a stone wall was constructed to divert the runoff rain water into open well. Two bore wells located in the premises of open well were recharged and area under irrigation was increased to 1 hectare.

Water level before recharge

Water level after recharge

Table 7: Impact of open well on recharge of borewells

Bore no.	Distance from open-well (m)	Water table depth (m)								Rainfall particulars		
		Sep, 13	Oct, 13	Nov, 13	Dec, 13	Jan, 14	Feb, 14	Mar, 14	Apr, 14	Month	Rain-fall (mm)	Rainy days
1	21 (F)	7.75	10.25	12.00	13.50	18.25	15.5	14.25	12.5	Sep,13	174	6
2	121 (De-funct)	9.00	10.87	11.37	14.87	21.50	12.75	13.00	17.50	Oct,13	24	3
										Nov,13	0	0
										Dec,13	0	0
										Jan,14	0	0
										Feb,14	0	0
										Mar,14	28	2
										Apr,14	13	1

Kurnool

Bore well recharge pits

Kurnool district is drought prone area in which ground water resources are becoming biggest constraint. In this context, an attempt was made to increase the water level in bore wells through recharge pits in NICRA village. Recharge of bore wells with recharge pits near bore wells were taken up in 10 farmer fields. The pits of size 2x2x2 were made and pits were filled with 40 mm stone material (0.6 m thickness) at the bottom. Then second layer with smaller stones of 20 mm (0.4 m thickness) followed by coarse sand (0.3m), fine sand (0.3m) and with coconut coir (0.2 m).

Preparation of bore well recharge pits

Desilting of Burrakunta tank

Desilting of Burrakunta tank was initiated in NICRA village of Kurnool district of Andhra Pradesh. After desilting, the water table in bore wells located in the premises of tank was increased from October 2013 to February 2014. The availability of water in water storage structure was highest in the month of September followed by October. Forty bore wells were available nearby the tank. On an average, each bore well could irrigate 3.5 acres in October and November 2013.

Table 8: Details of ground water recharge (Total number of borewells-40

Month	Water table in the bore well (ft)	Availability of water in Water storage structure (ft.)	Average area irrigated acre / Bore well	Rainfall (mm)
June	166	3.3		72.2
July	56	5.4	2.0	95.3
August	40	7	3	106.6
September	30	9	4	186.6
October	45	8	3.5	44.6
November	65	5	3	4.2
December	98	3.6	2.5	0
January	125	2.8	1	0
February	135	2.2	0.75	0

Srikakulam

Renovation of Jagannadha Naidu tank

Renovation of Jagannadha naidu tank was initiated in NICRA village of Srikakulam district of Andhra Pradesh during 2011-12. The rain water collected from July to December in

2011, 2012 and 2013 was 55531, 55531 and 138575 cu.m respectively. In 2013, the water collected from January to April was in the order of 98 and 722 $m^{3.}$ The average depth of water in 20 acre area of the tank was 4 feet. The water stored in the Jagannadha naidu tank was used for timely transplanting and other *kharif* paddy operations from May to June of 2013. The water in the tank was used for raising *rabi* crops like rice fallow pulses, maize, sunhemp, sun flower, brinjal, tamato, water melon and ground nut. Before bund strengthening, sluices repair and renovation of tank the water overflow occurred during heavy rains in tank fed areas. The flood intensity was reduced after the renovation due to enhanced storage capacity of the tank and strengthening works.

Improvement of Jagannadhanaidu tank

Repairs to Sluice

Telangana

Nalgonda

Desilting of check dam

Nalgonda is one of rain fed districts in Telangana state. Drought is a recurring problem in this area. Hence an attempt was made to desilt the check dam in NICRA village. The status of water level nearby bore wells was monitored. The study showed that the water level in the bore wells was maximum from October to December (30-35 ft). On an average each bore well near the vicinity of check dam could irrigate 2-3 acres.

Table 9: Status of ground water level

Month	Height of water level in the well (ft)	Availability of water in storage structure (%)	Average area irrigated acre/ well	Rainfall (mm)
June	10	25	2	68
July	17	75	3	241
August	20	100	4	234
September	25	100	4	239
October	35	100	4	225
November	33	75	3	111
December	31	60	3	-

Maharashtra

Ahmednagar

Desilting of water tanks

Desilting of water tank in NICRA village was started in 2011 and was completed in 2012. The amount of rain water harvested was 490.83 lakh liters. Desilting of tank helped to increase the water level of 126 wells and 183 bore wells in the vicinity of tank. The water stored in desilted tanks was to the tune of 2-4 m. Out of 9 tanks 6 tanks were filled once with water in 2013-14. As a result of ground water recharge, the water levels of surrounding wells increased by 3-5 feet.

Table 1 0: Water levels in the tank before and after desilting

Name of the tanks	Av. well depth in ft	Water level in well in ft.				
		Aug.	Oct	Dec	Feb	March
Gav tank	53.0	11.8	17.2	29.2	37.8	44
Nirmal tank-4	48.3	10.7	15	25.3	42	45.8
Nirmal tank-5						
Nirmal tank-6						
Ilhe tank	44.0	18.8	25.6	34	39.4	41.4
Above tanks were filled by lift irrigation						
Kavadvihir tank	46.0	20.2	26.8	34.4	43.2	54
KT weir -1	41.7	17.0	27.7	45.2	38.7	40.3
KT weir -2	50.0	21.2	35.2	38	44.8	47.2
KT weir -3	50.0	22.6	30	38.4	44.4	46.0
Water was not stored in above tanks						

Amravati

Desilting of farm pond and cement plug

The activities of desilting of farm ponds (3) were taken in NICRA village of Amravati district in Maharashtra during 2011-12. The capacity of structures before and after desilting was 2356 and 8400 meters respectively. The water stored in these structures was used for supplemental irrigation for *rabi* crops and also for spraying of pesticides in different crops. The depth of water in these structures ranged from 0.5 to 0.6 meters during the rainy season. About 75 trolleys of silt was applied to nearby farmers fields.

Renovated check dam

Nandubar

Creation of water storage in Nala

Water is needed for supplemental irrigation during dry spells as well as in *rabi* season. There are natural streams flowing in rainy season. But the water cannot be harvested as there is no sufficient storage. Water from these natural streams can be harnessed if there is

storage facility. Creation of ponds in nalas has provided water storage. Three ponds were dug out in the nala but two ponds were silted in the rainy season. Only one pond has found useful. The capacity of ponds in nala was 54 cu.m after digging. The depth of water in the farm pond was 1.5 m.

Construction of check dam-Sand bag structures

Construction of check dam with Sand bag structures was done in NICRA village of Nandurbar district to increase the area under irrigation and to improve the productivity of *rabi* crops under limited irrigation situation. Though the natural streams have been flowing throughout the *rabi* season, there is no sufficient storage of water for pumping, water is not being utilized by the farmers efficiently. Some of the farmers cultivate chick pea under rain fed conditions. Some of the farmers keep their land fallow in *rabi* season. The farmers who own their land along the sides of natural streams could not harness water for irrigation. Chickpea was irrigated thrice in the *rabi* season.

3.2 In-situ moisture conservation technologies

Conservation furrows

Anantapur

The pod yield in groundnut was enhanced by 16% by adopting conservation furrow at 3.6 m interval compared to farmers' practice in NICRA village at Anantapur. But, due to delayed monsoon, groundnut crop was sown in 2nd FN of August, yield was very low.

Conservation furrows in groundnut

Kurnool

At NICRA village of Kurnool, conservation furrows in between rows in castor gave higher bean yield 179 kg/ha) and net income (Rs. 5820/ha) than no conservation furrows (1156 kg/ha and net income Rs. 12499/ha)

Nalgonda

Formation of conservation furrows after every ten rows of cotton realized an additional yield of 250 kg seed cotton and also additional net income (Rs. 8500/ha) over no conservation furrows in NICRA village of Nalgonda district of Telangana state.

Aurangabad

In NICRA village of Aurangabad district, Opening of furrow after every fourth row in pigeonpea increased additional seed yield of pigeon pea by 160 kg/ha and net income by Rs. 6320/ha than no conservation furrows (1040 kg/ha) which gave net income of Rs. 43680/ha. In maize, conservation furrows enhanced the additional yield (567 kg/ha) than control (2710 kg/ha). Opening of furrow after every fourth row of Bt Cotton recorded higher net income (Rs. 4940/ha) over no conservation furrows (Rs. 43660/ha). Cultivation of ginger on raised bed increased rhizome yield by 46.66% than no conservation furrows (Rs. 22000 kg/ha).


Opening furrow in cotton


Opening furrow in pigeonpea

Broad bed furrow system

Amravati

Sowing of soybean on broad bed furrow gave highest seed yield (2400 kg/ha) and net income (Rs. 44200/ha) followed by ridge and furrow which gave the seed yield of 2250 kg/ha and also net income of Rs. 41750/ha. While conservation furrow system enhanced the seed yields by 300 kg/ha than no conservation furrows (1750 kg/ha). Improved conservation measures like broad bed furrow and ridges and furrows gave higher net returns by Rs. 17050/ha and Rs.14600 kg/ha respectively than no conservation furrows (Rs. 27150/ha). In cotton, formation of ridges and furrows and conservation furrows gave higher yield by 1250 and 750 kg/ha respectively than no conservation furrows (1500 kg/ha).


Broad bed furrow


Sowing across slope


Dead Furrow in soybean

Opening Furrow in Cotton

Sowing along the slope

Ridges and furrows

Nandurbar

Formation of ridges and furrows in maize gave increased yield by 266 kg/ha and also net income by Rs. 3808/ha than farmers practice NICRA village of Nandubar district (2125 kg/ha).

Ridges and furrows in maize

3.3 Supplemental Irrigation through Drip/Sprinkler system

Khammam

Protective or life saving irrigation from water harvested through farm pond at flowering and boll formation state in NICRA village of khammam district gave higher yield in cotton (250 kg/ha) and additional net income (Rs. 9500/ha) compared to the rainfed system (2000 kg/ha) which gave the net income of Rs. 76000/ha. Similarly supplemental irrigation from rainwater collected in farm pond through drip system in furrows enhanced the productivity by 10000 kg/ha and profitability (Rs. 15250/ha) in multicut fodder grass than rainfed environment (10000 kg/ha).

Nalgonda

Installation of drip irrigation was completed in 8.4 ha covering 11 farmers in chilies in Nalgonda district during the year 2013-14. Due to adoption of water saving technology (Drip) in chilies against flood irrigation, the area under irrigation was doubled. Drip system of irrigation enhanced the productivity of chilies to 1200 kg/ha and net income of Rs. 91000/ha over rainfed system (6200 kg/ha) which gave the net income of Rs. 259000/ha.

Drip irrigation in chillies

Amravati

Drip irrigation in cotton

Introduction of drip system enhanced the yields to 3675 kg/ha with a net income of Rs. 115900/ha in cotton compared to the farmers practice of rainfed farming which yielded 1375 kg/ha and net income of Rs. 16800/ ha.

3.4 Soil quality improvement

3.4.1 Use of vermicompost

Farmers are applying excess chemical fertilizers in commercial crops like chilies and cotton than recommended. Soil testing results indicated that all soil samples are low in organic carbon but the application of organic manures is very low. There is wide scope for preparation of vermi-compost in Nandyalagudem, since most of the farmers having biogas besides abundant quantities of crop residues available with the farmers.

Vermicompost unit

Use of vermicompost along with farmers practice gave marginal increase in yield (150 kg/ha) and net income (Rs. 1500/ha) over the use of chemical fertilizer alone.

Table 11: Influence of vermicompost application in NICRA village of Nalgonda district.

Crop	Area (ha)	No.of farmers	Technology demons-trated	Yield (kg/ha)	Cost of cultivation (Rs/ha)	Gross income (Rs/ha)	Net income (Rs/ha)	B:C ratio
Chillies	3	15	Farmers practice	6100	146000	427000	281000	2.92
			Use of vermicom-post + Farmers practice	6250	155000	437500	282500	2.82

3.4.2 Green manuring

The demonstrations on green manuring with dhaincha in paddy were conducted in NICRA village of Khammam district in Telangana State. The results indicated that green manuring with dhaincha gave higher grain yield of 100 kg/ha and also additional net returns of Rs. 5649/ha compared to no green manuring (5350 kg/ha). The practice of green manuring

Dhaincha crop at vegetative stage

Green manure incorporation

in paddy reduced the cost of fertilizer by 15-20%.

Table 12: Effect of Green Manuring on yield and income of paddy in Khammam district of Telangana state.

