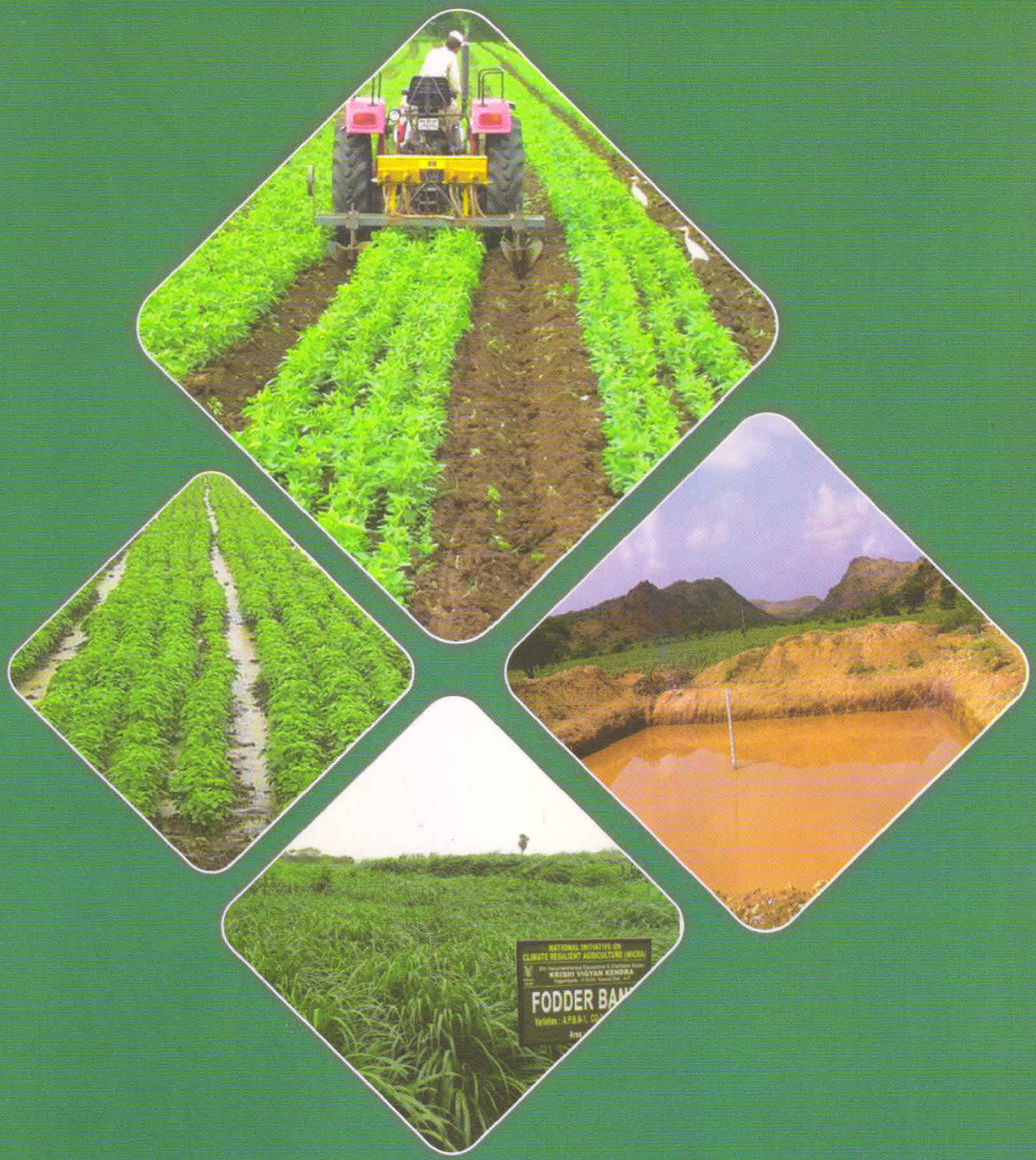
National Innovations in Climate Resilient Agriculture (NICRA)

Annual Report 2014-15



ICAR- Agricultural Technology Application Research Institute (ATARI)

CRIDA Campus, Santhoshnagar, Hyderabad-500059
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Editing

G. Rajender Reddy, N.Sudhakar,
K. Dattatri, Chari Appaji,
J. V. Prasad, A.R. Reddy

Compilation

G. Rajender Reddy
Nodal Officer-NICRA
Ms. Himabindu Tanguturi
Senior Research Fellow-NICRA

Secretarial Assistance

Mr. B. Amarnath, Assistant Administrative Officer
Mr. S. Bala Kamesh, Assistant Finance & Accounts Officer
Mr. V. V. Ramana, Assistant

Published by

Director
ICAR- ATARI (Formerly ZPD, Zone-V)
CRIDA campus, Santoshnagar
Hyderabad-500059, Telangana, India.
Phone: 040-24530300
Fax: 040-24533543
E-mail: zcu5hyd@yahoo.com

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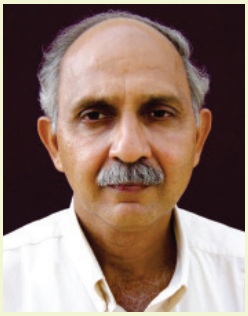


Dr. N. Sudhakar
Director

ICAR-ATARI,
CRIDA Campus, Santoshnagar,
Hyderabad-500059, Telangana, India
Tel. : 040-24530300 Fax: 040-24533543

Preface

Considering the immense vulnerability 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 Innovations in 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 ICAR-ATARI, Hyderabad through Krishi Vigyan Kendras. The experiences concerning these technologies demonstrated have been compiled in the form of Annual Report of 2014-15 by ICAR-ATARI, Hyderabad.

I am highly grateful to Dr. S. Ayyappan, Director General, ICAR and Secretary, DARE, Dr. A.K. Singh, 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, ATARI, Hyderabad and Dr. G. Subba Reddy, Former Head, Division of Crop Sciences & 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 ATARI, Hyderabad 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 6th August, 2015
Hyderabad

CONTENTS

कार्यकारी सारांश

वर्ष 2011 के दौरान भा.कृ.अनु.प. द्वारा राष्ट्रीय जलवायु समत्थान कृषि पहल (निक्रा) नामक एक बहु-संस्थागत, बहु-विषयपरक नेटवर्क परियोजना का आरंभ किया गया। परियोजना का उद्देश्य अनुकूल अनुसंधान एवं प्रौद्योगिकी के प्रदर्शनों द्वारा भारतीय कृषि को जलवायु परिवर्तन एवं जलवायु विविधता के समुत्थान में वृद्धि करना है। निक्रा का आधार प्रौद्योगिकी प्रदर्शन घटक है एवं इसे क्षेत्र-V के अंतर्गत आंध्र प्रदेश, तेलंगाना एवं महाराष्ट्र के राज्यों में स्थित 13 जलवायुवीय रूप से अति संवेदनशील जिलों में कृषि विज्ञान केंद्रों द्वारा कार्यान्वित किया जा रहा है। इसमें आंध्र प्रदेश के अनंतपुर, कर्नूल, श्रीकाकुलम एवं पश्चिम गोदावरी, तेलंगाना के खम्मगम एवं नलगोंड़ा, महाराष्ट्र के अहमदाबाद, अमरावती, औरंगाबाद, पूणे, बुलदाना, नंनदुराबाद एवं रत्नरगिरी के कृषि विज्ञान केंद्र शामिल हैं।

क्षेत्रीय परियोजना निदेशालय, क्षेत्र-V, ने आंध्र प्रदेश, तेलंगाना एवं महाराष्ट्र के तीन राज्यों के 2458 हेक्टेयर क्षेत्र को शामिल करते हुए 35146 किसानों की भागीदारी से कार्यक्रमों के आयोजन में सहायता प्रदान किया। इस परियोजना को क्रमश: 1247, 915, 494, 891, 5609 एवं 25995 किसानों की भागीदारी से प्राकृतिक संसाधन प्रबंधन, फसल उत्पादन, पशुधन एवं मत्स्यकी, संस्थागत हस्तक्षेपों, क्षमता निर्माण एवं प्रसार गतिविधियों का कार्यान्वयन किया गया। इस परियोजना द्वारा तीन राज्यों के चयनित निक्रा गांवों में प्राकृतिक संसाधन प्रबंधन का क्षेत्रीय प्रदर्शन 810 हेक्टेयर क्षेत्र में एवं फसल उत्पादन गतिविधियों का क्षेत्रीय प्रदर्शन 336 हेक्टेयर क्षेत्र में किया गया।

वर्षा पैर्टन

वर्ष 2004 दौरान आंध्रप्रदेश के कर्नूल, श्रीकाकुलम जिले एवं महाराष्ट्र के अमरावती, नंदुरबार, पूणे एवं रत्नगिरी जिलों में स्थित निक्रा के केंद्रों में वार्षिक वर्षा की तुलना में अधिक वर्षा हुई। वर्ष 2014 के दौरान अनंतपुर (आंध्र प्रदेश), खम्मम एवं नलगोंडा (तेलंगाना) एवं अहमदनगर, औरंगाबाद (महाराष्ट्र) जिलों में स्थित केंद्रों में वर्षा वार्षिक वर्षा से कम थी। आंध्र प्रदेश में, कर्नूल एवं श्रीकाकुलम जिलों के निक्रा केंद्रों में साधारण वार्षिक वर्षा की तुलना में क्रमश: 21 एवं 418 एम एम अधिक वर्षा हुई। लकिन अनंतपुर में वार्षिक वर्षा की तुलना में 247 एमएम कम वर्षा हुई। खम्मम एवं नलगोंडा जिलों में वर्षा वर्ष 2014 के दौरान हुई साधारण वर्षा की तुलना में क्रमश: 24.97 एवं 56.32 प्रतिशत अलग हो गई। अहमदनगर एवं औरंगाबाद जिलों में हुई वर्षा तदनुसार साधारण वार्षिक वर्षा की तुलना में क्रमश: 133 एवं 185 एमएम कम थी। अमरावती, नंदुरबार एवं रत्नणगिरी जिलों में वर्ष 2014 के दौरान हुई साधारण वार्षिक वर्षा की तुलना में क्रमश: 55, 34 एवं 40 एमएम अधिक वर्षा हुई।

प्राकृतिक संसाधन प्रबंधन

प्राकृतिक संसाधन प्रबंधन हस्तक्षेपों के अंतर्गत, अनंतपुर के तुंगभद्रा हाई लेवल केनाल से रिसाव जल को ले जाने के लिए फीडर चैनल के निर्माण से चेक डेम एवं फीडर चैनल के समीप स्थित बोर वेलों में 5-6 मीटर जल स्तर में वृद्धि हुई, इससे 36 हेक्टेयर के क्षेत्र में विभिन्न फसलों की खेती की गई। करीब 50 बोर वेल एवं 9 खुले कुओं का रीचार्ज किया गया एवं 5 निष्क्रिय बोर वेल सक्रिया हो गए। कर्नूल में अंत:स्रवण तालाबों से गाद निकालने से अंत:स्रवण तालाब के निकट करीब 250 बोर वेलों के जल स्तर में वृद्धि हुई। कृषि तालाबों में वाष्पण रोधक (Evaporation retardant) के उपयोग से हरेक कृषि तालाब से प्रति माह 1.48 लाख लीटर जल की बचत की गई।