Crop	Technology demonstrated	Area	No.of farmers	Yield (kg/ ha)	Cost of production	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
Paddy	No green manuring	21.6	12	5350	52612	69550	16938	1.32
	Green manuring with dhaincha			5250	45750	68337	22587	1.49

3.4.3 Gypsum application

Sodic soils in NICRA village Yagantipalle of Kurnool district are becoming a problem to reap higher productivity in different crops. The initial pH of the soil was ranging from 9.02-9.16. The demonstrations were organized in these problematic soils of paddy in 5 ha area with the involvement of 20 farmers. The results indicated that gypsum application in paddy gave additional grain yield (1068 kg/ha) and higher net returns (Rs. 8735/ha) over no gypsum application (4852 kg/ha) with net returns of Rs 36702/ha.

Application of gypsum for reclamation of sodic soils

Table 13: Influence of conservation furrows and Gypsum application on productivity and profitability of different crops.

Name of the centre	Crop	Area (ha)	No of Demon-strations	Technology demonstrated	Yield (kg/ ha)	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
Andhra Pradesh									
Anantapur	Groundnut (K-6)	4.0	2	No conservation furrows	120	19150	16940	-2210	0.88
				Conservation furrow at 3.6 m interval	140	19650	17680	-1970	0.90
Kurnool	Castor (PCH-111)	10.0	25	No conservation furrows	1156	22181	34680	12499	1.56
				Conservation furrow between two rows	1335	22681	40050	15283	1.77
	Paddy	8.0	20	No Gypsum application	4852	43835	80537	36702	1.84
				Gypsum application	5920	52835	98272	45437	1.86
Telangana									
Khammam	Cotton (Mallika BT-II)	2.8	1	Rainfed farming	2000	40000	76000	36000	1.90
				Supplemental irrigation through furrows and drip	2250	41250	85500	44250	2.00
	Chilies (Tejaswini)	0.6	1	Supplemental irrigation through furrows and drip	412	125000	288750	163750	2.31
				irrigated	425	127000	297500	170500	2.34
	Fodder grass (Tanzania)	0.4	4	Rainfed	10000	7500	20000	12500	2.60
				Supplemental irrigation through furrows and drip	20000	12750	40000	27250	3.10
Nalgonda	Cotton	15.2	38	No conservation measures	2350	38500	89300	50800	2.31
				Conservation furrows	2600	40500	98800	58300	2.43

Maharashtra									
Aurangabad	Pigeonpea	23.6	59	No conservation furrows	1040	13100	43680	30580	2.33
				Opening of furrow after every fourth row of pigeon pea	1200	14900	50400	35500	2.38
	Maize	21.2	53	No conservation furrows	2710	13600	37944	24344	1.79
				Opening of furrow after every fourth row of maize	3277	14800	45880	31080	2.10
	Cotton (Bt)	21.2	53	No conservation furrows	1570	16500	59660	43660	2.61
				Opening of furrow after every fourth row of Bt Cotton	1700	17300	64600	47300	2.73
Nandurbar	Maize	4.8	12	Sowing across the slope	2125	15650	40625	24975	2.59
				Ridges and furrows	2391	16300	40083	28783	2.76

4. CROP PRODUCTION

4.1 Improved varieties

4.1.1 Tolerant varieties for flood prone areas

The NICRA village of Srikakulam district experienced floods due to rains from 11-13th June, when direct sown paddy was at seedling stage. The denudation was categorized as high when paddy crop has undergone submergence for 5 days, medium for 4 days and low for 3 days. The crop experienced floods also during flowering and panicle initiation stages due to rains from 9-14th October and back water from vamshadhara river. The number of days taken for categorizing high, medium, low denudations during this period were 9, 6 and 4, days respectively. Once again the incidence of floods occurred during 20-27th October as a result of heavy rains, caused damage to the crop as the period coincided with flowering and pollination stages of paddy.

Direct sown paddy at seedling stage was inundated nearly for 5 days and resulted in crop failure.

Table 14: Categorization of inundation periods

Stage of the paddy crop	Number of days inundated		
	Low	Medium	High
Panicle initiation to flowering	4	6	9
Flowering to pollination	6	9	15
Total days of inundation	10	15	24

Among the varieties tested PLA-1100 performed better followed by MTU-1061 and RGL-2357 at different levels of inundation. In low inundated areas PLA-1100 performed better and reduced loss compared other varieties followed by MTU-1061 (Indra). MTU-1140 is having non-lodging characters and has 5 days more duration than BPT-5204, the plant height is also more than BPT-5204, as a result the panicle is not inundated during the time of flood.

Table 15: Yields of flood tolerant paddy varieties

S. No	Inundation category	Yields (kg/ha)					
		PLA - 1100	MTU-1061 (Indra)	RGL -2537	POOJA	SWARNA	SAMBA-MASURI
1	Low	5840	5570	5470	5160	4570	4830
2	Medium	5060	4880	4510	360	2840	3110
3	High	1540	1400	1150	680	510	760

Table 16: Performance of flood tolerant paddy varieties in Low Inundation Areas

Low Inundation	PLA 1100	MTU-1061 (Indra)	RGL 2537	POOJA	SWARNA	SAMBA MASURI
PLA 1100	***	+ 4.8	+ 6.7	+ 13.2	+ 27.8	+ 20.9
MTU-1061 (Indra)	- 4.8	***	+ 1.8	+ 7.9	+.21.9	+ 15.3
RGL 2537	- 6.7	- 1.8	***	+ 6.0	+ 19.7	+ 13.2
POOJA	- 13.2	- 7.9	- 6.0	***	+ 12.9	+ 6.8
SWARNA	- 27.8	- 21.9	- 19.7	- 12.9	***	- 5.7
SAMBA MASURI	- 20.9	- 15.3	- 13.2	- 6.8	+ 5.7	***

In low inundated areas PLA-1100 performed better and reduced extent loss compared other varieties followed by MTU-1061(Indra)

Table 17: Performance of flood tolerant paddy varieties in Medium Inundation Areas

Medium Inundation	PLA 1100	MTU-1061 (Indra)	RGL 2537	POOJA	SWARNA	SAMBA MASURI
PLA 1100	***	+ 3.7	+ 12.2	+ 60.1	+ 78.1	+ 62.7
MTU-1061 (Indra)	- 3.7	***	+ 8.2	+ 54.4	+ 71.8	+ 56.9
RGL 2537	- 12.2	- 8.2	***	+ 42.7	+ 58.8	+ 45.0
POOJA	- 60.1	- 54.4	- 42.7	***	+ 11.2	+ 1.6
SWARNA	- 78.1	- 71.8	- 58.8	- 11.2	***	- 9.5
SAMBA MASURI	- 62.7	- 56.9	- 45.0	- 1.6	+ 9.5	***

Table 18: Performance of flood tolerant paddy varieties in High Inundation Areas

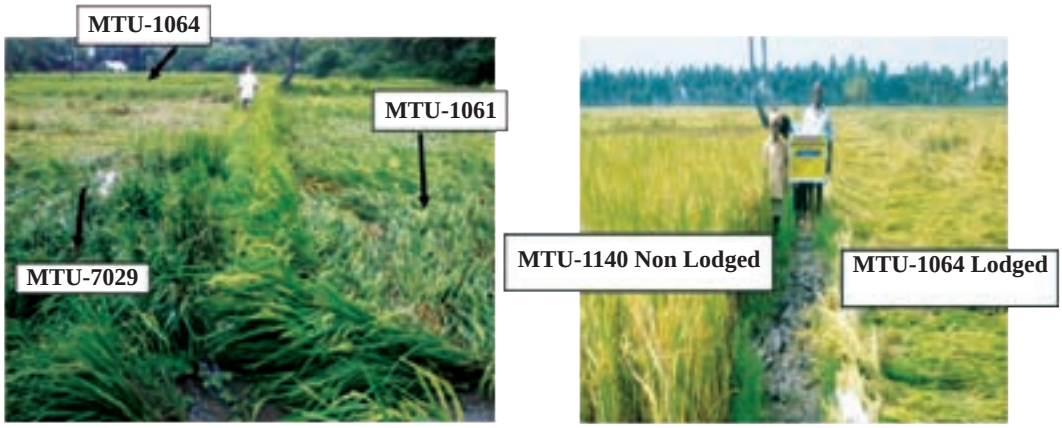
High Inundation	PLA 1100	MTU-1061 (Indra)	RGL 2537	POOJA	SWARNA	SAMBA MASURI
PLA 1100	***	+ 10.0	+ 33.9	+ 126.4	+ 201.9	+ 102.6
MTU-1061 (Indra)	-10	***	+ 21.7	+105.8	+174.5	+-84.2
RGL 2537	-33.9	-21.7	***	+69.1	+125.5	+51.3
POOJA	-126.4	-105.8	-69.1	***	+33.3	-11.7
SWARNA	-201.9	-174.5	-125.5	-33.3	***	-49.0
SAMBA MASURI	-102.6	-84.2	-51.3	+11.7	+49.0	***

Table 19: Performance of Submergence tolerant paddy varieties.

Treatments	Seed yield (kg/ha)	Straw Yield (kg/ ha)	Cost of cultivation (Rs/ha)	Gross income (Rs/ha)	Net income (Rs/ha)	B:C ratio
Local var/Traditional Swarna (MTU-7029) variety	1500	-	43000	19600	-23400	0.45
Tolerance of submergence & lodgging in MTU-1061variety	3675	2200	39300	50960	11660	1.30
Tolerance of submergence& lodgging in MTU1064 variety	3975	2500	39700	55120	15420	1.39

West Godavari

During 2nd and 3rd week of October heavy rains were received due to Helen cyclone as a result most of the fields were submerged and crops were damaged. It was observed that the Swarna variety was completely lodged due to heavy rains where as MTU-1061 and MTU-1064 were not lodged but they were lodged due to Helen cyclone.



Improved variety MTU-1140

4.1.2 Tolerant varieties for drought prone areas

Andhra Pradesh

Kurnool

At NICRA village of Kurnool district, improved variety PRG-158 of pigeon pea recorded the seed yield of 1364 kg/ha as against local LRG-30 (1095 kg/ha). Improved variety PRG-158 derived net income of Rs 37843/ha while local LRG-30 recorded the net income of Rs 27137/ha. In chickpea Nandyala sanaga-1 registered additional seed yield by 179 kg/ha as against farmers variety JG-11 (1125 kg/ha). Improved variety gave the additional net income of Rs 1191/ha over local genotype of JG-11 (Rs 13720/ha).

Drought tolerant variety PRG-158

Telangana

Khammam

Demonstrations conducted in NICRA village of Khammam indicated that improved variety of redgram (LRG-41) increased the seed yields by 100 kg/ha and also gave additional net returns of Rs 1300/ha than farmers variety which yielded 1600 kg/ha and also recorded net income of Rs 40400/ha.

Drought tolerant variety PRG-158

Salinity tolerant paddy Siddi

The salt tolerant variety Siddi of paddy was found suitable for saline soils. This variety gave higher grain yield and net income by 7 and 29.5 percent than farmers variety (5250 kg/ha). Improved variety Sheetal in paddy was found suitable for cool temperatures in Khammam district.

Nalgonda

The long duration varieties of pigeon pea in black soils of NICRA village quite often face moisture stress during flowering and pod development stages. Hence the demonstrations on medium duration variety of PRG-158 (150 days duration) were conducted with local (LRG-41) involving 31 farmers in 4 ha. The results indicated that improved variety of pigeonpea gave additional yield of 80 kg/ha over local variety LRG-41 (1420 kg/ha).

PRG-158

Maharashtra

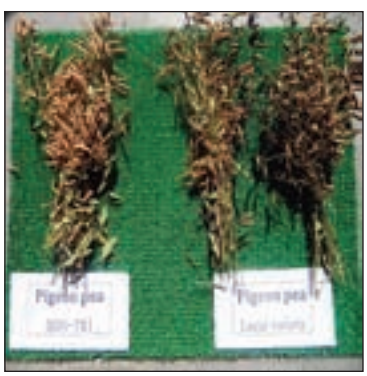
Amravati

In chickpea, improved variety Digvijay produced 1302 kg/ha as against the traditional variety (895 kg/ha). In Amravati district, improved variety JS-9305 of soybean recorded 2110 kg/ha while traditional variety JS-335 gave 1260 kg/ha.

Nandurbar

Demonstrations conducted in NICRA village of Nandurbar district showed that improved variety GM-6 of maize gave additional net income of Rs. 4691/ha compared to the farmers variety (Rs. 24151/ha). Improved variety of chickpea recorded seed yield of 1487/ha.

Aurangabad



Improved variety of green gram-2003-02 gave the seed yield of 800 kg/ha than local (600 kg/ha). An increase of Rs 1269/ha was realized with improved variety over local genotype (Rs12700/ha). Improved variety of BDN-711 of pigeonpea gave higher seed yield of 300kg/ha and net returns of Rs 11000/ha as compared to local variety which gave the mean seed yield of 850 kg/ha and also net income of Rs19550/ha over two years of 2013 and 2012. In 2013, improved variety of chickpea Akash increased the seed yield (300 kg/ha) and also net income (Rs. 3610/ha) over local (23 kg/ha and net income Rs 157500/ha). Improved variety of Netravati (NAIW-1415) produced 1000 kg/ha as against of local (800 kg/ha) in 2013. Improved variety of parbhani moti in *rabi* sorghum registered an increased seed yield by 200 kg/ha and also net returns of Rs. 2200 as compared to local Dagdi (400 kg/ha). Improved variety in soybean (MAUS-71) recorded seed yield of 1500kg/hand also net income of Rs. 29900/ha in 2013.

Pune

The demonstration of *rabi* Sorghum variety Phule Revati for cultivation in medium black soil with at least 2 irrigations and variety Phule Vasudha on medium black soil with at least 1 irrigation were taken up with 30 farmers in the village. It was observed that variety Phule Revati gave 34.3% more yield than local variety with 41.5% increase in net income. The variety Phule Vasudha gave 26.1% more yield than local variety with 33.4% increase in net returns compared to the local.

Gondia

The local variety gave the net income of Rs 31550. Improved variety of pigeonpea PKV-Tara recorded the seed yield of 644 kg/ha as against local variety Devtur (580 kg/ha) in NICRA village of Gondia.

Table 20: performance of different varieties under major climatic vulnerabilities

Name of the centre	Crop/ varieties	Area (ha)	No of Demon-strations	Technology demonstrated	Yield (kg/ ha)	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
Andhra Pradesh									
Anantapur	Groundnut	2.0	5	K-6	377	20150	27226	7076	1.35
				K-9	305	20150	24562	4412	1.22
				Dharani	433	20150	28151	8001	1.40
Kurnool	Pigeonpea	5.0	20	Local (LRG-30)	1095	16663	43800	27137	2.63
				PRG-158	1364	16663	54506	37843	3.27
	Chickpea	24.0	60	Local (JG-11)	1125	22905	32625	13720	1.42
				Nadyala sanaga-1	1304	22905	37516	14911	1.65
Srikakaulam	Paddy	0.07	1	BPT-5204	3180	30500	31800	1300	1.04
				MTU-1140	5510	30500	55100	24600	1.80
	Greengram	2.8	7	Non descriptive variety	390	7000	14040	7040	2.00
				TM-96-2	468	7000	16848	9848	2.40
	Chickpea	6.8	17	Non descriptive variety	407	7300	16280	8980	2.23
				LBG-752	488	7300	19520	12220	21.67
Telangana									
Khammam	Paddy	4.2	10	Local (JGL-384)	5250	52000	70875	18875	1.36
				WGL-44 (Siddi)	5625	48500	75937	27437	1.50

Nalgonda	Pigeonpea	4.0	31	Local (LRG-41)	1420	18000	53380	37380	3.08
				PRG-158	1500	18750	58500	39750	3.12
		11.2	28	Local (ML-267)	1000	14250	45000	31578	3.15
				LGG-460	820	14000	36900	22900	2.63
	Paddy	1.8	6	MTU-1010	6500	37500	91000	53500	2.42
				MSRI (RNR-15048)	7000	36750	98000	61250	2.66
Maharashtra									
Amravati	Soybean	10	25	Local (JS-335)	2050	32,500	67650	35150	2.08
				JS-9305	2400	35,000	79200	44200	2.26
Aurangabad	Greengram	12	30	Kopargao	600	12500	25200	12700	1.02
				BM-2003-2	800	13400	33600	20200	1.51
	Pigeonpea	24	60	Non descriptive variety	900	15500	37800	22300	1.44
				BDN-711	1200	16900	50400	33500	1.98
	Chickpea	22.4	56	Non descriptive variety	500	13890	17500	3610	0.25
				Akash	800	15200	28000	12800	0.84
	Wheat	12	30	Non descriptive variety	800	21200	9600	-11600	-0.54
				NAIW-1415	1000	21800	12000	9800	-0.45
	Rabi sorghum	44	110	Dagdi	400	3750	4000	250	0.06
				Parbhani moti	600	3800	6000	2200	0.58
	Soybean	44	110	JS-335	1180	14300	35400	21100	1.48
				MAUS-71	1500	15100	45000	29900	1.98

Gondia	Pigeonpea	4	4	Local (Devtur)	580	16000	23200	7200	1.40
				PKV-Tara	644	16000	25760	9760	1.60
Nandurbar	Maize	4.8	12	Traditional variety	1927	13925	38076	24151	2.73
				GM-6	2284	14850	43692	28842	2.94
	Chickpea	3.2	8	Local (Kharya)	11.75	15300	31725	16425	2.07
				Digvijay	14.87	15950	40149	24199	2.51
Pune	Sorghum	12	30	Maldandi	1420	15598	47148	31550	3.02
				Phule Revati	1910	18137	62767	44630	3.46
	Sorghum	24	60	Maldandi	1230	15789	39248	23459	2.48
				Phule vasudha	1550	17624	48915	31291	2.77
Ratnagiri	Cowpea	4.5	25	Non descriptive variety	600	24000	33500	18500	1.30
				Konkan sadabahar	1100	31500	60500	27000	1.96

4.2 Intercropping systems

At NICRA village of Kurnool district demonstrations on intercropping systems of foxtail millet (Setaria) + pigeon pea (5:1) and castor + pigeonpea (1:1) were conducted along with the respective sole crops. The results indicated that intercropping system of foxtail millet + pigeonpea recorded additional net returns of Rs 25113/ha and Rs 12553/ha compared to respective sole crops of foxtail millet (Rs 14577/ ha) and pigeon pea (Rs 27137/ha). Similarly, castor + pigeonpea (1:1) enhanced net returns by Rs 32101/ha and Rs 19085/ha compared to the sole crops of castor (Rs 14127/ha) and sole pigeonpea Rs 27137/ha respectively. These systems on an average gave additional yield advantage by 85 and 79 percent compared to the respective sole crops. Thus it is clearly indicated that intercropping systems are advantageous than sole crops under rainfed environment.

Demonstrations on cotton + pigeonpea intercropping system (8:1) were conducted in 4 ha with active participation of 10 farmers in NICRA village of Srikakulam district of Andhra Pradesh. The results showed that intercropping system of cotton and pigeonpea gave additional net income of Rs 800/ha compared to the sole crop of cotton Rs 10980/ha.

The assessment of soybean + pigeonpea (4:2), pearlmillet + pigeonpea (3:3), cotton + green gram (1:1) were conducted in NICRA village of Aurangabad district in Maharashtra. Among these systems the highest net returns were recorded with soybean + pigeonpea (Rs 31900/ha) followed by cotton + green garm (Rs. 29700/ha). The soybean + pigeonpea (4:2) intercropping system enhanced the net returns by Rs 31660/ha than sole soybean (Rs. 18240/ha) while pearlmillet + pigeon pea (3:3) gave higher net returns of Rs. 20850/ ha than sole pearl millet (Rs 1200/ha). Similarly cotton + greengram (1:1) system gave additional net returns by Rs 22200/ha than sole crop of cotton (Rs 7500/ha).

Pearl millet + Pigeonpea (3:3)

Soyabean + Pigeon pea (4:2)

At NICRA village of Nandurbar district of Maharashtra intercropping systems of soybean + pigeon pea (3:1), groundnut + soybean (4:1) and *rabi* sorghum + safflower (3:3) were conducted in 2, 4 and 3 hectares respectively. Among the intercropping systems groundnut + soybean recorded highest net returns (Rs. 43992/ha) followed by soybean + pigeonpea (Rs 20360/ha). Intercropping system of soybean + pigeonpea (3:1), groundnut + soybean (4:1) and *rabi* sorghum + safflower (3:3) gave higher net returns of Rs. 3510, Rs. 5052, Rs 7600/ha respectively than corresponding sole crops of soybean, groundnut and *rabi* sorghum.

Soyabean + pigeon pea intercropping

Groundnut + Soyabean intercropping

Table 21: Yield and economics as influenced by sole and inter cropping systems.

Name of the centre	Crop/ Cropping system	Area (ha)	No of Demon-strations	Technology demonstrated	Yield (kg/ha)	Cost of cultivation (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ ha)	B:C ratio
Kurnool	Seteria+ Pigeonpea (5:1)	12.0	30	Sole Seteria	2320	12955	27532	14577	2.13
				Sole Pigeon pea	1095	16663	43800	27137	2.63
				Seteria+ Pigeon pea	2084+ 815	18960	58650	39690	3.09
	Castor+ Pigeonpea (1:1)	8.0	20	Castor	1086	18459	32580	14121	1.76
				Sole pea	1095	16663	43800	27137	2.63
				Castor+ Pigeon pea	1063+ 900	21668	67890	46222	3.13
Srikakaulam	Cotton + Pigeonpea (8:1)	4.0	10	Cotton	1212	37500	48480	10980	0.29
				Cotton+ Pigeon pea	1202	37500	49280	11780	1.64

Maharashtra									
Aurangabad	Soybean + Pigeon pea (4:2)	5.6	14	Sole Soybean	1200	23760	42000	18240	0.77
				Soybean + Pigeon pea	1000+ 600	24100	56000	31900	1.32
	Pearl millet + Pigeon pea (3:3)	5.2	13	Pearlmillet Sole crop	1600	14800	16000	1200	0.08
				Pearlmillet + Pigeonpea	1300+ 700	15450	37500	22050	1.42
	Cotton + green gram (1:1)	2.8	7	Sole Cotton	800	24500	32000	7500	0.31
				Cotton + green gram	750+ 500	25300	55000	29700	1.17
Nandurbar	Soybean+ Pigeonpea (3:1)	2.0	5	Sole Soybean	11.75	13700	30550	16850	2.22
				Soybean+ Pigeon pea	10.25+ 3.10	14350	34710	20360	2.41
	Ground nut +Soybean (4 :1)	4.0	10	Sole Ground nut	16.80	20200	59140	38940	2.92
				Ground nut + Soybean	19.54+ 3.80	21500	65492	43992	3.04
	Rabi Sorghum + Safflower (3:3)	2.8	7	*Rabi* Sorghum Sole crop	900	4000	9000	5000	1.25
				Rabi Sorghum + Safflower	1100+ 300	4400	17000	12600	2.86

4.3 Nutrient Management

The productivity of paddy depends upon soil quality, dosage and time of nutrient application in both rainfed and irrigated environment. The demonstrations on nutrient management were conducted in various NICRA centers of Andhra Pradesh and Maharashtra states.

At NICRA centre of Anantapur, demonstrations were conducted in 20 ha area with involvement of 50 farmers to improve the productivity of paddy grown in saline soils. The results showed that top dressing of Gypsum @ 500 kg/ha at 20-25 days after transplanting improved the productivity of paddy (MTU-1010) by 1792 kg/ha compared to no top dressing of gypsum (3832 kg/ha). This improved practice gave additional net returns of Rs 21796/ha than control (Rs 35086/ha). In order to improve the soil health and productivity of groundnut, demonstrations on sheep penning were conducted during 2013. The practice of sheep penning gave higher pod yield by 48 kg/ha compared to no sheep penning (160 kg/ha).

Top dressing of gypsum in paddy field

The demonstrations focusing organic production of pigeonpea was taken up in 2.4 ha with active participation of 6 farmers in NICRA village of Kurnool district. The results indicated that production of organic pigeonpea reduced the seed yield by 8% but enhanced the net returns of Rs 4127/ha over inorganic production of pigeonpea which yielded 1325 kg/ha with net income of Rs 30908/ha.

In Sirusuwada village of Srikakulam district spraying of liquid fertilizer 19:19:19, Multi K (13:0:45) at maximum tillering stage in flood prone paddy gave higher grain yield of 440 kg/ha than control (3990 kg/ha). This simple practice gave additional net returns of Rs 3300/ha. However these practice becoming difficult to adopt in medium and high yielding and inundated areas.

Soil test based nutrient management not only increased the yield of paddy but also reduced the cost of cultivation. In this context demonstrations on soil test based nutrient management were conducted in 4 ha area with active participation of 10 farmers in NICRA village of West Godavari district. The improved technology of soil test based nutrient management (90:60:60 N:P:K / ha) in the form of urea, SSP and murate of potash gave additional grain yield of 350 kg/ha and net returns of Rs 8453/ha than farmers practice (108:50:22.5 N:P:K / ha) and gave the grain yield of 3675 kg/ha. The cost of cultivation with soil test based nutrient management was reduced by Rs 3600/ha.

At Ahmednagar foliar nutrient application at critical growth stages of soybean gave higher seed yield of 218 kg/ha and net returns of Rs 4622/ha than no foliar application of nutrients which gave the seed yield of 1025 kg/ha and net income of Rs 8626/ha. Similarly use of potassium nitrate spray in chickpea enhanced the productivity and profitability by 164 kg/ha and Rs 4071/ha than control (948 kg/ha) respectively.