कर्नूल के अरंड़, नलगोंड़ा के कपास एवं औरंगाबाद कपास एवं अरहर में संरक्षण कूंड, अमरावती के सोयाबीन में मेंढ़ एवं कूंड़ तथा चौड़ी क्यारी, नंदुरबर के मक्का में मेंढ़ एवं कूंड़ जैसे स्व-स्थाने नमी संरक्षण प्रौद्योगिकियों द्वारा वर्षाजल के संरक्षण से संबंधित नियंत्रित प्लॉटों की तुलना में 10-15 प्रतिशत उत्पादन में वृद्धि हुई। वर्षा आधारित परिस्थितियों की तुलना में फसल वृद्धि के क्रांतिक स्तरों पर कर्नूल के आम, नलगोंड़ा के मिर्च, अमरावती के कपास, सोयाबीन, चना एवं गेहूं में सूक्ष्म0 सिचांई द्वारा अतिरिक्त सिंचाई देने से उत्पादन में 25-30 प्रतिशत की वृद्धि हुई। नलगोंडा एवं खम्मम के चावल में हरा खाद एवं कर्नूल के लवण मृदा में जिप्सम के प्रयोग से मृदा गुणता में वृद्धि के साथ-साथ फसल उत्पादन में यथेष्ट वृद्धि हुई।

फसल उत्पादन

श्रीकाकुलम के निक्रा गांव में, निचले बाढ़ग्रस्त क्षेत्रों पर चावल की किस्म आरजीएल-2537 ने श्रेष्ठ निष्पादन दिया उसके बाद एमटीयू-1061 एवं एमटीयू-1064 का स्थान रहा। पश्चिम गोदावरी जिले के बाढ़ प्रवण (flood prone) क्षेत्र में उन्न त किस्मए एमटीयू-1064 ने बेहतर निष्पा दन दिया, उसके बाद 1061 का स्थावन रहा। वर्षा आधारित पर्यावरण में कर्नूल में आशा (अरहेर), NBeG-1 (चना); श्रीकाकुलम में एलजीजी-460 (मूंग), एलबीजी-752 (उड़द); अहमदनगर में चावल लवण सहीष्णु1 किस्मध सिध्धीश, शीतलता सहीष्णुि किस्मआ शीतल एवं चौब किस्मे पीकेएम-1; अमरावती में जेएस-9305 (सोयाबीन) ; नंदुरबर में जीएम-6 (मक्का) ; औरंगाबाद में बीडीएम-711 (अरहर), आकाश (चना), गेहूं में नेत्रावती (एनएआईडब्युक), परभनी मोती (रबी ज्वातर) ; पुणे में चना का मुरझान प्रतिरोधी विजय जैसे उन्ने किस्मोंक के प्रयोग से उत्पीादन में स्थिरता आई।

सस्ययन प्रणालियों में, कर्नूल में कंगनी (Foxtail millet) (सेटारिआ) + अरहर) (5:1), महाराष्ट्र के औरंगाबाद जिले के निक्रा के गांवों में सोयाबीन + अरहर (4:2), बाजरा + अरहर (3:3), बीटी कपास + मूंग (1:1) एवं रबी ज्वार + कुसुंभ (6:3) के अंतरा सस्ययन प्रणालियों ने विभिन्न निक्रा गांवों की आय में स्थिरता प्रदान की।

किसानों की संगत प्रक्रियाओं की तुलना में पश्चिम गोदावरी जिले में पोषक प्रबंधन आधारित मृदा जांच, अहमदनगर में सोयाबीन के क्रांतिक उगाऊ स्तरों पर पर्ण पोषक प्रयोग, अमरावती के सोयाबीन में पोषक प्रबंधन (पीएसबी + सिफारिश की गई रसायनिक उर्वरक (30:75:0) सहित अहाता खाद 10-15 टन प्रति हेक्टेयर एवं बीज उपचार), औरंगाबाद में बीटी कपास में समेकित पोषक प्रबंधन, कपास में पर्ण पोषक प्रयोग (सूक्ष्म पोषक एवं 19:19:19 या 12:61:00 का घुलनशील उर्वरक), बारामती में प्याज एवं मक्का में समेकित पोषक प्रबंधन ने अधिक आर्थिक लाभ दिया।

अनंतपुर में ट्रेक्टर चालित इंटरकल्टीवेटर से मूंगफली का यांत्रिक निराई-गुडाई, कर्नूल के अरहर में उन्नत बीज ड्रिल के उपयोग से न केवल श्रम की लागत में बचत (40-50 प्रतिशत) बल्कि पारंपरिक प्रक्रियाओं की तुलना में 100 प्रतिशत इकाई समय में प्रचालन क्षेत्र में भी वृद्धि हुई।

देर से बोवाई के अंतर्गत, वर्षा आधारित परिस्थितियों में कर्नूल के देसी कपास की तुलना में कंगनी (Foxtail millet) का लघु अवधि का सूर्यानंदी किस्म बेहतर विकल्पि हो सकता है। अनंतपुर में मूंगफली की तुलना में मूंग एवं ग्वालर की लघु अवधि फसलें भी लाभदायक पाई गई। खम्मम में पारंपरिक फसलों की तुलना में दलहनों (एमजीजी-347, मूंग) से फसल विविधिकरण लाभदायक पाया गया।

अनंतपुर के मूंगफली में फली विकास स्तर पर कारबेनडाज़िम + मनकोज़िब का उपयोग, चूषक नाशीजीवों के नियंत्रण के लिए कर्नूल अरंड में 2.5 मि.ली. की दर से क्लो रोपाइरिफॉस एवं 1 ग्राम प्रति लीटर की दर से कारबेनडाज़िम का छिड़काव तथा अरहर में मौसम आधारित समेकित नाशीजीव प्रबंधन और बोवाई के 40 और 60 दिनों बाद तना प्रयोग, श्रीकाकुलम के बीपीएच के लिए समेकित नाशीजीव प्रबंधन प्रक्रियाएं यानि बीज उपचार, एल्लोवेस निर्माण एवं आवश्यकता आधारित रसायन छिड़काव, अमरावती में प्रोपीकोनोज़ोल का प्रयोग एवं नंदुरबर में ज्वा र प्ररोह के लिए इमिडीक्लोरोप्रिड का छिड़काव जैसे फसल संरक्षण उपाय लाभदायक पाए गए।

पशुधन एवं मात्स्यिकी

पशुधन आधारित हस्तक्षेपों में, अनंतपुर में उन्नत चारा ज्वार किस्म Co-4, खम्मम में बहु कटाई मीठा ज्वार (मीठी घास) किस्म, नलगोंड़ा में बहु-कटाई एपीबीएन-1, अहमदनगर में चारा बाजरा, अमरावती में यशवंत घास, पूणे में मारवेल घास (फूले गोवर्धन) एवं नंदुरबर में बहु-कटाई लेसेर्न (आरएल-88) ने चारा उत्पादनों के संबंध में आशाजनक परिणाम दर्ज किए। आंध्रप्रदेश के कर्नूल में खनिज मिश्रण द्वारा पोषण में सुधार से दुग्धे उत्पांदन में 19.48 प्रतिशत एवं श्रीकाकुलम में 6.2 प्रतिशत की वृद्धि हुई। अहमदनगर में डेरी पशुओं में साइलेज निर्माण से किसानों की प्रक्रिया की तुलना में 5.08 प्रतिशत अधिक दुग्ध उत्पादकता दर्ज की गई। अहमदनगर में हाइड्रोपोनिक्स द्वारा उन्नत चारा उत्पादन पद्धत्ति ने हारा चारा की कमी एवं लागत में 46 प्रतिशत कम किया। स्थानीय नस्लों की तुलना में कुक्कुट के उन्नत नस्ल (राजश्री एवं वनराज) से 20-25 प्रतिशत अधिक अतिरिक्त आय प्राप्त हुआ। श्रीकाकुलम में उन्नत प्रजनन भेड़ के समावेश ने अधिक ऊचाई, लंबाई एवं भार वाले भेड़ों के उत्पादन में सहायता मिली। खम्मम में उन्नत प्रजनन लामबिन हेर्ड (Lambin herd) के रख-रखाव से स्थानीय किस्मों की तुलना में भेड़ों के उत्पादन में वृद्धि एवं मृत्युदर में कमी आई।

आंध्रप्रदेश के श्रीकाकुलम, नलगोंड़ा एवं पश्चिम गोदावरी जिलों में चेक डेमों में कट्ला, रोहू, ग्रास कार्प के उन्त नस्लों के मात्स्यिकी पालन की गतिविधियों से किसानों के जीविकोपार्जन में वृद्धि हुई। निक्रा के विभिन्नई गांवों में व्या पक टीकाकरण एवं पशु स्वाकस्यूद शिविरों के आयोजन से पशुओं में मृत्युदर एवं मॉरबिडिटी हानियों में कमी आई।

संस्थागत हस्तरक्षेप

संस्थागत हस्तक्षेपों के अंतर्गत, तेलंगाना, आंध्रप्रदेश एवं महाराष्ट्र के सभी निक्रा के गांवों में कस्टम हायरिंग केंद्र, बीज एवं चारा बैंक शुरू किए गए। इन केंद्रों ने किसानों की न केवल समय पर कृषि प्रचालनों में सहायता की बल्कि इसके अलावा नलगोंड़ा, खम्मम (तेलंगाना), अनंतपुर, कर्नूल, श्रीकाकुलम एवं पश्चिम गोदावरी (आंध्रप्रदेश) एवं महाराष्ट के अहमदनगर, अमरावती, औरंगाबाद, पूणे, नंदुरबर एवं रत्नगिरी जिलों में 2010 से 31740 रुपए प्रति केंद्र प्रति वर्ष तक का अतिरिक्त निवल आय भी प्रदान किया गया। 21.5 हेक्टेयर क्षेत्र में 44 किसानों के सहयोग से बीज उत्पादन गतिविधी के भाग के रूप में मूंगफली (के-6, के-9, धरनी), कंगनी (एसआई-3085), कुलथी एवं चारा ज्वार के क्रमश: 100, 100, 350, 100 तथा 100 किलोग्राम के उन्नत बीज का उत्पादन किया गया।