Foliar nutrient application in soyabean

Demonstrations in NICRA centre of Amravati district showed that improved Nutrient management (FYM 10-15 tons/ha and seed treatment with PSB + recommended dose of chemical fertilizer (30:75:0) gave higher seed yield of soybean of 500kg/ha and additional net income of Rs 14600 compared to the farmers method (1750kg/ha). Improved foliar nutrient application (micronutrients and soluble fertilizer i.e., 19:19:19 or 12:61:00) enhanced the productivity of soybean to190 kg/ha and also net income of Rs 4074/ha compared to the farmers method (1220 kg/ha).

The demonstrations on Bt cotton with INM in NICRA village of Aurangabad showed that INM practice enhanced the productivity of 140 kg/ha and also additional net income of Rs 4020/ha compared to the farmers practice (1350 kg/ha).

15 demonstrations on integrated nutrient management were conducted over 6 ha area in NICRA village Baramati of Pune district of Maharashtra. Results showed that the increase in yield due to INM in onion was 23% over control. Farmers have obtained profit worth of Rs.44880/ha more over the control. INM practice in maize increased the cob yield by 1030 kg/ha and also the additional net income of Rs 10041ha compared to the farmers method (2990 kg/ha). Foliar application of urea @ 1%, potassium nitrate @ 1 gm/lit and micro nutrient solution @ 7ml/lit of water to the *rabi* sorghum enhanced the grain yield by 15.6% compared to the farmers practice (1065 kg/ha). This technology enhanced the net returns by 18.2% over control (Rs 2898/ha).

Table 22: Effect of improved nutrient management practices on productivity and income in different crops.

Name of the centre	Crop/ varieties	Area (ha)	No of Demon-strations	Technology demonstrated	Yield (kg/ha)	Cost of production (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
Andhra Pradesh									
Anantapur	Paddy	20	50	Without top dressing of gypsum	3832	32230	67316	35086	2.09
				Top dressing of gypsum@500 kg/ha	5624	33730	90612	56882	2.69
	Groundnut	0.4	1	No sheep penning	160	18700	18900	200	1.01
				Sheep penning	208	20100	20820	720	1.15
Srikakaulam	Paddy	4.0	7	No fertilizer application	3990	30500	39900	9400	1.30
				Liquid fertilizer application	4430	31600	44300	12700	1.40
West Godavari	Paddy	4.0	10	Farmers method	3675	40950	50960	10010	1.24
				Soil test based nutrient management	4025	37350	55813	18463	1.49
Maharashtra									
Ahmednagar	Soybean	20.0	50	Farmers method	1025	22124	30750	8626	1.38
				Foliar nutrient application of KNO_3	1243	24042	37290	13248	1.55
	Chickpea	20.0	50	Farmers method	11.12	20882	30024	9142	1.44
				Foliar nutrient application of KNO_3	9.50	20532	25650	5118	1.24

Amravati	Soybean	20.0	50	Farmers method	1750	30600	57750	27150	1.89
				Improved Nutrient Management	2250	32500	74250	41750	2.28
	Soybean	20.0	50	Farmers method	1220	12747	35176	22428	2.75
				Foliar application of nutrients	1410	14216	40718	26502	2.86
Aurangabad	Bt cotton	2.0	5	Farmers practice	1350	20400	51300	30900	1.51
				INM	1490	21700	56620	34920	1.61
Pune	Onion	6.0	15	Farmers method	8100	40092	202500	162407	5.05
				INM	9963	41696	249083	207287	5.97
	Maize	12.0	30	Farmers method	2990	12148	35253	23104	2.90
				INM	4020	14337	47483	33145	3.31
	Pearl millet	27.2	68	Farmers Practice	1065	13086	15984	2898	1.22
				Foliar application of nutrients	1250	14611	18750	4138	1.28
	Rabi Sorghum	20.4	51	Farmers practice	1220	12747	35176	22428	2.75
				INM	1410	14216	40718	26502	2.86

Table 23: Influence of different seeding methods on yield and economics of different crops

Name of the centre	Crop/ Varieties	No of Demon-strations	Area (ha)	Technology demon-strated	Yield (kg/ha)		Cost of produ-ction	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
					Seed	Fodder				
Anantapur	Groundnut	5	2	Bullock drawn	305	1185	22550	24700	2150	1.09
				Improved seed drill (Planter)	365	1290	21200	27100	5900	1.28
Khammam	Maize	3	1	Farmers method of seeding	7000	50,000	40000	65800	25800	1.6
				Improved seed drill	7000	50,000	22000	65800	43800	2.9
Kurnool	Pigeonpea	2	1	Farmers method of seeding	1260	-	17800	50400	32600	2.8
				Improved seed drill	1364	-	16663	54506	37843	3.3
West Godavari	Paddy	5	15	Manual transplanting	2531	750	45750	33072	-12678	0.72
				Machine transplanting	3938	2000	40000	51457	11457	1.29
Amravati	Soybean	25	10	Improved Tractor drawn seed drill	1800	3060	21600	60120	38520	2.78
				Traditional method of seeding	1565	2660.5	17998	52271	34274	2.98
				Improved Bullock drawn seed drill	1440	2448	16560	48096	31536	2.98

4.4 Farm machinery

Different seeding methods

Sowing of groundnut with improved planter in Anantapur district of Andhra Pradesh enhanced the pod yield by 60 kg/ha and also realized additional net returns of Rs 3750/ha than sowing groundnut with bullock drawn seed drill which gave 305 kg/ha.

Use of improved seed drill in pigeonpea gave higher seed yield by 8% and also additional net income of 16% over farmers method of seeding with bullock drawn seed drill (1260 kg/ha) in NICRA village of Kurnool district.

Machine transplanting of paddy during *kharif* in West Godavari district gave higher grain yield by 55.6% than manual transplanting (2531 kg/ha).

Sowing of maize with improved seed drill in NICRA village of Khammam district of Telangana state realized additional net returns of Rs 18000/ha than farmers method of seeding (Rs 25800/ha).

Sowing of soybean with improved tractor drawn seed drill in NICRA village of Amravati registered the highest seed yield (1800 kg/ha) followed by traditional method of seeding (1565 kg/ha). Among various seeding methods use of tractor drawn seed drill in soybean gave 12% higher returns than traditional method of seeding Rs 34274/ha.

Paddy Drum seeder

Direct sowing of paddy drum seeder in NICRA village of Khammam district of Telangana state recorded additional grain yield of 375 kg/ha and also additional net returns of gave Rs 5056/ha over manual transplanting (4687 kg/ha).

Direct sowing of paddy by using drum seeder in NICRA village of Nalgonda district of Telangana state recorded additional grain yield of 880 kg/ha and also additional net returns of gave Rs 16560/ha over manual transplanting (6120 kg/ha).

Manual transplanting of paddy

Sowing of paddy with drum seeder

Table 24: Influence of Drum seeder on yield and economics of paddy (Telangana)

Name of the centre	Crop	Area (ha)	No of demon-strations	Technology demonstrated	Yield (kg/ha)	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
Khammam	Paddy	2.4	6	Manual transplanting	4687	52000	63281	11281	1.17
				Direct seeding with drum seeder in paddy	5062	48000	68337	20337	1.42
Nalgonda	Paddy	1.2	6	Manual transplanting	6120	37000	78440	41440	2.12
				Direct sowing with drum seeder	7000	33500	91550	5800	2.72

Table 25: Crop diversification strategies for higher yield and income in different NICRA villages of Andhra Pradesh.

Name of the centre	Major crop	Area (ha)	No of Demon-strations	Technology demonstrated	Yield (kg/ ha)	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
Anantapur	Groundnut	0.8	2	Groundnut (K6)	140	19870	17680	-2190	0.89
				Setaria (Suryanandi)	1250	7500	22500	7500	3.0
Kurnool	Castor	10.0	25	Desi Cotton	375	12350	16875	4525	1.37
				Castor (PCH-111)	1206	18459	36180	17721	1.96
				Setaria (SIA-3085)	2320	12955	27532	145777	2.13

4.5 Crop diversification

Farmers in rainfed agriculture sow the crops by virtue of tradition. In changing agriculture scenario there is need to identify alternative profitable crops for higher returns through crop substitution. In this context demonstrations were laid to find out alternative profitable crops compared to the normal traditional crops in NICRA villages of Anantapur and Kurnool districts of Andhra Pradesh.

Under delayed sowings, short duration variety Suryanandi of foxtail millet was found profitable by realizing higher net returns of Rs 7500/ha, while traditional groundnut crop recorded negative net income of Rs 2190/ha.

Desi cotton was a traditional crop in NICRA village in Kurnool district of Andhra Pradesh. Under delayed sowing conditions castor crop (PCH-111) was found profitable. The improved variety SIA-3085 of foxtail millet performed better than traditional desi cotton. Castor and foxtail millet recorded higher net income of Rs 13196/ha and 100582/ha respectively over traditional desi cotton (Rs 4525/ha).

Crop diversification with castor (Kurnool) and setaria (Anantapur and Kurnool)

4.6 Water saving technologies

Demonstration on SRI method of cultivation of paddy was conducted in NICRA village of Anantapur district of Andhra Pradesh. The results showed that SRI method of cultivation in paddy gave higher grain yield of 1758 kg/ha and also additional net returns of Rs 29666/ha compared to the farmers practice (6842 kg/ha). The farmers practice realized the net income of Rs 61909/ha.

At NICRA centre Gondia of Maharashtra adoption of SRI method of cultivation in paddy gave the grain yield advantage of 700 kg/ha over farmers method of cultivation (3200 kg/ha). SRI method of cultivation increased the net returns by 11400 Rs/ha than farmers practice (Rs 9400/ha).

Demonstrations on drip method of irrigation in Bt cotton were conducted in NICRA village of Aurangabad district of Maharashtra. Drip irrigation in cotton gave 64% of increased yields and also additional net income by 93.7% compared to the flood system of irrigation (1428 kg/ha). Flood irrigation in cotton realized the net income of Rs 33864/ha. Demonstrations on sprinkler irrigation in pigeon pea realized higher seed yields of 412 kg/ha and also additional net returns of 18673/ha over flood method of irrigation (1308 kg/ha).

Drip irrigation in cotton

Sprinkler irrigation in pigeonpea

Sprinkler method of irrigation in *rabi* sorghum at NICRA centre Gondia in Maharashtra state produced higher grain yields of 400 kg/ha than flood method of irrigation (1370 kg/ha).

Sprinkler irrigation in rabi sorghum in NICRA village of Pune realized additional net income of Rs 10640/ha over flood method of irrigation (Rs 26324/ha).

Table 26: Effect of SRI method on yield and economics of paddy

Name of the centre	Crop/ Varieties	Area (ha)	No of Demon-strations	Technology demonstrated	Yield (kg/ha)	Cost of production	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
Andhra Pradesh									
Anantapur	Paddy BPT-5204	1.0	2	Farmers practice	6842	53550	115459	61909	2.10
				SRI method	8600	53550	145125	91575	2.70
Maharashtra									
Gondia	Paddy	22.4	112	Farmers practice	3200	29000	38400	9400	1:1.3
				SRI method	3900	26000	46800	20800	1:1.8

Table 27: Influence of water saving technologies on yield and income of different crops in various NICRA centers in Maharashtra

Name of the centre	Crop/ Varieties	Area (ha)	No of Demon-strations	Technology demonstrated	Yield (kg/ha)	Cost of production (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
Aurangabad	Bt cotton	1.0	40	Flood irrigation	1428	20400	54264	33864	1.66
				Drip irrigation	2348	23600	89208	65608	2.78
	Pigeon pea	1.0	40	Flood irrigation	1308	17900	54953	37053	2.07
				Sprinkler irrigation	1720	18700	74426	55726	2.98
Pune	*Rabi* sorghum	3.2	8	Flood irrigation	1370	12934	39259	26324	3.03
				Sprinkler irrigation	1770	15692	52657	36964	3.35

4.7 Crop protection

Andhra Pradesh

Among various management practices crop protection contributes 30-40% increase in production different crops. In this context demonstrations focussing crop protection measures were conducted in 94 farmer's fields covering 52 ha. Use of Carbendazim + Mancozeb at pod development stage in groundnut increased the pod yield to 127 kg/ha than control (167 kg/ha) in NICRA village of Anantapur district.

Spraying to control LLS in Groundnut

At Kurnool spray of Chloropyriphos @ 2.5 ml and Carbendazim @ 1gm/lit in castor through weather based IPM technology produced higher bean yield of 133 kg/ha as against the farmers practice (no plant protection measures) 100 kg/ha. Improved weather based technology contributed for higher net returns of Rs 6184 as against farmers practice (Rs 12350/ha) in castor. Similarly weather based improved IPM technology in pigeonpea recorded higher seed yield of 120 kg/ha than farmers practice (1240 kg/ha). This practice contributed to realize 20% of higher net returns compared to the farmers practice (31975 Rs/ha).