कर्नूल में 16 किसानों के सहयोग से कंगनी किस्म सूर्यनंदी (5.0 टन) एवं अरहर किस्म आशा (2.0 टन) का उत्पादन किया गया। अमरावती में 40 किसानों की सक्रिय भागीदारी से सोयाबीन की किस्म जेएस-9305 (26.4 टन) एवं जकी-9218 (28.05 टन) का उत्पादन किया गया।

क्षमता निर्माण

वर्ष 2014-15 के दौरान विभिन्न निक्रा के गांवों में 5604 किसानों की भागीदारी से क्षेत्र-V के अंतर्गत निक्रा परियोजना केंद्रों द्वारा 226 आवश्यकता आधारित प्रशिक्षण कार्यक्रमों का आयोजन किया गया। आंध्रप्रदेश के निक्रा गांवों में किसान, 1854 किसानों की भागीदारी से 58 प्रशिक्षण कार्यक्रमों में भाग लिए। तेलंगाना राज्य में, 585 किसानों की भागीदारी से 16 प्रशिक्षण कार्यक्रमों द्वारा कौशल सिखाया गया। जबकि महाराष्ट्र में, 2513 पुरूषा एवं 652 महिला किसानों की सक्रिय भागीदारी से 152 प्रशिक्षण कार्यक्रमों में भाग लिया। आयोजित किए गए प्रशिक्षण कार्यक्रमों की सूची में प्राकृतिक संसाधन प्रबंधन, सिफारिश अंतरा-सस्ययन प्रणालियों की प्रौद्योगिकियां, आकस्मिक फसल योजना, मृदा उत्पादकता सुधार, फसल विविधता, समेकित नाशीजीव प्रबंधन, उर्वरक आवश्य कताओं पर आधारित मृदा जांच, बीज बैंक एवं समेकित पशुधन प्रबंधन उद्यम आदि शामिल हैं।

प्रसार गतिविधियां

क्षेत्र-V के अंतर्गत निक्रा परियोजना केंद्रों में 25995 किसानों के भागीदारी से 456 प्रसार गतिविधियों का आयोजन किया गया। इनमें से, आध्रप्रदेश के राज्यआ में 19476 पुरूष एवं 2279 महिला किसानों से 237 प्रसार गतिविधियों का आयोजन किया गया। जबकि, तेलंगाना राज्यक में, 356 पुरूष एवं 60 महिला के भागीदारी से 42 प्रसार कार्यक्रमों का आयोजन किया गया। वर्ष 2014-15 के दौरान महाराष्ट्र राज्य में करीब 3924 महिला एवं पुरूषों ने 177 प्रसार गतिविधियों में भाग लिया।

Executive Summary

The National Innovations in 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 ATARI, Hyderabad. These include KVKs of Anantapur, Kurnool, Srikakulam and West Godavari of Andhra Pradesh. Khammam and Nalgonda of Telangana and Ahmednagar, Amravati, Aurangabad, Pune, Buldhana, Nandurabar and Ratnagiri in Maharashtra.

ATARI, Hyderabad (Formerly ZPD, Zone-V), facilitated in organizing programmes with participation of 35146 farmers covering 2458 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 1247, 915, 494, 891, 5609 and 25995 farmers respectively. The project organized field demonstrations in 810 ha of NRM and Crop production activities in 336 ha in selected NICRA villages of three states.

Rainfall Pattern

The NICRA centers located in Kurnool, Srikakulam districts of Andhra Pradesh and Amravati, Nandurbar, Pune and Ratnagiri districts in Maharashtra received excess rainfall compared to the respective annual rainfall during 2014. The centers located in Anantapur (Andhra Pradesh), Khammam & Nalgonda (Telangana) and Ahmednagar, Aurangabad (Maharashtra) districts received deficit rainfall during 2014. In Andhra Pradesh, the NICRA centers of Kurnool and Srikakulam districts received excess rainfall by 21 and 418 mm compared to the normal annual rainfall respectively. But the rainfall in Anantapur was deficit by 247 mm than annual rainfall. The rainfall in the districts of Khammam and Nalgonda was deviated to the extent of 24.97 and 56.32 percent compared to the respective normal rainfall received during 2014. The rainfall received in the districts in Ahmednagar and Aurangabad was less by 133 and 185 mm respectively than corresponding normal annual rainfall. The rainfall was excess by 55, 34 and 40 mm in Amravati, Nandurbar and Ratnagiri districts over corresponding normal annual rainfall in 2014.

Natural Resource Management

Under Natural Resource Management interventions, Formation of feeder channel to carry leakage water from Tungabhadra High Level Canal (THLC) at Anantapur increased the water levels by 5-6 m in bore wells located in the vicinity of check dam and feeder channel, 36 ha of area brought into cultivation of various crops. About 50 bore wells and 9 open

wells were recharged and 5 defunct bore wells became functional. Desilting of percolation tank in Kurnool lead to increase in water table of around 250 bore wells surrounding the percolation tank. Use of evaporation retardant in farm ponds saved 1.48 lakh litres of water/ month/farm pond in NICRA village of Ahmednagar district (Maharashtra).

Conservation of rainwater through insitu-moisture conservation technologies like conservation furrows in castor at Kurnool, cotton at Nalgonda, cotton and pigeonpea at Aurangabad, ridges and furrows and broad bed furrows in soybean at Amravati, Ridges and furrows in maize at Nandurbar enhanced the yields by 10-15%over respective control plots. Supplemental irrigation at critical stages of crop growth through micro irrigation in mango at Kurnool, chillies in Nalgonda, Cotton, Soybean, chickpea and wheat in Amravati enhanced yields by 25-30% over rainfed environment. Green manuring in Paddy at Nalgonda and Khammam and Gypsum application in saline soils of Kurnool helped in improving the soil quality besides considerable increment in the crop yields.

Crop Production

In NICRA village of Srikakulam, RGL-2537 of paddy performed best followed by MTU-1061 and MTU-1064 at low inundation areas. In West Godavari Improved variety MTU-1064 performed best followed by MTU-1064 in flood prone area. Improved varieties Asha (Pigeonpea), NBeG-1 (Chickpea) at Kurnool, LGG-460 (Green gram), LBG-752 (Black gram) at Srikakulam and salt tolerant variety Siddi at khammam and cold tolerant variety Sheetal in Paddy at Anantapur. Drum stick variety PKM-1 at Ahmednagar, JS-9305 (Soybean) in Amravati, GM-6 (Maize) at Nandurbar, BDN-711 (Pigeonpea), Akash (Chickpea), Netravati (NAIW-1415) in Wheat, Parbhani Moti (*Rabi* sorghum), MAUS-71 (Soybean) in Aurangabad, wilt resistant variety Vijay of chick pea in Pune gave stable yields in rain fed environment.

Among cropping systems, intercropping systems of foxtail millet (Seteria)+pigeon pea (5:1) at Kurnool, soybean+pigeonpea (4:2), pearlmillet+pigeonpea (3:3), Bt cotton+greengram (1:1) and rabi sorghum+safflower (6:3) in NICRA village of Aurangabad district, Maharashtra, imparted stable income in different NICRA villages.

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 Pune gave higher economic benefits than corresponding farmers practices.

Mechanized inter cultivation of groundnut with tractor drawn intercultivator in Anantapur, Use of improved seed drill in pigeonpea at Kurnool 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 (Seteria) can be better alternative, profitable than desi cotton at Kurnool under rain fed situation. The short duration crops of green gram and cluster bean were also found profitable over groundnut in Anantapur. Crop diversification with pulses (MGG-347, Green gram) was found beneficial compared to traditional crops at Khammam.

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 and stem application at 40, 60 DAS with imidachloprid at Kurnool for control of sucking pests, IPM practices i.e. seed treatment, Alleyways formation and need based chemical spray for BPH at Srikakulam, use of propiconozole in wheat in Amravati and spraying of imidachloprid 17.8 S.L against sorghum shoot fly at Nandurbar were found as profitable crop protection measures.

Livestock and Fisheries

In livestock based interventions, improved fodder sorghum var Co-4 in Anantapur, multicut variety sweet sorghum (Sugar graze) at Khammam, multicut APBN-1 of hybrid napier at Nalgonda, multicut fodder pearl millet at Ahmednagar, Yashwant grass at Amravati, Marvel grass (Phule Govardhan) at Pune and multicut lucern (RL-88) at Nadurbar, recorded promising results in terms of fodder yields. Improvement of nutrition through mineral mixture increased the milk yield by 19.48% in Kurnool and 6.2% in Srikakulam of Andhra Pradesh. Silage making at Ahmednagar registered higher milk productivity by 5.08% than farmers practice in dairy animals. Improved method of fodder production through hydroponics reduced the scarcity of green fodder and cost by 46% at Ahmednagar. 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 in increased height, length and weight of lambs at Srikakulam. Maintenance of Superior breeding lamb in herd increased the production of lambs and reduced the mortality as compared to local 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 and animal health camps 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 2010 to 31740 Rs/center/year in Nalgonda and Khammam (Telangana), Anantapur, Kurnool, Srikakulam and West Godavari (Andhra Pradesh) and Ahmednagar, Amravati, Aurangabad, Pune, Nandubar and Ratnagiri districts

in Maharashtra. Improved seeds of Groundnut (K-6, K-9, Dharani), Foxtail millet (SI-3085), Horse gram and fodder sorghum were produced to an extent of 100,100, 350,100 and 100 kg as a part of seed production activity with involvement of 44 farmers in 21.5 ha area.

At Kurnool Foxtail millat variety Suryanandi (5.0 t) and Pigeonpea variety Asha (2.0 t) were produced with involvement of 16 farmers. At Amravati JS-9305 variety of soyabean (26.4 t) and Jaki-9218 (28.05) were produced with active participation of 40 farmers.

Capacity Building

NICRA Project centers under ICAR-ATARI, Hyderabad organized 226 need based training programmes with participation of 5604 farmers in different NICRA villages during 2014-15. The farmers in NICRA villages of Andhra Pradesh underwent 57 training programmes with participation of 1854 farmers. In Telangana State, farmers were imparted skills through 16 training programmes with participation of 585 farmers. While in Maharashtra, the farmers of NICRA villages experienced 152 training programmes with active participation of 2513 male and 652 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

456 extension activities were conducted with participation of 25995 farmers in NICRA project centers under ICAR-ATARI, Hyderabad. Among these, 237 extension activities were organized with 19476 men and 2279 farm women in the state of Andhra Pradesh. While in Telangana state, 42 extension programmes were organized with participation of 356 men and 60 women. About 3824 women and men were participated in 177 extension activities in the state of Maharashtra during 2014-15.

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. 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 declining productivity and profitability of farming enterprise.