Maharashtra

Integrated Crop Management practice (ICM) enhanced the productivity by 1250 kg/ha over farmers method (1500 kg/ha). Adoption of ICM in cotton gave higher net returns of Rs 31700/ha than control (Rs 21800/ha) in NICRA village of Amravati district

Spraying weedicide on sorghum

In NICRA village of Nandurbar district use of weedicide 2,4-D in sorghum produced additional grain yield of 195 kg/ha compared to the farmers practice of one hoeing at field capacity followed by one hand weeding (2590 kg/ha). The demonstrations on IPM in soybean resulted in additional seed yield of 144 kg/ha than farmers practice (1041 kg/ha). IPM technology in soybean contributed 21.5% additional returns.

Table 28: Effect of crop protection measures on productivity and profitability of different crops

Name of the centre	Crop	Area (ha)	No of Demon-strations	Technology demonstrated	Yield (kg/ ha)	Cost of production (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
Andhra Pradesh									
Anantapur	Groundnut	25.0	27	No spray	167	19870	21084	1214	1.06
				LLS spray	294	20720	23378	2658	1.13
Kurnool	Castor	4.0	10	No protection measures	1100	20650	33000	12350	1.60
				Spray of Chlorophyriphos @2.5ml and Carbendazim @ 1g/lt	1233	18466	37008	18534	2.00
	Pigeonpea	4.0	10	Farmers practice	1240	17625	49600	31975	2.80
				Chlorophyriphos@2.5ml and Dichlorovos @ 1ml/lt.	1360	15882	54400	38518	3.30
Maharashtra									
Amravati	Cotton	10.0	25	Farmers method	1500	38200	60000	21800	1.57
				Improved method ICM	2750	56500	110000	53500	1.94
Nandurbar	Sorghum	4.0	10	Farmers practice	2590	14500	36605	22105	2.52
				Application of weedicide (2,4-D) in sorghum	2785	15350	39457	24107	2.57
	Soybean	4.8	12	Farmers practice	1041	13850	27066	13216	1.95
				Improved method	1185	14750	30810	16060	2.08

5. Live Stock and Fisheries

Agriculture is lifeline of 60% of the population in our country. The livelihood of this population depends upon favourable environmental factors like climate. The income of the farming community quite often fluctuates due to extreme weather events like floods, drought and other biotic stresses. Livestock is the integral part of the farming community in our country it provides buffer in influencing the income against the climatic risks. Keeping these situations in view demonstrations were conducted to enhance/stabilize the productivity, profitability and health of livestock and fisheries in different villages of NICRA centres of Telangana, Andhra Pradesh and Maharashtra. The salient features are detailed bellow:

5.1 Performance of improved fodder varieties

In NICRA village of Anantapur district of Andhra Pradesh fodder sorghum var SSG-S-93 produced 118 t of green fodder as against local fodder variety (106 t/ha). The improved variety gave higher the net profit of Rs. 5000/ha against local (Rs. 17500/ha).

At Khammam, multicut fodder sorghum variety (Tanjania) produced 20 tonnes of fodder as against local which gave 10t/ha. Multicut fodder sorghum enhanced the additional net income by Rs. 14750/ha over local fodder variety (Rs. 12500/ha).

Demonstrations were conducted on fodder varieties in NICRA villages of Nalgonda district of Telangana state. These demonstrations were conducted in 1.6 ha with active participation of eight farmers. The results showed that multicut fodder variety APBN-1 gave more than 50% higher fodder than conventional fodder variety of SSG-1. This improved variety helped in increased fodder availability throughout the year. This helps the farmers to make available green fodder during fodder scarcity particularly during summer.

At NICRA village of Ahmednagar district multicut fodder sorghum variety (Devgan rasila) produced 50 t/ha of fodder compared to the local variety (27 t/ha). Improved multicut fodder sorghum variety Devgan produced additional net returns of Rs. 40116/ha over local which recorded the net income of Rs. 36989/ha.

At Amravati (Maharashtra) demonstrations on improved fodder varieties in 2 ha involving five farmers. The results revealed that improved fodder maize variety produced fodder in the range of 290 t/ha as against local which gave 230 t/ha fodder. Improved variety of maize gave the net returns of Rs. 21250/ha: while local variety MP chari gave the net returns of Rs. 15750/ha.

At NICRA village of Nandubar, growing of multicut Lucern (RL-88) produced 17.33 t/ha of fodder and realized the net income of Rs. 32990.

Fodder jowar cultivation in Anantapur

Fodder maize production in Amaravati

Cultivation of Lucerne in Nandurbar

Cultivation of APBN-1 in Nalgonda

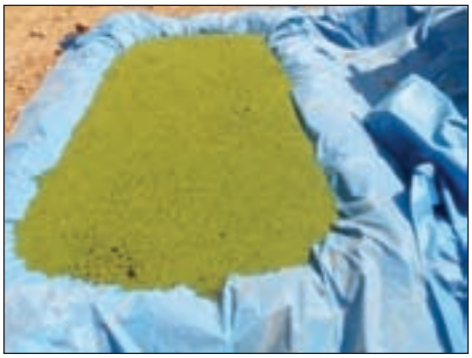
Table 29: Performance of fodder crops and varieties on yield and economics in different NICRA centres

Name of the centre	Crop/ Varieties	Area (ha)	No of Demon-strations	Technology demonstrated	Fodder Yield (t/ha)	Cost of production (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ ha)	B:C ratio
Andhra Pradesh									
Anantapur	Hybrid Napier Bajra	1.0	1	Local variety	106	12500	30000	17500	1.40
				SSG-S-93	118	12500	35000	22500	1.80
Telangana									
Khammam	Sorghum	1.8	9	Local variety	10	7500	20000	12500	2.60
				Improved variety (Tanjania)	20	12750	40000	27250	3.10
Nalgonda	Multi cut bajra	1.2	8	SSG-1	800	54500	240000	185500	4.40
				APBN-1	200	80000	600000	520000	7.50
Maharashtra									
Ahmednagar	Multicut fodder sorghum	22	10	Local variety	268	19761	53750	33989	2.72
				Multicut variety- Devgan, rasila	495	24945	99000	74105	3.96
Amravati	Maize	2.0	5	Local variety (Kadau) MP Chari	230	6750	22500	15750	3.33
				Improved variety of Maize	290	7500	28750	21250	3.83

5.2 Nutrient Supplementation in dairy animals

Generally farmers were using paddy straw for feeding dairy animals. Some of the farmers are adding salt and urea to dried paddy straw for increasing the palatability. In addition some are supplying groundnut cake to the animals.

Dairy is the major component in drought districts of Anantapur in Andhra Pradesh and also Ahmednagar in Maharashtra. Majority of the farmers feed dry straw to the milch animals. Farmers could not feed required quantity of concentrates due to its high cost. Keeping this limitation in view demonstrations on use of Azolla to supplement the concentrates were organized to reduce the cost of production in addition to the enhancement of milk production.



Azolla production

Mineral mixture feeding

Demonstrations on Improvement of nutrition through azolla in live stock were carried out in Anantapur district of Andhra Pradesh. The results indicated that improved practice of feeding (Ricebran @ 50 kg/90 days duration)+mineral mixture @ 50kg/90days+azolla @ 1/2kg /animal/day) gave higher milk yield by 10 L/animal/60 days as against farmers practice of feeding of rice bran+ mineral mixture (360 L/60days duration). The improved practice of feeding gave higher net returns of Rs. 1795/60days/animal than farmers practice of feeding (Rs. 8940/animal/60 days).

Ahmednagar (Silage making)

At NICRA village of Ahmednagar fodder used through silage reduced the cost by Rs. 1/kg as against the green fodder purchased from outside to feed dairy animals during summer (3 Rs/kg). The green fodder prepared through silage reduce the cost by Rs. 20/cow/day compared to the green fodder purchased from outside (Rs. 54.50/cow/day). Though there is no variation in milk yield per day per cow the green fodder cost during scarcity period was reduced by Rs. 2167/animal/3 months of scarcity period than farmers practice of purchasing green fodder from outside (Rs. 4903/animal/3 months).

Silage making by pit method

Silage making by plastic bag method

Table 30: Use of nutrient supplements on milk yield and net income in dairy animals.

Name of the centre	Livestock type	No of Demon-strations	Technology demonstrated	Yield (kg/ha)		Cost of feeding	Gross returns (Rs/animal)	Net returns (Rs/ animal)
				Average milk yield/animal (L/day)	Total milk yield per animal (L/60days)			
Anantapur	Buffalo	5	Without Azolla	5	300	660	9600	8940
			With Azolla	6	360	785	11520	10735

Table 31: Effect of mineral mixture on milk yield and income in dairy animals in NICRA Kurnool district.

Animal	No of Demon-strations	Technology demon-strated	Yield		Cost of feeding	Gross returns (Rs/animal)	Net returns (Rs/animal)
			Average milk yield/animal (L/day)	Total milk yield per animal (L/60days)			
Dairy animals	50	Feeding of concentrates	4.45	267.0	1602.00	9345.0	7743.0
		FP+Mineral mixture (80g/ animal/day)	5.13	307.8	2593.20	10773.0	8179.8

Table 32: Feeding of silage fodder on productivity of milk and income in dairy animals in NICRA village of Ahmednagar

Treatments	Average green fodder/animal	Green fodder cost (Rs/kg)	Green fodder cost (Rs/cow/day)	Green fodder cost (Rs/animal/90 days)	Milk production (lit/ day/animal)
Farmers practice	18.16	3	54.48	4903.2	11.40
Silage making	15.21	2	30.42	2736.0	11.75

5.3 Backyard poultry for augmenting farm income

Agriculture alone cannot meet livelihood security of small and marginal farmers in rain fed regions. There is need to supplement the income of the farmers though income generating activities like back yard poultry. In this context, demonstrations on Backyard poultry were conducted in in Anantapur district revealed that Egg laying capacity of Rajasree birds and Desi birds was 140 and 35 per bird per year respectively. Higher body weight (3.5 kg/bird/year) was recorded with rajasree birds. Whereas, desi birds recorded an average body weight of 2.25 kg/bird/year.

Rajasree poultry birds at village

At Siruswada of Srikaulam district, rearing of vanaraja birds as backyard poultry, the percentage increase in weight of female and male birds was 55.9 and 80.5% over local birds. Farmers opined that Vanaraja birds are superior over local birds in growth and egg laying capacity but they are easily caught by the predators, as they are low in movement. Hence protected conditions are needed to rear vanaraja birds. In Khammam district the improved breed Vanaraja gained additional net weight of 2.0 kg/bird and 58 additional eggs/bird/year with an additional income of Rs. 515/bird/year compared to local breed.

Rearing vanaraja birds

Demonstrations on Backyard poultry were conducted in NICRA village of Nalgonda by comparing improve breed vanaraja against local birds in 33 farm families. These studies revealed that improved breed vanaraja gained 2 k.g weight against local breed (2.2 kg) with in a period of one year. Vanaraja birds laid 116 eggs whereas local birds produced only 54 eggs in a year. Thus the improved bird vanaraja gave total income of Rs. 2100 over local bird which gave the income of Rs. 1256 in a year.

In Amravati district of Maharashtra, Improved birds of Vanaraja/Giriraja produced body weight of (2.75 kg/bird) after one year; while local birds gave 1.75 kg weight after one year. The egg laying capacity of improved birds was in the range of 150-18/year as against 80-100/year in local birds. On an average improved vanaraja/giriraja gave additional net income of Rs. 260/bird/year than local birds.

5.4 Grading up of breed

Mortality and morbidity losses due to abiotic stress cause health hazards and low productivity and profitability with livestock of small and marginal farmers. Keeping this limitation in view, superior breeding rams were introduced in selected NICRA villages. Supplementation with graded ones for improvement of sheep will be helpful to gain income. In NICRA village of Khammam district. Introduction of superior breeding ram helped to produce 40 lambs as against local (26 no) in a year. Mortality of sheep decreased by 2% over local breeding. Eventually, this process increased the total income by Rs.19750 over local practice (Rs. 27700).

Small ruminants in NICRA village of Srikakulam district of Andhra Pradesh are mostly local breeds. Hence, the genetically superior breeding rams were supplied by replacing the local inferior breeds from the sheep flock to improve genetic potentiality of local sheep

Table 33: Production of genetically superior breeding lambs in Srikakulam district

Discription	2012-13	End of Feb 2013-14	Remarks
Total no.of Sheep in 3 Flocks	82	107	Sheppard's were satisfied with this intervention in 2012-13 and they are replaced 2 Rams and purchase another 2 new Rams for excess population in farmers own
No of breeding Rams	3	5	
No of Shepards	3	3	
No of Lambs born	58	87	
No of sheep came for Pregnancy	20	33	
No of lambs Sold out (all male lambs , some female lambs)	33	50	

Table 34: Performance of poultry birds in augmenting the farm income.

Name of the centre	Type of breed	Initial wt (g)	Weight of bird (kg) after 1 year	No.of eggs bird/year	Total expenditure (Rs/bird)	Income from eggs/year (Rs)	income from meat (Rs)	Total income (Rs/ year)	Number of farmers
Andhra Pradesh									
Anantapur	Local Breed	250	2.25	35	120	105	450	435	45
	Rajasree	350	3.50	140	180	420	700	940	
Khammam	Local Breed	650	2.5	52	615	260	450	710	60
	Vanaraja	650	4.5	110	925	550	675	1225	
Nalgonda	Local bird	600	2.2	54	590	270	396	1256	33
	Vanaraja	650	4.2	116	900	580	630	2100	
Amravati	Local Breed	50-60	1.75	90	750	800	280	520	38
	Giriraja & Vanraja	80-85	2.75	165	900	1060	420	640	

Table 35: Influence of improved species of sheep on mortality and income in NICRA village of Khammmam in Telangana.

Name of the intervention	Technology demonstrated	No.of beeding rams	Cost of breeding ram+feeding expenditure (Rs)	No. of lambs produced/ year	No.of sheep selling	Income selling from sheep (Rs)	No.of lambs/ Sheep keep with holder	Mortality of the Sheep (%)	Total income (Rs)
Up grading of breed	Local Breeding ram	01	8,000+3500	26	14	39200	4	2.08	27700
	Superior breeding ram	01	9850+5000	40	24	62300	14	0.8	47450

5.5 Fish culture

Composite fish culture was taken up in one check dam at Boring thanda village of Nalgonda district. A total of 6000 fish seed (fry stage) of catla, rohu, and common carp were released in the check dams on 11.08.2013. Fish was harvested in the last week of March 2014. Fish rearing activity in check dam with improved species of Catla, rohu, grass carp and common carps was initiated in NICRA village with involvement of 9 farmers covering 0.6 ha. The results showed that rearing of improved species of fish in check dams gained additional yield of 85 kg/pond and realized the net profit of Rs. 75600 over farmers practice (280 kg/ha) which gave the net income of Rs. 12400.

At Khammam, improved species Rohu gained weight of 350-400 g/species as against local species of Ciprinus carpio (200-250 g/sps).

In NICRA village of Sirsuwada of Srikakulam district in Andhra Pradesh, rearing of fish fry up to fingerling stage was done in nursery pond. About 25000 no. fish fry was realized as input from the beginning. After 30 days, about 15000 fish-lings (5-6 cm) were available. The cost of cultivation was Rs. 12000. The net returns realized after 30 days in pond was Rs. 10,500.

Table 36: Captive rearing of Fish seed (Rearing of fish fry up to fingerling stage in nursery pond)

IN PUT	**Captive rearing (30 days)**		**Outside purchase**	
No of Fish fry released 25,000	No of Finger-lings (5-6 cm) available to stock	15,000	No of Finger-lings	15,000
	Cost of Cultivation		**Cost at present market**	
	Cost of Fish fry	9,500.00	@ Rs. 1.50 per fingerling 15,000*1.5 0	22,500.00
	Feed Cost for 30 days	1,500.00		
	Labour Charges	1,000.00		
	Total Cost of Cultivation	**12,000.00**		
	Gross Returns 15000*Rs. 1.50	**22,500.00**		
	Net Returns in 30 days Period	**10,500.00**		

Captative rearing of fish

Composite fish culture

The Performance of Indian major carps in grama panchayat tank in the was in 13.8 ha with involvement of 4 farmers. The results indicated that the species Catla was surface feeder. While the species of Rohu, Bighead were coloumn feeders. The species of mrigala and CC are bottom feeders. Grass Crab feeds on aquatic vegetation and marginal weeds.

Table 37: Feeding habit of different types of fish varieties

Species name	Feeding Habit	No Released
Catla	Surface feeder	3900
Rohu	Column feeder	6000
Bighead	Column feeder	900
CC	Bottom feeder	1500
Mrigala	Bottom feeder	1500
Grass Carp	Feeds on aquatic vegetation & marginal weeds	1200
Total		**1500**

Demonstrations were conducted on observation of water quality parameters by using test kits and also to avoid sudden mortality due to changes in water quality parameters in NICRA village of undi in west Godavari district of Andhra Pradesh. The units covered in these demonstrations were five with participation of 5 farmers. Regular testing and monitoring of water quality parameters (pH, Dissolved Oxygen, Ammonia etc.) reduced the mortality of the fish and enhanced the net income by Rs. 21000/unit compared to the famers practice of no regular checking of Water quality parameters (Rs. 65000/unit). Though the yield of fish was little higher in farmer's method, in Srikakulam district the net income was higher with regular monitoring of water quality.

Table 38: Production and Economics of rearing fish in different NICRA villages

Name of the centre	Area (ha)	No of Demon-strations	Technology demon-strated	Yield (kg/ ha)	Cost of production (Rs/ha)	Gross returns (Rs/ ha)	Net return (Rs/ ha)	BC ratio
Nalgonda	0.6	9	Farmers practice	280	8000	16,800	88,000	2.1
			Composite fish culture	365	9500	21,900	12,400	2.30
West Godavari	5	5	No water quality management	500	335000	400000	65000	1.19
			water quality management	450	276000	360000	86000	1.3

5.6 Livestock health improvement

Mortality and morbidity losses due to abiotic and biotic stresses in livestock plays an important role in deriving supplementary income for small and marginal farmers in rain dependent villages. There is need to improve the health of existing sheep and goat through deworming activity.

Deworming for 200 animals was done in NICRA village to improve the health and mortality.

In NICRA village of Kurnool district calf registration was started to reduce the mortality of calves. Calf registration (Monthly de-worming + Vitamin A and B-complex supplementation and feeding of calf starter for 5 months @ 500g/day) in cattle and buffaloes enhanced the net returns of Rs. 4220 and Rs. 6770 as against untreated calves and buffalo calves which gave the net benefit of Rs. 3600 and Rs. 4980 respectively.

Table 39: Calf registration programme (2013-14)

Particulars	Farmers practice*		Treated Calf registration (Monthly de-worming + Vit.A and B-complex supplementation and feeding of calf starter for 5 months @ 500 g/day	
	Cattle calves	Buffalo calves	Cattle calves	Buffalo calves
Initial body weight (kg)	36.8	28.2	33.6	26.8
Final body weight (Kg)	64.2	64.4	68.4	78.6
Body weight gain (kg)	27.4	36.2	34.8	51.8
Total Gross returns (Rs)	4110.00	5430.00	5220.00	**7770.00**
Total cost (Rs)	450.00	450.00	1000.00	1000.00
Net returns (RS)	3660.00	4980.00	4220.00	6770.00

Demonstrations on use of Saf kit for Prevention of Mastitis were conducted in NICRA village of Pune district. Use of Saf kit reduced the problem of Mastitis in milking cows. The occurrence of mastitis and pustule on teats was reduced by 85% due to use of Saf Kit in Cross bred HF cows. As the occurrence of mastitis is reduced, Rs. 3000/- per animal per year is saved. The average market rate for milk was Rs 24/liter.

Table 40: Demonstration of SAF kit for prevention of Mastitis

Treatment	Average milk yield/ animal (L/ day)	Total milk yield/animal (L/305days)	Cost of feeding (Rs/animal + Treatment)	Gross return (Rs/animal)	Net return (Rs/animal)
Farmers practice	10.5	3202	61500	76848	15348
Use of SAF kit in cows	10.5	3202	60300	76848	16548

SAF kit for prevention of mastitis

6. Institutional Interventions

6.1 Custom hiring center

Timeliness of agricultural operations is crucial to cope with climatic variability, especially with sowing and intercultural operations. With increasing climatic variability, timely sowing or re-sowing alone can reduce crop losses significantly. However, farmers are often not able to complete critical operations in time for want of labour availability

Use of high capacity and energy efficient farm implements are more important in changing climate scenario. This includes limited sowing (window) period available due to delayed monsoon or long dry spells between rainfall events to complete farm operations. It is also relevant after prolonged water logging or for limited period suitable for various intercultural practices such as weeding or harvesting. Keeping this limitation, NICRA centers located in Telangana, Andhra Pradesh and Maharashtra states established the custom hiring centers from 2011 onwards.

Custom hiring envisages promoting establishment of farm machinery banks for hiring by way of providing financial assistance to self-help groups or farmers' co-operatives since the prohibitive cost of hi-tech and high productive equipments renders it difficult for individual ownership, It also include promotion and strengthening of agricultural mechanization through training, testing and demonstration.

Andhra Pradesh

Anantapur

Groundnut is an important oilseed crop grown in NICRA village of Anantapur district. Timeliness and precision in seeding and other operations are must to raise the productivity of this crop. But farmers are sowing the crop even up to the end of August due to non availability of labour and draft power. Efforts were made to establish custom hiring centre for providing timely services for various agricultural operations to the farmers during 2011. The machinery required for this centre was provided with financial support of the project. During 2012-13, the centre provided the service to the 25 ha area of groundnut and realized the income of Rs. 4200. In 2013, the custom hiring centre provided hiring services to 44.8 ha area of groundnut and earned the net income of Rs.14500. During *rabi*, it helped to provide services on hire basis to chilies and Tomato in 10.5 ha area. The total net income realized due to providing services in NICRA village is Rs. 21500. The progress of the centre is managed by Village Climate Risk management committee.

Ananta planter

Groundnut thresher

Kurnool

Custom hiring center was established in 2011 with the investment of Rs. 6.25 lakh as a group based activity. The centre consists of seed drills, Rotavator, Drum seeders, Taiwan sprayer, sprinklers with Pump set and sheep de- worming gun etc. During 2012, the custom hiring centre provided hiring services for various operations in crops of pigeon pea, castor, chickpea and sorghum. The area covered under different crops was 79.4 ha. The centre realized due to hiring services was Rs. 12000 in 2011-12. About Rs. 1575 was incurred towards the maintenance of tools in the centre. The net amount realized by the centre was Rs. 10425/year.

During 2013-14, the centre provided services to various farmers' fields covering 85.4ha and realized the income of Rs. 12772. About Rs. 2500 was incurred towards the maintenance of tools. The net amount realized due to providing need based services was Rs. 12272/year. The progress of the centre was monitored by the VCRMC of the village.

Seed cum fertilizer drill

Rotavator

Srikakulam

The custom hiring centre was established in NICRA village of Srikakulam district to provide community based hiring services with agricultural implements for timely agricultural operations during 2012-13. About 60 families became the members of the center. The management committee was formed in the village to guide the operations of the center on 20th November 2011. The project supported the center with an investment of 6.25 laks. The committee assessed the needs of mechanization for different crops before finalizing action plan in each year..

The center provided hiring services to the crops of paddy, cotton, vegetables in *kharif*, pulses, maize and vegetables during *rabi* season covering 64.5 ha area during 2012.The center realized the net amount of Rs.12380 during this year. The center provided hiring services to the crops of paddy (20 ha), Cotton (10 ha), vegetables (15 ha) in *kharif* season and Pulses (15 ha), vegetables (15.5 ha) and maize (0.5 ha) in *rabi* season. In 2013 the center realized the net amount of Rs. 5100 during 2013. The VCRMC suggested for proper utilization of the equipments, prompt collection of services charges and timely repairs of the equipments.

West Godavari

The custom hiring centre was established in NICRA village of undi in west Godavari district on 25.10.11 with the investment of Rs. 482077. The centre provided hiring services in various agricultural crops like paddy and vegetable to the extent of 31ha in 2012. The centre realized the net income of Rs. 3100 for the year 20012-13. The centre provided hiring services for paddy covering 31 ha and earned the net profit of Rs. 3100 during 2013. The centre was operated under the guidance of village risk management committee. The committee meetings were held for every month to monitor the progress of the work and performance of the centre.

Telangana

Khammam


Paddy reaper

The centre was established in Nacharam village (NICRA village) of Khammam district during 2010-11 with the investment of Rs. 55047 for providing hiring services for different agricultural operations to the farmers. About 9 persons are engaged in running the centre. In the process of operation, different commodity groups are formed to identify and assess the demand of various crops

and various operations, formation of schedule to be implemented during the year. This centre is operated by VLRC voluntarily formed in the village. The centre procured Tiwan Sprayer (1), seed cum- fertilizer drill (1), paddy reaper (1), multi-crop thresher (1) and 2-M.B. plough (1). It provided hiring services for 52.8 ha and realized the amount of Rs. 20041.

In 2013, the centre provided hiring services for paddy, cotton, chilies and maize covering 19.4 ha and realized the amount of Rs. 4400.