The majority of farmers are small and marginal land owners 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, National Innovations in Climate Resilient Agriculture (NICRA) is implemented as a network project of 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 were organized in 13 districts in Andhra Pradesh, Telangana 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 ATARI, Hyderabad 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, 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 61 mm 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 has a population of 1835 members 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 1077 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, 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 annual rainfall is 804 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 Nirmal Pimpri 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 457 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 (Tehsil) 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 918 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 644 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.

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 of 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 3375 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) 2014	Soil types	Major climatic variability
Andhra Pradesh				
Anantapur	Chamaluru and Chakrayapeta	305	Red soils	Drought
Kurnool	Yagantipalle	654	Black soils	Drought
Srikakulam	Sirusuwada	1682	Red sandy soils	Floods
West Godavari	Matsyapuri and Veera Varsam	773	Alluvial soils	Floods
Telangana				
Khammam	Nacharam	871	Black red soils	Drought, Heat stress
Nalgonda	Nandyalagudem and Boring Thanda	351	Black soils	Drought, Heat stress
Maharashtra				
Ahmednagar	Nirmal Pimpri	324	Black soils	Drought
Amravati	Takali BK	973	Black soils	Drought, floods
Aurangabad	Shekta	459	Black soils	Drought
Nandurbar	Umarani	847	Red&Black soils	Heat stress, drought
Pune	Jalgoan KP	511	Black soils	Drought
Ratnagiri	Haral	3415	Red & Lateritic solis	Floods

2.1 Rainfall pattern in NICRA centers

The primary source of water for agricultural production in most of the world is rainfall. The crop productivity in rainfed regions depends upon the amount, intensity and distribution of rainfall in a given season and place. Precise documentation of these three main characteristics is essential for planning its full utilization in view of changing climate scenario, especially rainfall. Hence there is need to study the rainfall pattern to understand the crop and livestock behavior in different NICRA centers.

Quantum of rainfall

The NICRA centers located in Kurnool, Srikakulam districts of Andhra Pradesh and Amravati, Nandurbar, Pune and Ratnagiri districts in Maharashtra receive excess rainfall compared to the respective annual rainfall during 2014. The centers located in Anantapur and West Godavari (Andhra Pradesh), Khammam and Nalgonda (Telangana) and Ahmednagar, Aurangabad (Maharashtra) districts received deficit rainfall during 2014 (Table1). In Andhra Pradesh, the centers of Kurnool and Srikakulam districts received excess rainfall by 21 and 418 mm compared to the normal annual rainfall respectively. But the rainfall in Anantapur was deficit by 247 mm than annual rainfall. The rainfall in the districts of Khammam and

Nalgonda was deviated to the extent of 24.97 and 56.32 percent compared to the respective normal rainfall received during 2014. The rainfall received in the districts in Ahmednagar and Aurangabad was less by 133 and 185 mm respectively than corresponding normal annual rainfall. The rainfall was excess by 55, 34 and 40 mm in Amravati, Nandurbar and Ratnagiri districts over corresponding normal annual rainfall in 2014. (Table 2).

Table 2: Rainfall details of NICRA villages in Andhra Pradesh, Telangana and Maharashtra

Name of the centre	Normal annual rainfall (mm)	Rainfall during 2014 mm	Excess/deficit rain fall	Deviation of rain fall from the normal *i.e.*, $\frac{\text{Actual} - \text{Normal}}{\text{Normal}} \times 100$
Andhra Pradesh				
Anantapur	552	305	-247	-44.74
Kurnool	633	654	+21	+3.32
Srikakulam	1264	1682	+418	+33.06
West Godavari	1077	773	-304	-28.22
Telangana				
Khammam	1161	871	-290	-24.97
Nalgonda	804	351	-463	-56.32
Maharashtra				
Ahmednagar	457	324	-133	-29.10
Amravati	918	973	+55	+6.03
Aurangabad	644	459	-185	-28.75
Nandurbar	813	847	+34	+4.15
Pune	505	511	+6	+1.21
Ratnagiri	3375	3415	+40	+ 1.18

2.2 Distribution of rainfall in different NICRA centers

Andhra Pradesh

During *kharif* 2014, the rainfed crops in Anantapur experienced prolonged dry spells during critical crop growth stages, which lead to reduction in yield. Total rainfall received during the year 2014 was 305 mm in 26 rainy days and rainfall during June-December is 235 mm in 19 rainy days. Rainfall received in the month of June is useful for land preparation. Farmers in NICRA village have sown groundnut crop in first fortnight of July with 20 mm rainfall only. From sowing to harvesting, every month recorded deficit rainfall when compare to

normal. Some farmers have taken up sorghum, green gram and cluster bean (Guar) crops in the month of second fortnight of August, as contingent crops (Table 2 and 3).

During *Kharif* monsoon onset was late (Third week of July) in NICRA center of Kurnool district. *Kharif* sowings were taken up with the rain fall received during last week of July. The crops experienced prolonged dry spells during grand growth period. Cotton could not be taken up due to late onset of monsoon. Sorghum was sown but it was affected with terminal moisture stress. The demonstrations of short duration varieties of Seteria like SIA-3085 and Suryanandi escaped drought due to its shorter duration.

In Srikakulam district, the paddy crop was at seedling stage. There was occurrence of floods during14th to 21st July which coincides the seedling stage of paddy. The crop experienced 5, 4 and 2 days of high, medium and low inundation respectively. Paddy crop experienced incidence of flood due to rains in village & back water from Vamsadhara river at tillering stage in the month of August. Paddy crop experienced 6, 6 and 2 days of high, medium and low inundation respectively. Further paddy crop underwent floods at tillering/panicle initiation stages from 14th to 21st in September. Paddy crop in NICRA village faced the occurrence of floods at Panicle initiation to flowering stages during 11th and 12th of October, where it experienced 7, 6 and 3 days of high, medium and low inundation respectively. Thus paddy crop faced 44, 34 and 13 days of high, medium and low inundations respectively during the growth stages of paddy.

The NICRA village Matsyapuri of West Godavari district, there was occurrence of Hudhud cyclone during the month of October 2014 in Andhra Pradesh. The Hudhud cyclone affect was not much in West Godavari District and there was no crop damage. However increased incidence of BPH in paddy especially in the variety MTU 7029 was noticed which was due to climate change especially after Hudhud cyclone.

Telangana

The cluster of villages of Nacharam in Khammam district received the deficit rainfall of 92.6. 18.0, 56.0, 60.8 and 100 percent compared to the normal rainfall received in the months of June, July, August, November and December respectively. The village tank was dried due to the deficit rainfall. Paddy crop could not be cultivated during *rabi* season. The paddy area in the village was reduced by 50%. The germination of cotton and pulses were affected and poor growth was observed in green manure crop Dhaincha. The incidence of sucking pests in cotton was increased. There was fodder shortage to the livestock in the project village.

In Nalgonda district, the farmers utilized the receipt of 30 mm of rainfall for land preparation of various crops. The rainfall received 30 mm in last week of July and also about 55mm received in first fortnight of August were used for sowing of pigeon pea and short duration of pulses. The crops experienced severe moisture stress at vegetative stage of long duration crops like pigeon pea and at flowering growth stages of short duration pulses.

Maharashtra

The onset of rainfall was late by 45 days *i.e*. by the end of July in Nirmal Pimpri village of Ahmednagar district. The sowing of *kharif* crops were completed at end of July and first week of August. A dry spell of 19 days immediately after sowing of crops affected initial vegetative growth of crops. The dry spell of 41-days from flowering to harvest resulted in wilting of crops The deficit rainfall at harvesting stage of crops affected the yield and quality. The limited rainfall in the months of October and November affected the sowing of rabi crops.

The Takali village in Amarvati district received the deficit rainfall of 7.16, 33.44, 54.7 in terms of percentage of deviation during the months of June, July and october as compared to normal rainfall received in corresponding months during rainy season. The rainfall received on10 and 100 mm on 11th and 17th of June fecilitated in land preparation and sowing of soybean, cotton and pigeonpea. But severe dry spell immidiately after sowing affected the vegetative stage of cotton, pigeon and soybean. The dryspell experianced during the month of october affected flowering of pigeonpea and boll formation of cotton. The wetspell experianced in the month of August and September resulted in water logging in fields, which affeted aeration problem in soil and also eventually yields.The cold wave occurance during first fortnight of december 2014 adversely affect the yields of pigeonpea.

The Shekta village in Aurangabad district received the deficit rainfall of 92, 16, 63 and 84, percent during the months of June, July, September, October and December compared to the normal rainfall received in corresponding month during rainy season in 2014. The rainfall of 10.5 mm in the month of June and 50 mm received upto 17th July helped in land preparation and sowing of *kharif* crops (Cotton, pigeon pea, short season pulses and soybean in the season. The severe dry spell from 10th September to October affected the yields of soya bean and cotton and also flowering in pigeonpea. The scarce rainfall received in the month of october and November affected the sowing of chickpea, *rabi* sorghum and wheat crops.

The Umarani village in Nandurbar district received the deficit rainfall 61, 19, 3 and 54 percent during the months of June, August, September and October comapred to the corresponding normal monthly rainfall respectively during this year. The onset of monsoon was delayed by one month (14th July). The sowing of *kharif* crops were done during 15th-16th July. Due to continous rainfall, sowing of crops (Maize, desi cotton, horsegram and short duration pulses) could not be done upto first week of August. There was dryspell for two months from 16th September. Heavy rainfall events occurred three times during rainy season.

The village Jalgaon in Baramati tehsil of Pune district received deficit rainfall of 40, 50 and 60 mm percent during the months of June, September and October compared to the normal rainfall of respective months. The rainfall received at this site was near to normal in the

month of July. In month of February to May the total rainfall received is 156.2 mm during the months of February to May damaged the wheat crop in the village. On set of rain fall during *kharif* was normal. But there was long dry spell of 22 day in month of June 2014. Rain fall received in the month of June is (38.2 mm) helped the farmers for preparatory tillage operation; The pearl-millet crop could not be sown due to insufficient rainfall the month of June and July. Fodder maize was sown as contingency crop with the receipt of 57.4 mm in the month of July. The amount of 190.6 mm rainfall received in the month of August helped for filling of desilted check dams and cement Bandhara. This situation helped in deep percolation and increased water levels in open wells. It helped for sowing of *Rabi* Sorghum. In the month of August there is long dry spell of 21 days and there was no rainfall in month of September. In total there are 4 long dry spell of more than 20 days and one dry spell of more than 10 days was observed from June to October. These dry spells adversely affected the *Kharif* as well as *Rabi* crops in the area.

Haral, in Ratnagiri district received deficit rainfall of 485.8, and 70 mm in the months of June and August as compared to the monthly respective normal rainfall in the cropping season. The rainfall was excess by 236, 135, 63, 61 and 57 mm in the months of July, September, October, November and December respectively.