Paddy drum seeder

Multiple thresher

Nalgonda

The centre was established in Nandyalagudem and boring Thanda villages in Atmakur Mandal of Nalgonda district during 2011-12. About 6.71 lakh rupees were invested in establishment of the centre. The amount taken as loan from the bank for support of the centre was Rs. 44000. About 12 members were engaged to run this centre.

The steps in process of operation of the centre include:

1. Assessment of demand driven crops that require hiring services

2. Planning schedule of operational calendar for *kharif*, *rabi* and summer seasons.

3. Implementation of schedule

4. Monitoring the progress and also guidance by VCRMC.

About 155 no of families are the members in the centre. During 2011-12, the centre provided hiring services for *kharif* groundnut, paddy, cotton, green gram and vegetables and covered the area of 92 ha. It earned the net amount of Rs. 23720 in 2011-12. During 2013, the centre provided the hiring services for 57.8 ha and realized the net amount of Rs. 26000/year. The VCRMC met five times in 2012 and one time in 2013 to suggest various measures for improvement. The equipment procured for the operation of the centre is as follows:

S.no	Name of Equipment	No of units
1	Rotavator	2
2	Power weeder	1
3	Six row planter	1
4	Three row planter	1
5	Portable water lifter	2
6	Neem seed pulvariser	1
7	Dehuller	1
8	Deflashing machine	1
9	Bakery unit	1
10	Computer with accessories	1
11	Drum seeder	2
12	Groundnut decorticators	4
13	Maize sheller	1
14	Paddy field leveller	1
15	Bund former	1
16	Wheel hoe weeders	4

During 2013, the centre provided hiring services with rotovator (29.2 ha), six row planter (11.8 ha), three row planter (10.4 ha), power weeder (2.4 ha), paddy field leveller (2 ha) and drum seeder (2 ha) thus the centre generated the revenue of Rs. 16000.

3 row planter

Maize Sheller

Maharashtra

Ahmednagar

The custom hiring center was estabilished in NICRA village of Ahmednagar to provide hiring services for agricultural operations during 2011-12. Financial support of Rs. 6.25 lakhs received f from the project. The center intiated the operation activities of hiring services and covered an area of 29.4 ha in 2011-12 and earned the net profit of Rs. 21980. During 2012-13, the centre provided hiring charges for the crops of soybean, pearl millet, chickpea, onion, pomegranate, Lucerne, fodder maize covering 16.4 ha and realized the

net income of Rs. 12130. In 2013-14, the center provided hiring services for the crops of soybean (25.8 ha), pearl millet (9.8 ha), Chickpea (20 ha), onion (42.6 ha), pomegranate (34 ha), Lucerne (17.8 ha) and fodder maize (2 ha). It realized the net amount of Rs. 69260 by covering 152 ha with revenue generation of Rs. 61580.

The list of equipment procured in the center is as follows:

S. No.	Name of the equipment	No. of units bought	Remark
1	Sprinkler sets	5 no.	Use for custom hiring
2	Tractor operated seed drill cum fertilizers machine (CRIDA)	1 no.	Use for custom hiring
3	Tractor drawn rotavator	1 no.	Use for custom hiring
4	Power tiller	1 no.	Use for custom hiring
5	Tractor operated Sara yantra	1no.	Use for custom hiring
6	Motorized Sprayer (Mist blower)	3 no.	Use for custom hiring
7	Diesel engine	1 no.	Use for custom hiring
8	Tractor operated cultivator	1 no.	Use for custom hiring
9	Single wheel hoe	6 no.	Use for custom hiring
10	Mini weather station	1 no.	Daily weather data recording in village
11	GPS system	1 no.	Mapping village resources
12	Computer (Laptop)	1 no.	Documentation
13	Digital still Camera	1 no.	Action photographs
14	Platform balance	1 no.	Inputs measurement

Amravati

As a part of institutional innovations, the center established community based custom hiring center with the investment of 9.40 lakhs with involvement of 294 family members in NICRA village during October 2010. The space for the establishment was provided by the farming community in the village. Two persons were engaged in running the center.

Custom hiring centre at Amaravati

During 2012, the centre provided services for various agricultural operations to the crops of soybean, cotton and chickpea. It covered the total area of 633.7ha and realized the net amount of Rs. 60728. The center helped the farmers for performing timely operations for the crops of soybean, cotton and chickpea and earned the net profit of Rs. 33100 by covering 480.5ha in 2013.

S. No.	Name of Implement/Instrument	S. No.	Name of Implement/Instrument
1	GPS Map Unit	8	Weather station WS-2350
2	Reaper machine	9	3 Furrow plough HD
3	Seed cum fertilizer drill	10	Sprinkler sets
4	Dalmill unit	11	Dandekar rigder (Bullock Drawn)
5	Rotavator	12	Danlaxmi Sickles (100 no)
6	Honda crop cutter	13	Seed treatment Drum
7	Ridger with cultivator (Tractor Drawn)		

Rotavator

Gondia

The custom hiring center was established to cater the needs of farmers by arranging need based equipments and performing different agricultural operations in NICRA village in 2012. About 42 farm families became the members of the centre. In 2012, the center provided need based services on hire basis for 13.0 ha and realized the net amount of Rs. 7093. While in 2013, the center provided services for 2.6ha and earned the net profit of Rs. 1397.

Nandurbar

The center was established to provide custom hiring services to the farmers of NICRA village with an investment of 6.24 lakhs on 20th June 2011. About 257 families in the village are the members of the center. The center provided hiring services for different agricultural operations covering the crops of sorghum, soybean, chickpea, wheat, maize, ground nut and Mango in 2012. It realized the net income of Rs. 7000 by covering the cropped area of 110 ha. An amount of Rs. 1200 was incurred towards maintenance of tools. In 2013, the center realized the amount of Rs. 2315 as hiring charges by covering the total

cropped area of 99 ha. An amount of Rs.1630 was incurred as repairing and maintenance charges of tools. The important crops covered during 2013 were maize, sorghum, soybean, chickpea, wheat, garlic, groundnut, mango and vegetables. The activities of the center were monitored by VCRMC of the village. The recommendation of the committee for improved functioning of the centre was to place the implements at 4-5 places for easy accessibility since villages are scattered in hilly areas. About 12 farmers purchased their own allen cultivator for their use. Small hand tools are also purchased by the farmers. The key learning's for the sustainability of this center are: 1. The implements which are light in weight, can be transported manually have been preferred by the farmers. 2. The implements should be kept at 4-5 places for easy accessibility 3. Implements which are suitable for small bullocks are preferred by the farmers. The list of equipments procured for the establishment of the center is as follows:

S. No.	Name of farm equipment	No. of units
1	Iron plough	5
2	Allan cultivator (4 in 1)	5
3	Two bowl seed drill	5
4	Bullock drawn multi crop planter	2
5	Mogi-improved wheel hoe	5
6	Seed treatment drum	2
7	Knapsack sprayer	5
8	Rocking sprayer	3
9	Sprinkler irrigation set (3 hp pump set – 1)	4
10	Multi crop thresher (Diesel engine)	1
11	Bullock drawn groundnut digger	1
12	Hand operated Winnower (Upner)	1
13	Hand operated grain cleaner	2
14	Anand separator (Spiral)	1
15	Hand operated oil expeller	2
16	Solar dryer	2
17	Hand operated flour mill	5
18	Charring kiln	1
19	Briquetting machine	1
20	Hand operated tubular maize sheller	10
21	Groundnut decorticator	1
22	Vaibhav sickle	10
23	Laxmi sickle	10
24	Hand operated chaff cutter	2

Ratnagiri

The Custom hiring center was established as a group based activity to provide hiring services of agricultural operations in NICRA village in 2011with the project support of Rs. 6.25lakhs. About 13 VCRMC members are engaged in running the center. The center helped in providing hiring services for paddy for 170ha and realized the net amount of Rs. 2200 after incurring maintenance charges of Rs. 3500 in 2012. In 2013, the center earned the net profit of Rs. 14000 by covering 172ha. An amount of Rs. 4000 was incurred for repairing the tools of the center. The equipment procured for the running of the center was:

Pune

Custom hiring center was established in NICRA village with the investment of Rs. 6 lakhs during 2011. The center was established with the investment of 8.6 lakhs. About 115 farm families are the members in the center. The center helped in providing hiring services for Pearl-millet, Onion and *rabi* sorghum in 64.4 ha and realized the hiring charges of Rs. 10090, but Rs. 10900 was incurred towards repair and maintenance charges of tools. The centre helped the farmers in providing hiring services for 36.1 ha and realized the net loss of Rs. 3940 in 2012, the center hired the services for 36.1ha area and realized the amount of Rs. 6960.

Table 41: Performance of custom hiring centres in different NICRA villages-2013.

Name of the centre	Crops in demand for servicing custom hiring center	Area covered (ha)	Amount realized due to custom hiring services (Rs)	Amount incurred in maintenance of tools and centre	Net amount realized due to custom hiring centre
Anantapur	Grounnut, tomato,chillies	54.8	15200	-	15200
Kurnool	Pigeonpea, castor,black gram, sorghum	85.4	12772	2500-00	12272
Nalgonda	Paddy, cotton, pigeonpea, vegetables	57.8	18000	2,000	16000
Khammam	Paddy, cotton, chillies and maize	18.4	3400	-	3400

West Godavari	Paddy	30.0	3000	-	3000
Srikakaulam	Paddy, cotton, vegetables, pulses, maize	18.0	5100	3250.00	8350
Ahmednagar	Soybean, pearl millet, chichpea, onion, pomegranate, lucern, fodder maize	145.4	64140	-	64140
Amravati	Soybean, cotton, chickpea	480.5	33100	6450	33100
Pune	Pearl millet, onion, *rabi* sorghum wheat	36.1	6960	10900	-3940
Gondia	Paddy	2.6	1397	-	1397
Nanadurbar	Maize, soybean, sorghum, wheat, groundnut, vegetables	110	8200	-	7000
Ratnagiri	paddy	172	18000	4000	14000
Total		**1211**	**189269**	**29100**	**173919**

Thresher

Seed cum fertilizer drill

6.2 Seed Bank activities

Anantapur

The seed Bank was established in NICRA village of Anantapur district in 2012. It was established to meet the seed requirement of the village. About 12 families became the members of the seed Bank. Farmers in the village contributed 25% of money for the establishment of Bank; while the project contributed the remaining 75% of cost for the establishment. The members in the bank assessed the requirement of improved seed of the farmers in the village. The members approached the Univeristy/ ICAR institutes and procured the foundation seed of Ground nut (k-9, Dharani), Foxtail millet, paddy (NLR-34449) horsegram and fodder sorghum and Fodder sorghum and other crops.

Table 42: Details of seed bank activity in Anantapur

Name of the intervention	Name of crops / Commodity groups / Implements		Quantity / Number / Rent / Charges	No. of farmers	Area (ha)
Seed bank	1.Groundnut	K-6	200 kg pods	05	1.1
		K-9	90 kg pods	02	0.4
		Dharani	120 kg pods	04	1.1
	2. Setaria		20 kg	02	1.5
	3. Guar gum		30 kg	02	0.4
	4. Paddy (NLR 34449)		350 kg	05	2.0
	5. Yellow Jowar		350 kg	26	27.2
	6. Horse gram		200 kg	14	10.0
	7. Fodder jowar		500 kg	10	5.0

7. Capacity Building

There is need to build confidence among the farmers of NICRA villages in different districts of Andhra Pradesh and Maharashtra. Focus should be given on skill oriented training programmes pertaining to On-farm technological demonstrations on participatory mode, extending their cooperation in recording need based data, technologies in respect of raising crops and livestock, NRM activities and crop production. The NICRA centers working in the state of Andhra Pradesh organized 85 skill oriented training programmers with the active participation of 1831 participants. While the NICRA centers in the state of Telanaga, organized 13 need based training programmes on improving the productivity of agricultural and horticultural crops, livestock, and Custom hiring centers with active involvement of 523 participants. In Maharashtra, the NICRA centers organized 101 training programmes with participation of 3323 farmers. Thus the Programme Coordinators in the states of Telangana, A.P. and Maharashtra organized 199 training programmes with participation of 5677 farm men and women. The list of training programmes organized includes: Natural Resource Management, technologies of recommended intercropping systems, contingency crop planning, soil productivity improvement, crop diversification, Integrated Pest Management, Soil test based fertilizer requirements, Seed Banks and integrated livestock Management etc.,

Table 43: Capacity building Activities of NICRA project during 2013-14.

Centre	Title of the training programmes	No.of programmes organized	No. of participants		
			Male	Female	Total
Andhra Pradesh					
Anantapur	Water conservation methods	01	78	--	78
	Natural resource management	02	52	--	52
	Zero tillage maize cultivation	01	11	02	13
	Focussed group training on groundnut + red gram inter cropping system	01	27	03	30
	Contingency crop planning	01	20	--	20
	Gypsum application in alkaline soils	01	51	--	51
	Formation of Rythu clubs	17	17	05	22
	Training on Bakery products for farm women	03	--	09	09

Kurnool	Resource conservation technologies	4	102	40	142
	Crop diversification	5	200	32	232
	Fodder & feed management	2	61	22	83
	Nursery raising	3	56	23	79
	Nutrient management	2	52	08	60
	Pest& disease management	5	128	34	162
	Livestock management	4	127	52	179
	Drudgery reduction with farm implements	1	9	24	33
	Crop management	3	100	26	126
	Weed control	1	15	2	17
	Home science	2	0	48	48
Srikakulam	Training programme on Mini weather station data collection	1	12	3	15
	Training programme on Captive rearing of fish	1	20	5	25
	Nutrient & Pest Management in paddy	1	27	8	35
	Training Programme on Tamoto trelly system	1	14	6	20
	Training Programme on Azolla pit preparation	1	15	5	20
	Training Programme on Production on Technology on Pulses in Rice fallows.	1	28	5	33
	Zero tillage maize sowing	1	12	4	16
	Fish sampling (Growth & Health observation).	1	5	3	8
	Weedicide spraying in Zero tillage maize.	1	13	4	17
	Pest & disease management in Zero tillage maize	1	15	4	19
	Pest & disease management in Vegetable crops.	1	13	4	17
	Making Trellis in tamato field	1	14	4	8

West Godavari	Importance of Green manuring and soil testing in Paddy crop	1	23		23
	Village committee meeting with ADR about the culvert work	1	19		19
	Training programme on Nursery mangemnet in Paddy	1	13		13
	Training programme on Pest management in Paddy	1	15		15
	Training programme on Pest & Disease management in Paddy	1	15		15
	Training programme on Water quality management in Fish	1	13		13
	Training programme on Flood ameliorative measures in Paddy	1	12		12
	Training programme on Mangement practices in Paddy Helen cyclone	1	13		13
	Field day in Mechanical transplanted Paddy	1	10		10
	Training Programme on Direct sowing & Machine transplanting in Rabi Paddy	1	24		24
	Machine transplanting in Paddy	2	30		30
	Direct sowing with drum seeder in Paddy	2	35		35
	Training Pest and disease management in Rabi Paddy	1	18		18
Andhra Pradesh Total		**85**	**1456**	**385**	**1831**
Telangana					
Khammam	Importance of Farm ponds	1	41	11	52
	Climate resilient technologies in agriculture	1	55	01	56
	Silage making	1	42	04	46
	Seasonal diseases in Livestock	1	49	01	50
	Low cost technologies in paddy	1	46	-	46
	Pest and disease management in paddy and chillies	1	47	03	50

	Advantages of custom hiring centre and Farm machinery	1	54	03	57
Nalgonda	Natural resource management	01	27	06	33
	Crop diversification	01	20	-	20
	Crop management	01	28	02	30
	Nursery raising techniques in vegetables	01	29	02	31
	Live stock management	01	26	08	34
	Vermi-composting	01	14	04	18
Telangana Total		**13**	**478**	**45**	**523**
	Maharashtra				
Ahmed-nagar	Fish farming in farm pond	1	47	5	52
	Integrated feed & fodder management in cows	1	99	24	123
	Pomegranate cultivation under changing climate	3	81	37	118
	Integrated feed & fodder management in livestock	3	74	32	106
Amravati	Crop Management	5	67	14	81
	Employment generation	2	62	4	66
	Farm implements and machineries	7	85	23	108
	Fodder and Feed management	1	25		25
	Live stock management	3	156		156
	Natural resource management	5	67	6	73
	Women awareness	1		65	65
	Nutritional gardening	1		42	42
	Organic farming		35		35
	Pest and Disease management	2	68	9	77
Auranga-bad	Integrated weed management in Rabi crop	1	40	19	59
	Vermi composting as a bust for crop production	1	46	15	61
	Pre seasonal sugarcane production technology	1	30	19	49

	Sugarcane Trash management beneficial for soil and crop management	1	30	15	45
	Micro irrigation benefits and its maintenance	1	30	17	47
	Pest and diseases management in Bengal gram and Wheat	1	30	22	52
	Management of poultry and Goat units	1	40	21	61
Gondia	Soil sample collection	1	49	6	55
	Kharif crop planning	1	36	4	40
	Seed treatment of Paddy	1	46	2	48
	Paddy nursery	1	40	8	48
	Kirtankar Melava	1	105	11	116
	Tur cultivation	1	61	2	63
	Rabi Kisan melava	1	202	36	238
	Rabi crop planning	1	65	5	70
	Pulses and oilseed cultivation	1	47	3	50
	Fodder crop cultivation	2	74	6	80
Nandurbar	Soil and water conservation	1	19	0	19
	Desilting	1	17	0	17
	Diffuser	1	12	3	15
	Diffuser	1	22	2	24
	Ground nut stripper	1	5	16	21
	Interculturing operation	1	13	0	13
	Ridges and furrows	1	21	0	21
	Intercropping.	1	20	0	20
	Seed treatment.	1	12	0	12
	Production technology of red gram.	1	15	0	15
	Nutrient management in maize	1	14	0	14
	Nutrient management in mango	1	15	0	15
	Spodoptera control in soybean	1	15	0	15
	Disease management in groundnut.	1	18	0	18
	Pest management in red gram.	1	18	0	18

	Application of weedicide	1	12	0	12
	Seed dressing drum.	1	12	08	20
	Improved wheel hoe	1	16	04	20
	Improved wheel hoe	1	15	0	15
	Improved sickles.	1	09	17	26
	Ridges and furrows for rabi crops	1	14	0	14
	Interculturing operation in rabi crops	1	13	0	13
	Production technology of Bengal gram.	1	17	0	17
	Foliar application of nutrients in Bengal gram.	1	15	0	15
	Nutrient management in Bengalgram.	1	17	0	17
	Nutrient management in garlic.	1	15	0	15
	Seed treatment for rabi crops	1	14	0	14
	IPm in Bengalgram.	1	16	0	16
	Pest & disease management of mango.	1	10	0	10
	Lucern cultivation	1	12	0	12
	Feed management for cows.	1	12	0	12
	Allen cultivator	1	12	06	18
	Improved wheel hoe	1	15	10	25
	Spraying pumps	1	05	00	5
	Foliar application of KNO_3 in chick pea	1	35	13	48
	Management of pod borer in chick pea	1	35	13	48
	Protection of mango blossom	1	35	13	48
	Deworming	1	43	08	51
	Deworming	1	35	13	48
	Vegetable growers group	1	35	13	48
Pune	Ridger seed planter	1	20	0	20
	Integrated fertilizer management in rabi Sorghum and Maize	1	20	0	20
	Loose housing system for dairy	1	10	0	10

	Problems identification in the village and its rectification methodologies	1	28	0	28
Ratnagiri	Contingency crop planning	1	25	7	32
	Crop management	2	27	11	38
	Live stock management	1	15	7	22
Maharashtra Total		**101**	**2652**	**636**	**3323**
Grand Total		**199**	**4586**	**1066**	**5677**

8. Extension Activities

The programme Coordinators located in respective districts of NICRA villages of Telangana, Andhra Pradesh and Maharashtra states were involved in transfer of climate resilient agricultural technologies. The extension activities organized by different KVKs in NICRA centers during 2013-14 includes awareness programmes on climate resilient agriculture, field days, kisan melas, health camps, diagnostic visits, agro-advisory services, exposure visits and television and radio talks etc., During 2013-14, The NICRA programme Coordinators, conducted 421 programmes with participation of 29868 farmers. Among these, the extension activities of 188 were organized with 23889 farm men and 559 farm women in the state of Andhra Pradesh: while in Telangana state, 23 programmes of extension activities were organized with participation of 325 farm men and women. About 5095 farm women and men were participated in 201 extension activities in the state of Maharashtra during 2013-14. The details are presented below:

Table 44: Extension Activities of NICRA project during 2013-14.

Centre	Title of the activity	No. of programmes organized	No. of participants		
			Male	Female	Total
Andhra Pradesh					
Anantapur	Method demonstrations	4	120	18	138
	Agro advisory services	74	552	172	724
	Field days	3	154	12	166
	Group discussions	5	60	3	63
Kurnool	Method demonstrations	7	206	76	282
	Agro advisory	44	21712	19	21731
	Awareness	7	186	64	250
	Exposure visits	8	176	49	225
	Field days	1	45	16	61
	Group discussions	7	144	48	192
	Diagnostic visits	4	71	29	100
Srikakulam	Tamato nursery raising in protrays	2	20	5	25
	Trellis system in tomato	3	40	10	50
	Azolla Production	2	20	10	30
	Orientation cum interaction meeting on resilient agricultural practices	1	186	21	207

	Technology week	5	28	7	35
West Godavari	Field days	1	17	-	17
	Method demonstrations	5	93	-	93
	Group discussions	5	59	-	59
Andhra Pradesh Total		**188**	**23889**	**559**	**24448**
Telangana					
Nalgonda	Method demonstration	2	46	6	52
	Agro advisory services	4	22	2	24
	Group discussions	2	38	6	44
	Field days	1	22	-	22
Khammam	Group discussions	14	153	30	183
Telangana Total		**23**	**281**	**44**	**325**
Maharashtra					
Ahmednagar	Field days on bengal gram, silage making	2	46	54	100
	Mobile alert system	0	302	121	423
	Exposure visits	3	47	8	55
Amravati	Group dynamics	2	57	7	64
	Method demonstration	10	126	29	155
	Exposure Visit	3	252	65	317
	Field day	2	105	15	120
	Kisan Melas	1	125	15	140
	Technology Week	1	241	102	343
Aurangabad	Group discussions	3	50	16	66
	Method demonstrations	10	400	80	480
	Awareness	4	220	40	260
	Kisan melas	1	52	24	76
Gondia	Demonstration of paddy seed treatment	6	120	40	160
	Demonstration on cono weeder	6	120	40	160
	Demonstration of urea briquette	4	110	30	140
	Demonstration of pigeon pea on bunds	10	80	20	100
	Field day	3	120	30	150
	Kisan melas	1	150	25	175

	Kirtankar melava	1	80	10	90
	Agro Advisory Services	5	700	200	900
Nandurbar	Awareness	5	143	0	143
	VCRMC meeting	12	37	2	39
	Commodity group	1	23	0	23
	Group discussion	7	103	0	103
	Exposure visit	2	16	0	16
	Field day	4	63	0	63
	Diagnostic visit	8	37	3	40
Pune	Exposure visits	2	4	43	47
Ratnagiri	Method demonstrations	1	18	9	27
	Agro advisory services	90	90	30	120
Maharashtra Total		**201**	**4037**	**1058**	**5095**
Grand Total		**421**	**28207**	**1661**	**29868**

Field day organized at Anantapur

Training programme on top dressing of gypsum

Extension activities at Srikakulam

Extension activities at Kurnool

Extension activities at Aurangabad

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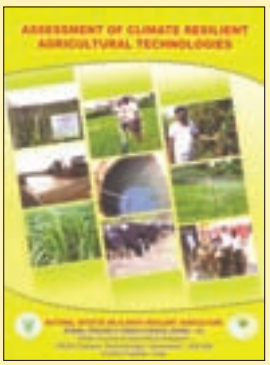
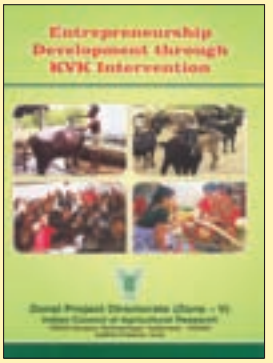
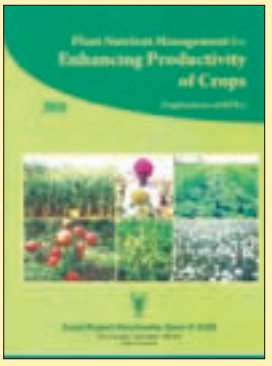

ASSESSMENT OF CLIMATE RESILIENT AGRICULTURAL TECHNOLOGIES

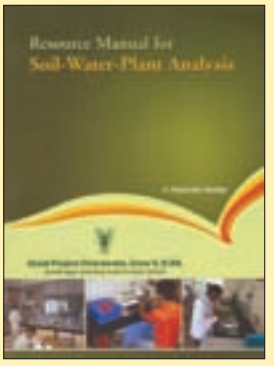

ENHANCING RESILIENCE TO CLIMATE CHANGE TECHNOLOGICAL INTERVENTIONS


NICRA
Technological Interventions by KVKs of Andhra Pradesh and Maharashtra


Entrepreneurship Development through KVK Intervention


Interventions and Innovations of Krishi Vigyan Kendra, Nalgonda and its Impact


Enhancing Productivity of Crops


Resource Manual for Soil-Water-Plant Analysis

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