Table 3: Rainfall Distribution of different NICRA centers during cropping season of 2014

Centre	June		July		Aug		Sep		Oct		Nov		Dec		Total	
	N	2014	N	2014	N	2014	N	2014	N	2014	N	2014	N	2014	N	2014
Andhra Pradesh																
Anantapur	64.0	42.0	67.0	28.0	89.0	53.0	118.0	36.0	111.0	49.0	35.0	5.0	10.0	22.0	493.7	235.0
Kurnool	65.0	135.4	107.0	50.3	115.0	238.8	120.0	32.1	117.0	115.9	26.0	24.0	8.0	5.0	558.0	601.5
Srikakaulam	146.0	59.6	239.0	251.6	205.0	394	188.0	372.1	177.0	260.2	60.0	30.5	1.0	0.0	1016.0	1368
West Godavari	115.0	12.2	265.0	188.6	190.0	140.8	178.0	218.6	190.0	87.2	65.0	11.4	15.0	0.0	1018.0	659.0
Telangana																
Khammam	131.0	9.6	304.0	249.2	300.0	131.8	151.0	207.6	114.0	146.0	25.0	9.8	3.0	0.0	1161.0	754.0
Nalgonda	102.5	30.0	185.2	38.0	194.7	122.0	151.1	28.0	114.1	70.0	26.7	0.0	1.7	0.0	776.0	288.0
Maharashtra																
Ahmednagar	95.4	0.0	69.4	70.0	56.9	143.0	133.1	0.0	58.1	28.0	9.1	73.0	5.3	3.8	427.3	317.8
Amravati	146.0	124.5	276.5	191.3	219.8	239.3	172.2	190.3	46.4	12.0	20.5	87.0	8.6	45.8	890.0	745.4
Aurangabad	131.8	10.5	101.0	85.0	133.3	166.0	172.2	64.5	69.0	11.20	22.8	32.0	11.1	7.5	641.2	376.7
Pune	78.5	40.2	56.7	59.4	67.4	190.4	150.1	2.0	72.2	12.0	32.1	36.0	5.3	11.0	462.3	351.2
Nanadurbar	120.1	47.0	256.0	439.0	198.0	155.0	187.6	182.0	51.8	24.0	0.0	0.0	0.0	0.0	813.5	847
Ratnagiri	817.9	332.1	1239.8	1476.2	829.0	759.1	359.7	494.7	128.4	191.2	0.0	61.0	0.0	57.4	3374.8	3371.7

Table 4: Incidence of dry spells and continuous wet spells in different NICRA centers during 2014

Centre	Rainfall during the cropping season (mm)	Dry spells (More than 10-15 days)	Continuous wet spells (More than 100 mm)
Andhra Pradesh			
Anantapur	235	June 4-14th (11 days), June 16-31st (16 days), July 15-31st (17 days), Aug1-12th (12 days), Sep1-15th (15 days), Sep 18-31th (13 days), Oct 7-20th (14 days), Nov 1-12th (12 days), Nov 14-31st (18 days), Dec 13-31st (19 days)	No wet spells were observed
Kurnool	601.5	June 16-62th (11days), July 15-26th (12 days), Aug 1-11th (11 days), Sep 18-30th (13 days), Oct 8-24th (17 days), Nov 15-30th (16 days), Dec 31st (20 days)	Nov 25-27th (111.5 mm)
Srikakaulam	1368	Nov 1-11th (11 days), Nov 14-31st (18 days), Dec (31 days)	Aug 13-17th (223.2 mm), Aug 25-31st (114.2 mm), Sep 4-13th (141 mm)
West Godavari	659	June 5-16th (12 days), Nov 20-31st (11 days), Dec (31 days)	Sep 13-21st (161.6 mm)
Telangana			
Khammam	754	Aug 13-25th (13 days), Nov 15-31st (17 days), Dec (31 days)	July 27-31st (105.6 mm)
Nalgonda	288	July 1-11th (11 days), July 13-26th (14 days), Sep 1-24th (24 days), Oct 1-15th (15 days), Nov (30 days), Dec (31 days)	No wet spells were observed
Maharashtra			
Ahmednagar	318	June 1-31st (31 days), Aug 5-22nd (18 days), Sep (30 days), Oct 4-16th (13 days), Oct 18-31st (14 days), Nov 1-13th (13 days, Nov 17-31st (14 days), Dec 1-11th (11 days) Dec 13-31st (19) days,	Aug 23-26th (111 mm)
Amravati	745	Nov 15-30th (16 days), Dec (31 days)	July 17-22nd (126.25 mm), Aug 25-31st (152.25 mm), Sep 5-9th (240.75 mm)
Aurangabad	377	June 6-49th (14 days), June 21-31st (11 days), Sep 10-31st (21 days), Oct 10-24th (15 days), Nov 1-14th (14 days), Nov 19-30th (13 days), Dec 1-12th (12 days), Dec 14-30th (16 days)	No wet spells were observed
Pune	351	June 8-31st (24 days), July 9-22nd (14 days), Aug 1-20th (20 days), Sep 2-31st (29 days), Oct 1-25th (25 days), Nov 1-14 (14 days), Dec 1-13th (13 days), Dec 15-31st (16 days)	Aug 25-31st (133.2 mm)
Nandurbar	847	June 1-11th (11 days), June 13-31st (19 days), July 1-13th (13 days), Sep 11-31st (21 days), Nov (30 days), Dec (31 days)	July 14-31st (431 mm), Sep 7-10th (138 mm)
Ratnagiri	3372	Nov 1-13th (13 days), Nov 16-31st (16 days), Dec 1-11th (11 days), Dec 13-31st (19 days)	June 10-26th (311.2 mm), July 31st (1476.2 mm), Aug 1-31st (759.1 mm), Sep 1-22nd (369 mm), Sep 24-30th (125.7 mm)

3. Natural Resource Management

3.1 Ex-Situ water harvesting and efficient use

Andhra Pradesh

Anantapur

Formation of feeder channel to carry leakage water from Tungabhadra High Level Canal

The ground water levels are decreasing over the years in Anantapur district of Andhra Pradesh due to decrease in rainfall and also due to over exploitation of ground water resources. In this context, an attempt was made to recharge ground water in bore wells by formation of feeder channel in Chamaluru village of the NICRA project.

A feeder channel was dug with the dimensions of 2 km length and 2 m breadth and 1.5 m depth to carry leakage water from Tungabhadra High Level Canal (THLC). By formation of feeder channel, check dam was filled with THLC leakage water. Water level raised by 5-6 m in bore wells, which were located in the vicinity of check dam and feeder channel. Due to this, 36 ha of area was brought under cultivation with different crops *i.e.,* paddy (22 ha), castor (4 ha), tomato (2 ha), vegetables (3.2 ha), green gram (2 ha) and fodder sorghum (2.8 ha) (Table 5). About 50 bore wells and 9 open wells were recharged and 5 defunct bore wells become functioning (Table 6). The water is useful for drinking water purpose of 10000 sheep every day.

Table 5: Cultivation of different crops under impact of checkdams

Crop	Area (ha)	Farmers	Bores	Open wells
Paddy	22	30	33	03
Castor	4	03	05	01
Tomato	2	03	03	-
Vegetables	3.2	03	03	02
Green gram	2	03	04	-
Fodder Sorghum	2.8	10	07	02
Total	**36**	**55**	**55**	**09**

Table 6: Water level (m) in bore wells after formation of feeder channel, check dam filled with water

Particulars	Before	After		
	10-12-2014	10-01-2015	10-02-2015	10-03-2015
Water level (m) in bore well (Nearest check Dam)	19.60	13.00	13.75	12.50
Water level in bore well (1Km away from check dam)	23.00	19.50	20.75	22.20

Formation of feeder channel

Percolation pond before and after renovation and filled with water

Renovation of percolation pond

A community percolation pond was renovated in Chamaluru village of Anantapur district. The storage capacity of pond before and after renovation was 90,000 and 8,10,000 liters. Done with water storage capacity of 200 cu.m (2,20,000 L) to recharge the bore wells in the vicinity with ground water. The capacity of percolation pond before and after renovation was 91 and: 810 cu.m, it was filled on 12th December, 2014. About 6 bore wells and 1 open well located in the vicinity of percolation pond were recharged and water level increased by 6-8 m in bore wells. About 6.8 ha of land brought under cultivation of different crops *viz.,* paddy (6.8 ha), ragi (0.4 ha) and castor (0.4ha). The stored water was useful as drinking water for small ruminants during summer season.

A pond of 45x3x3 mt. having storage capacity 405000 lit. of waterways constructed was constructed on 26th December, 2014. It was filled once with rainwater on 29th December, 2014. It created an impact to recharge three open wells and 6 bore wells and brought additional 12 acres of land into cultivation. In another site two farm ponds constructed on 11th November, 2013 (2.4 and 4.13 lakh lit. capacity) in September and October, 2014, resulted in conversion of 3 Acres fallow area in to cultivable area with drip irrigation. (2 acres chilli, 1 acre sapota and 0.5 acre under fodder), Discharge increased from 1" to 2.5 and one defunct bore well became functioning.

In Peravali village of Anantapur, pond was dug with a size of 25x15x2 m (7.5 lakh lit. of water storage capacity) on 27th November, 2013. It was filled four times (7th March, 16th, 17th and 29th October, 2014) in 2014. The aim was to give supplemental irrigation, ground water recharge and for drinking water for livestock. It created the impact of bringing 3 acres of tomato under drip.

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

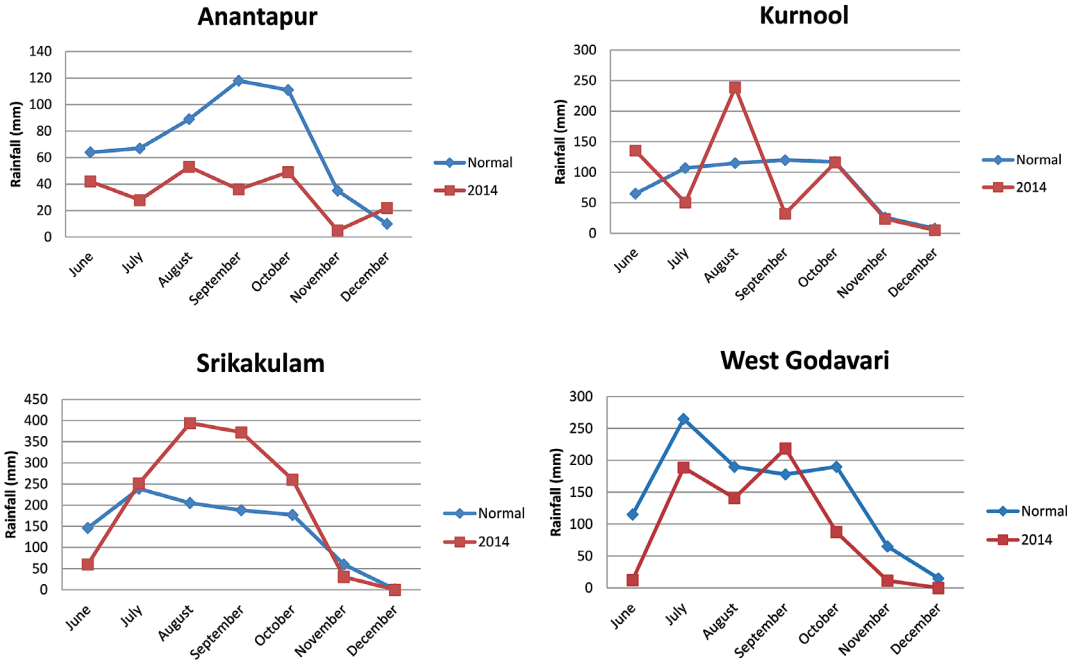


Fig. 2: Distribution of rainfall in different NICRA centres of Telangana

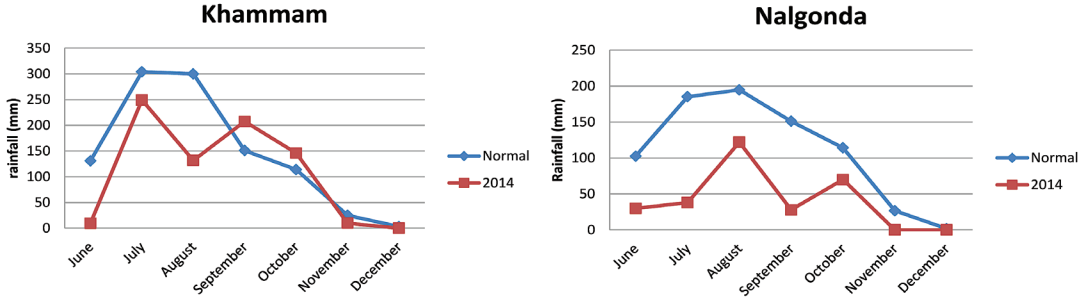
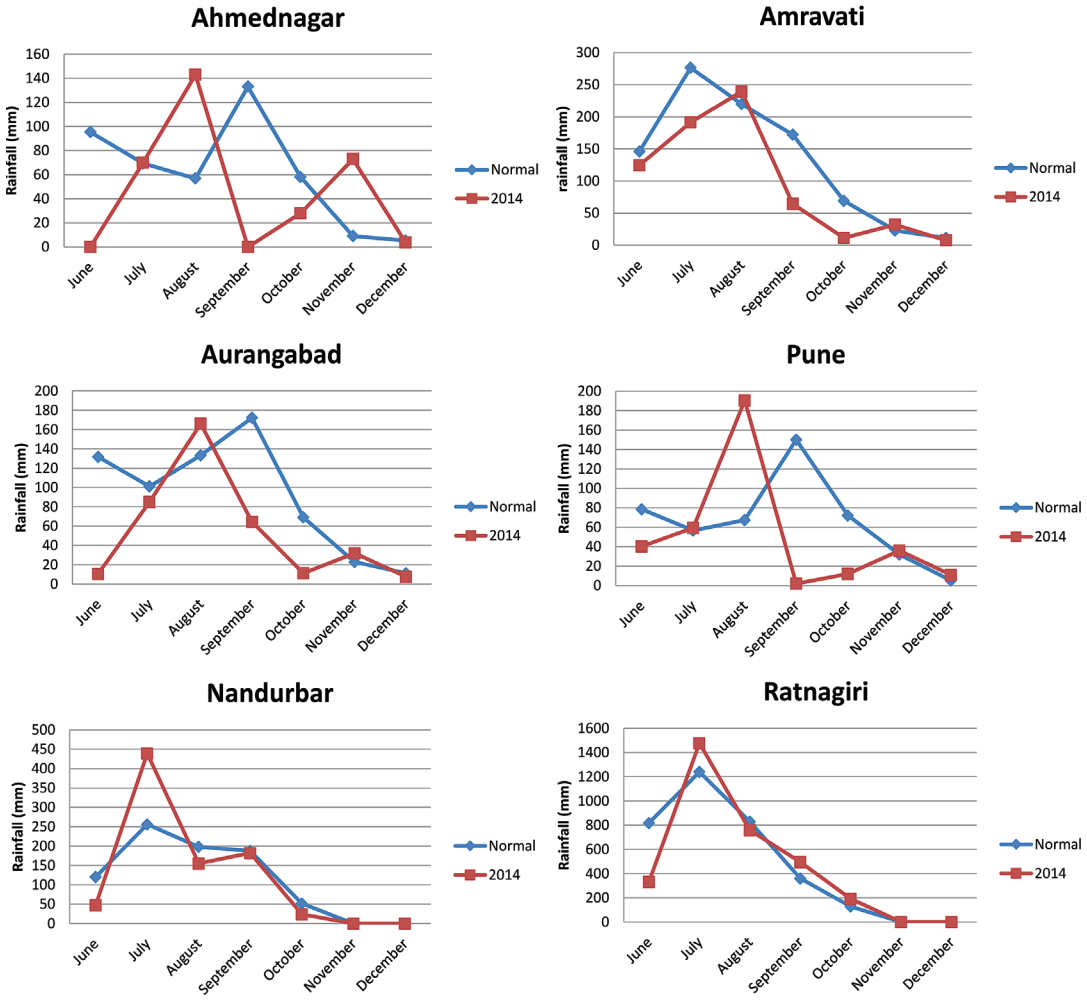


Fig. 3: Distribution of rainfall in different NICRA centres of Maharashtra



Kurnool

De-silting of existing percolation tank

The project committee proposed desilting of existing percolation tank (Burrakunta) for deepening and use of tank silt for marginal soils to improve soil physical properties and fertility. Focus group interactions were held with the villagers to sensitize them on the importance of water harvesting and application of tank silt. The de-silting of Burrakunta (PT) was taken up during July 2012 and 1260 Cu.mt silt was excavated. The silt was applied to 6 ha covering 10 farmers and transportation cost was borne by the farmers. Water table of around 250 bore wells surrounding the percolation tank raised by 12 ft from August to November in 2014 (Table 7**)**. Deepening of percolation tank increased the water storage capacity (12.60 lakh litres).

Table 7: Details ground water recharge of bore wells in NICRA village of Kurnool district

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	92.5	6.0	-	135.4
July	90.3	5.3	2.0	050.3
August	68.2	11.0	3.0	238.8
September	64.8	8.0	4.0	32.1
October	52.4	8.5	3.5	115.9
November	63.2	4.5	3.0	24.0
December	70.2	2.0	2.5	5.0
January-15	96.4	1.5	1.0	0.0
February-15	126	1.25	0.75	0.6
March-15	138	1.32	1.0	18.5

(Average of Six bore wells taken for data) -Total number of borewells-40)

Srikakulam

Impact of renovated Jagannadha Naidu tank in Srikakulam district

The tank capacity was increased to1,38,575 m^3 (25 acres in avg 4.5 feet) in 2014-15. Water stored in the renovated Jagannadanaidu tank was used for Kharif Paddy. Paddy transplanting operations were carried out in time. Water has been conveniently used up to end of the crop season. Transplanting operations were Independent of rainfall. Water is available to grow rabi crops, Cropping intensity was increased by 93 percent in the village. It also allowed to grow fish up to marketable size i.e., 1.0 to 1.5 kg. The area covered under rabi during 2014-15 was paddy (15 ha), maize (4 ha), vegetables (12 ha), sesame (9 ha and finger millet (1 ha). Due to renovation of Jagannadha Naidu tank, water table increased in bore wells adjacent to the tank (Table 8**)**.

Table 8: Recharge of bore wells adjacent to the Jagannadha Naidu tank

Farmers	Water depth from top (in ft)		
	In Jan, 2013	In Jan, 2014	In Jan, 2015
Killari Ramulu	14.0	12.5	12.0
Kotilingala Gourango	10.0	8.0	7.0
Volurouthu Laxminarayana	13.0	11.0	10.0

West Godavari

Arrangement of field drainage channels

Floods are major limiting factor for productivity of paddy in NICRA villages in coastal districts of Andhra Pradesh. The impact of floods on productivity of different crops can be minimized by providing drainage to drain out excess water besides implementing other need based management practices. Keeping this background information, arrangement of field drainage channels was made to minimize the water inundation aroused from Vamshadara river in NICRA village of West Godavari district.

Under NRM activity, deepening of two irrigation channels was taken up in NICRA village of West Godavari district. The deepening of channels in this village covered 1600 acres of paddy. About 300 farmers were benefited with this activity with proper supply of irrigation water to tail end areas. This activity facilitated in avoiding flood water due to heavy rains. Deepening of these two irrigation channels also helped to collect excess of flood water at the time of Neelam cyclone. The channels decreased the extent of submergence in the adjacent fields. It was noticed that the fields were partially submerged (upto 42 cm) in the area where channels were deepened and there is no overflowing of flood water in other areas the submergence was up to 122 cm and the crop was completely submerged due to flooded water. The yield obtained was 4-5 t/ha in the area where deepening was taken up and in either areas the yields ranged from nil to 1500 kg/ha in other areas. Crop submergence was reduced by 30% in the area of NRM activity when compared to other areas of Matsyapuri village.

Telangana

Khammam

The harvested rain water was not used efficiently due to breakage in checkdam in NICRA village of khammam district, Sand bag bridge was constructed during 2014-15 to improve the productivity of rainfed crops through supplemental irrigation, after renovation, about 6.8 ha of land brought under cultivation of different crops *viz.,* paddy, cotton, chilli and subabul during rabi season in 14 farmers fields.

Construction of sand bag check dam, water levels before and after construction of check dam

Maharashtra

Ahmednagar

Use of evaporation retardants

During summer 25-30 percent evaporation losses were observed from farm pond in NICRA village of Ahmednagar. It Increases cost on water management. Use of water evaporation retardant in plastic lined farm pond saved 429714 litre of water /3 months/farm pond (Table 9).

Table 9: Use of water retardant on storage of farm pond water

Month	Treatments	Average tank size (cu.mt.)	Av. water quantity (Lit.)		Water loss (lit./ month)	water saving (lit/month)
			Initial	After one month		
March	Without Water Evaporation Retardant	32.4x32.4 (1049)	7294984	6863220	431764	
	Use of Water Evaporation Retardant	32.75x 32.75 (1072)	7364870	7081290	283580	148184
April	Without Water Evaporation Retardant	32.4x32.4 x9.4m	6863220	6403233	459987	
	Use of Water Evaporation Retardant	32.75x 32.75 x 9.43 m	7081290	6740555	340735	119252
May	Without Water Evaporation Retardant	32.4x32.4 x9.4m	6403233	5726830	676403	
	Use of Water Evaporation Retardant	32.75x 32.75 x 9.43 m	6740555	6226430	514125	162278
Total Water Saving						**429714**

Pune

Construction of cement Bhandhara

Cement Bhandhara was constructed in NICRA village of Pune district during 2014 with 16 m length across the check dam. During 2014, the check dam was filled with 1.3 crore lit of rain water. The water level in the check dam was raised up to 7 feet. The available water needed for different crops covering 19 ha required two supplemental irrigations during rabi season (Table 10**)**.

Construction of cement bhandara

Table 10: Status of ground water level in open wells (In 500 M radius from check dam, No.of wells-7)

Month	Average Height of water layer in the well Bottom to top (ft)	Total area irrigated by wells Nearby Bandhara Site (ha.)	Total Rainfall in that month (mm)
June-2014	7.60	13.20	40.20
July -2014	12.75	18.00	59.40
August-2014	7.50	9.00	190.60
September-2014	8.25	17.20	2 .00

Ratnagiri

Construction of Vijaya Bhandhara

During 2014, 15 number of Vijaya Bhandhara (check dams) were constructed with storage capacity of 140 cubic mts. The crops like Groundnut, Horsegram, Cowpea, Leafy vegetables were raised due to storage of water.

Construction of Vijaya Bhandara

Impact of Vijaya Bhandhra

- Availability of water for protective irrigation.
- Active people's participation is sought during construction.
- Around 5 ha of land brought under rabi cultivation.
- Crops grown include cowpea, groundnut, horse gram and leafy vegetables.
- Availability of water in the nearby wells up to April, which used to dried up around February.
- Additional income generation to farmers involved through marketing of their produce, otherwise are dependent only on kharif rice.

3.2 In-situ moisture conservation technologies

Drought is recurring phenomena in rain fed red soils in Anantapur. The productivity of groundnut and pigeon pea can be stabilized through the practice of sub-soiling technology. The improved practice of sub soiling with chisel plough in groundnut and pigeonpea improved the productivity by 28 and 85 kg/ha over no-sub soiling respectively in Anantapur district of Andhra Pradesh. The practice of sub soiling gave additional net returns of 456 and 3250 Rs/ha as compared to control in respect of groundnut and pigeon pea respectively.

Formation of conservation furrows in between rows of castor (PCH-111) improved the productivity (96 kg/ha) and profitability (3298 Rs/ha) than no conservation furrows in NICRA village of Kurnool district of Andhra Pradesh. Conservation furrows increased soil moisture depth (cm) over no conservation furrows at different growth stages of crop growth. In NICRA village of Nalgonda district (Telangana state), conservation furrows in between cotton rows gave higher yield (180 kg/ha) and increased net returns (4710 Rs/ha) than no conservation furrows.

Pigeonpea at flowering stage

Conservation furrows in castor

In NICRA village of Amravati district of Maharashtra, formation of Broad bed furrows in soybean gave highest bean yields (1750 kg/ha), followed by Ridges and furrows (1550 kg/ha) and sowing across the slope (1475 kg/ha) against of no conservation furrows (1075 kg/ha). BBF in soya bean realized additional net income of 21700 Rs /ha over the farmers practice (13250 Rs / ha). Strip cropping in soybean enhanced the yield (375 kg/ha) compared to the farmers method of flat sowing (1175 kg/ha).

BBF in soybean

Formation of conservation furrows in between rows and ridges and furrows showed equal performance in conservation of moisture in cotton. On an average, these conservation measures gave higher yields (100 kg/ha) than no conservation furrows. Formation of conservation furrows in alternate rows in cotton and pigeon pea gave higher yields by 15 and 13 percent as compared to the farmers practice of no conservation furrows in Aurangabad district of Maharashtra. BBF system of sowing in soya bean realized the additional yield by 23 percent and also realized net benefit of 6223 Rs /ha than flat method of sowing (975 kg/ha). At Nandurbar, formation of ridges and furrows in maize gave higher cob yield (235 kg/ha) than farmers practice of no conservation furrows (Table 11).

Table 11: Influence of various insitu moisture conservation technologies on productivity and profitability of different crops

Name of the centre	Crop	Area (ha)	No of Demonstra-tions	Technology demonstrated	Yield (kg/ha)	Cost of Cultiva-tion (Rs/ha)	Gross Returns (Rs/ha)	Net Returns (Rs/ha)	B:C ratio
Andhra Pradesh									
Anantapur	Groundnut	2.0	03	Land preparation but no sub soiling	222	23150	24044	894	1.04
				Sub soiling with chisel plough	250	24150	25500	1350	1.06
	Pigeonpea	2.0	03	Land preparation but no sub soiling	265	10500	13250	2750	1.26
				Sub soiling with chisel plough	350	11500	17500	6000	1.52
Kurnool	Castor	10.0	25	No conservation furrows	986	20625	37468	16843	1.82
				Formation of conservation furrows	1082	20975	41116	20141	1.96
Telangana									
Nalgonda	Cotton	8.0	20	No conservation furrows	1580	31650	60040	28390	1.90
				Conservation furrows	1760	33780	66880	33100	1.98
Maharashtra									
Amravati	Soybean	1.2	03	No conservation measures	1075	24375	37625	13250	1.54
				Ridges & Furrows	1550	25600	54250	28650	2.12
				Sowing on Broad bed furrows	1750	26300	61250	34950	2.33
				Sowing across slope	1475	24375	51625	27250	2.12
	Soybean	6.3	03	Land preparation but no conservation measures	1175	25600	37625	12025	1.47
				Strip Cropping	1550	26200	54250	28050	2.07
	Cotton	103.2	285	Sowing along the slope in flat bed	2340	55875	98280	42405	1.76
				Opening Furrow	2515	58375	105630	47255	1.81
				Ridges and Furrow	2450	60938	102900	41963	1.69
Aurangabad	Cotton	20.0	50	No opening of furrows	1325	35447	53000	17552	1.50
				Opening of furrows	1520	38907	62000	23093	1.59
	Pigeonpea	20.0	50	Not opening of furrows	1087	34265	65250	30985	1.90
				Opening of furrows	1225	35670	73500	37830	2.06
	Soybean	8.0	20	Flat bed method of sowing	975	28585	34125	5540	1.20
				Broad Bed Furrow method	1200	30237	42000	11763	1.39
Nandurbar	Maize	5.2	13	No conservation practices	1812	15830	35450	19620	2.24
				Ridges and furrows	2047	16700	39188	22488	2.35
Pune	Pearl millet	20.0	37	No conservation practises	1239	24625	28497	3872	1.15
				Laser levelling (Flat bed)	1594	27125	36662	8165	1.35

3.3 Water saving technologies

Low water use efficiency with surface methods of irrigation is one of the problems faced by the farming community in different NICRA centres. In this context, demonstrations were organized focusing micro irrigation systems to save water in different crops (Table 12). Mango is one of the important fruit trees grown in Yagantipalle and also in other areas in Kurnool district of Andhra Pradesh. Farmers normally irrigate the trees through surface irrigation. Drip system of irrigation was introduced in mango field and its efficacy was compared with traditional method of surface irrigation. It is observed that drip in mango gave the fruit yield of 12542 kg/ha as against surface method of irrigation (8342 kg/ha). Drip system in Mango resulted in getting higher net income (343720 Rs/ha) over the farmers method (189430 Rs/ha).

Drip irrigation in mango

In Srikakulam district, Zero tillage in rice-fallows saved two irrigations *i.e.,* one at 15 DAS and other @ 30 DAS and also saving the expenditure of 3000 Rs/ha compared to the normal sowing practices with maize as a test crop. Using drip system in chillies gave higher fruit yield (1020 kg/ha) than farmers method of irrigation in project village of Nalgonda district of Telangana state. Similar yield gains and profitability were noticed with chilli and fodder crops in NICRA village of Khammam district. Broadcasting of seed in paddy resulted in saving of water and cost (4000 Rs/ha) in project site in Khammam district of Telangana state.

The productivity of crops fluctuates due to vagaries of monsoon. Use of harvested rainwater either through drip/sprinkler/by any other means increases the productivity, profitability and water productivity. Cotton is an important crop grown in Amravati district of Maharashtra. The productivity of cotton is dependent on nature, duration and time of occurrence of dry spell experienced during its life cycle. Keeping this problem in view, 4 supplemental irrigations were given to cotton (Bt-3028) at different growth stages in black soils by the 25 farmers in NICRA village covering 1ha area each.

Drip irrigation in cotton

Drip system of irrigation improved the productivity of cotton (3675 kg/ha) and recorded additional net returns (115900 Rs/ha) compared to the rainfed system. Sprinkler system of irrigation in soybean gave higher additional seed yield (175 kg/ha) and additional net returns (5855 Rs/ha) compared to rainfed system. In chickpea, supplemental irrigations (one at flowering and other at pod formation stages) gave higher pod yield (2080 kg/ha) and also additional net returns (88700 Rs/ha) compared to rainfed chickpea. Similarly supplemental irrigation of rainwater through sprinkler system gave the increased net benefit of 5100 Rs/ha compared to rainfed wheat (8625 Rs/ha).

Table 12: Influence of water saving technologies on yield and income of different crops in various NICRA centers

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									
Kurnool	Mango	10.0	10	Basin method	8342	102540	291970	189430	2.85
				Drip irrigation	12542	95250	438970	343720	4.61
Srikaku-lam	Maize	6.0	15	Normal practice	490	31500	61250	77500	1.94
				Zero Tillage	620	25250	77500	52250	3.07
Telangana									
Nalgonda	Chillies	4.0	10	Flood irrigation	5480	126000	383600	257600	3.04
				Drip irrigation	6500	130000	455000	325000	3.50
Kham-mam	Paddy	0.8	02	Manual transplanting	4800	53000	64800	11800	1.22
				Broad casting method	5000	49000	67500	18000	1.38
	Chilli	0.8	02	No mulching	20000	50000	150000	112000	3.00
				Mulching	22000	48000	154000	137000	3.21
Maharashtra									
Amravati	Cotton	25.0	25	Rainfed	1375	38200	55000	16800	1.44
				Drip irrigation	5050	67300	200000	132700	2.97
	Soybean	25.0	25	Flood irrigation	1375	27375	38500	11125	1.41
				Sprinkler irrigation	1550	25600	42580	16980	1.66
	Chickpea	10.0	10	No irrigation	2340	55875	98280	42405	1.76
				Sprinkler irrigation	4420	63375	194480	131105	3.07
	Wheat	10.0	10	No irrigation	1500	16875	25500	8625	1.51
				Sprinkler irrigation	1800	16875	30600	13725	1.81
Pune	Rabi sorghum	4.0	10	Flood irrigation	1230	27125	38290	11165	1.41
				Sprinkler irrigation	2050	29625	57150	27525	1.93

3.4 Soil quality and fertility management


Greenmanuring with Dhaincha

Soil is one of the basic resources in rainfed agro-ecosystem in our country. Many regions in our country are having the problem of soil salinity because of which the crop yields are declining. Keeping this limitation in view, demonstrations were organized in need based NICRA centers (Table 13). In Nacharam and cluster of villages in Khammam district, incorporation of green manure crop Dhaincha gave increased yield of Paddy (300 kg/ha) besides reducing the cost on fertilizer by 15-25 percent compared to use of chemical fertilizer alone (4200 kg/ha). At Nalgonda, the practice of green manuring with Dhaincha improved the productivity (255 kg/ha) and profitability (2580 Rs/ha) over no green manuring practice. It was observed that nearly 37% of cultivated soils of Yagantipalle village are (Kurnool) having pH more than 8.5 which comes under high alkaline category. Ten demonstrations were organized on reclamation of sodic soils with gypsum at Yagantipalle village of Banaganapalle Mandal. The initial soil pH ranged from 9.02 to 9.16 and after reclamation the range was from 8.61 to 8.78. The crop was cultivated after reclamation. The average yield of sorghum in green mannured plots was high (3920 Kg/ha) compared to control plots (3070 Kg/ha). The results indicated that 28 percent yield increase in demonstration plots was recorded over the control plots. An additional income of 14350 Rs/ha was realized in demonstrations due to enhanced yields.

Table 13: Influence of soil reclamation measures on productivity and profitability of various 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
					Seed	Fodder				
Kham-mam	Paddy	10.0	10	Without green manure	4200	5200	52610	54600	1988	1.03
				Green manuring	4500	5800	45755	58500	12750	1.28
Nalgonda	Paddy	6.0	10	Without green manure	5760	7500	40000	97160	57160	2.43
				Green manuring	6015	7750	41500	101240	59740	2.44
Kurnool	Sorghum	8.0	20	No gypsum application	3070	3684	25875	42980	17105	1.66
				Gypsum application	3920	4704	23425	54880	31455	2.34

4. Crop Production

4.1 Improved varieties

Andhra Pradesh

At Anantapur, assessment of improved varieties of groundnut was organized in 2 ha area covering 5 farmers in Chamaluru village of NICRA project. It is observed that improved variety Dharani of groundnut recorded marginally higher pod yield (24 kg/ha) and higher net returns (1248 Rs/ha) compared to K-6 (2752 Rs/ha). In NICRA village of Kurnool district, improved varieties of pigeonpea (Asha-87119) and chickpea (NBeG-1) gave additional seed yields of 219 kg and 227 kg/ha compared to the local varieties of pigeonpea (LRG-41) and chickpea (JG-11) respectively. These varieties are fairly tolerant to drought with well developed root system and also tolerant to wilt diseases. The increased grain yield with improved production technologies was mainly because of more number of pods/plant and higher 100 grain weight. Economics of demonstration and farmers practice indicated that the cultivation of Chickpea (Nandyala Sanaga-1) with improved technologies gained additional returns of 10822 Rs/ha with BC ratio of 1.7. The performance of Nandyala Sanaga-1 was superior to the control because of its rooting traits and heat tolerance. Farmers are planning for early rabi crops. Improved variety LGG-460 in green gram showed higher net returns (7330 Rs/ha) over the local variety of ML-267 in project village of Srikakulam district village .while LBG-752 in black gram registered the additional net income of 5750 Rs/ha over local variety (13700 Rs/ha) (Table 15).

Pigeonpea (Asha-87119)

Chickpea (Nandyala Sanaga-1)

In West Godavari district, there was occurrence of Hudhud cyclone during the month of October 2014. The Hudhud cyclone affect was not much in West Godavari district and there was no crop damage. Improved varieties MTU-1061 and MTU-1064 showed equal performance in realizing the yield of grain. But these varieties on an average gave the grain yield ranging 5905-5975kg/ha as against MTU-7029. Though there was no major affect due to hudhud cyclone in this area. It was observed that the Swarna variety was completely affected with Brown Plant Hopper (BPH) after hudhud cyclone due to climate change. Whereas MTU-1061 & MTU-1064 were less affected with BPH.

At Sirsuwada village of Srikakulam district, paddy crop experienced floods at seedling (14th to 21st July), tillering (12th to 16th and 26th to 31st August), tillering and Panicle initiation (4th to 10th and14th to 21st Sep) and panicle initiation to flowering stages (11th and 12th October) in 2014. Among the flood tolerant varieties tested RGL-2537 recorded higher grain yield followed by MTU-1061 In low inundation areas (Table 14). In high and medium inundation area all the flood tolerant varieties were completely damaged. Farmers are planning for early *rabi* crops In low inundated areas PLA-1100 performed better and reduced extent loss compared other varieties followed by MTU-1061 (Indra) and RGL-2357 at different levels of inundation. Among the varieties evaluated, PLA-1100 recorder an increased yield of 4.8%, 6.7%, 13.2% , 27.8% and 20.9% over MTU -1061, RGL 2537,pooja,swarna and samba masuri respectively under low inundation situation.

Table 14: Performance of flood tolerant varieties of paddy

Particulars	Yields (kg/ha)					
	MTU-1061	MTU-1064	RGL-2537	PLA-1100	SWARNA	POOJA
Average yield (kg/ha)	5400	5200	5800	5140	4750	4840
Cost of cultivation (Rs/ha)	38750	38750	38750	38750	38750	38750
Gross returns (Rs/ha)	69120	66560	74240	65792	60800	61952
Net returns (Rs/ha)	30370	27810	35490	27042	22050	23202
B: C ratio	1.78	1.71	1.91	1.69	1.56	1.59

PLA-1100

RGL-2537

MTU-1061

Telangana

In Nacharam village of Khamam district, salinity tolerant variety of paddy (Siddi) gave higher grain yield (540 kg/ha) and also increased net returns (Rs 6480/ha) than BPT-5204 (5580 kg/ha) which gave the net income of 14960 Rs/ha. Improved variety of MGG-347 of greengram recorded increased seed yield by 1500 kg/ha and also additional net income by 6000 Rs/ha over local variety (7500 kg/ha) (Table 15).


Paddy (Siddi)

Maharashtra

At Amravati, improved variety of JS-9305 of soybean gave the seed yield of 2560 kg/ha as against traditional variety JS-335 (1835 kg/ha). The improved variety BDN-711 in pigeonpea registered the additional seed yield by 15 percent over local variety (1000 kg/ha) in Aurangabad. Similarly MAU-71 variety in soybean gave higher seed yield (130 kg/ha) and also increased the net returns (3569 Rs/ha) than local variety of JS-335 (1010 kg/ha). The HYV variety (BM-2003-2) recorded the yield potential of 1250 kg/ha compared to the local cultivar Koppergoan (1000 kg/ha). Improved variety of Akash in chickpea gave 11percent increase in seed yield over the local variety (1475 kg/ha). Improved variety of rabi sorghum (Parbhani moti) gave 200 kg/ha of additional seed yield over local genotype which gave the grain yield of 250 kg/ha. Wheat variety of NIAW-1415 (Netravathi) gave 21 percent increase in seed yield than local LOk-1 (1950 kg/ha). At Nandurbar, GM-6 variety in maize showed additional net income by 3969 Rs/ha compared to the local cultivar (24655 Rs/ha). In, NICRA village of Pune district, High yielding and wilt resistant variety of Vijay recorded the additional net income of Rs 5510/ha compared to local variety, which gave the net income of 21615 Rs/ha (Table 15).

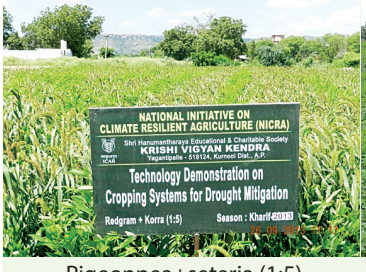
Soybean (JS-335 & JS-9305)

Wheat (Netravati)

Maize (GM-6)

4.2 Cropping systems

Erratic rainfall and frequent drought conditions during crop growth stages often results in crop failures in rainfed environment. Efforts were made to demonstrate the benefits of climate resilient cropping systems under varied climatic aberrations for the benefit of farming community in different NICRA centres in states of Andhra Pradesh, Telangana and Maharashtra. Intercropping of foxtail millet (seteria) and pigeon pea (5:1) in black soils of NICRA village in Kurnool district gave additional net returns of 22044 and 10254 Rs/ha compared to the sole crop of seteria (25996 Rs/ha) and sloe pigeonpea (37786 Rs/ha) respectively. Among intercropping systems demonstrated in Aurangabad district of Maharashtra, intercropping system of Bt Cotton and green gram/black gram recorded highest net monetary returns. Intercropping of cotton and greengram (1:1) gave additional net income of 13600 Rs/ha compared to sole cotton (31500 Rs/ha). While cotton Bt and black gram (1:1) recorded additional net returns of 6750 Rs/ha than sole cotton (31500 Rs/ha). The intercropping of soya bean and pigeonpea (1:2) gave net reruns of 31900 Rs/ha as against sole crop of soya bean (18240 Rs/ha). Pearl millet and pigeonpea (2:1) intercropping system gave the net returns of Rs 22050/ha as against sole crop of pearl-millet (1200 Rs/ha). Intercropping of rabi sorghum and safflower gave additional monetary gains of 1750 Rs/ha) as compared to sole sorghum (450 Rs/ha). At Amravati, soya bean and pigeon pea (2:1) system recorded higher net returns of 9450 Rs/ha and 20350 Rs/ha as compared to the net returns realized by sole soya bean (33550 Rs/ha) and sole pigeon pea (22650 Rs/ha) respectively. Sesame and sunflower intercropping system registered additional net gains of 9910 Rs/ha over sole crop of sesame (Table 16).



Pigeonpea+seteria (1:5)

Soybean+pigeonpea (6:1)

Cotton+greengram (1:1)

Soybean+pigeonpea (4:2)

Table 15: 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	05	K-6	226	21500	24252	2752	1.13
				Dharani	250	21500	25500	4000	1.19
Kurnool	Pigeonpea	9.2	23	LRG-41	1142	27450	66236	38786	2.41
				Asha-87119	1361	25202	78938	53736	3.13
	Chickpea	8.0	20	JG-11	1035	30150	39330	9180	1.30
				NBeG-1	1262	27954	47956	20002	1.72
Srikaku-lam	Green gram	6.0	15	ML-267	620	10800	40170	29370	3.72
				LGG-460	750	12050	48750	36700	4.05
	Black gram	0.6	03	Non descriptive variety	500	11300	13700	13700	1.21
				LBG-752	600	13550	33000	19450	2.44
West Go-davari	Paddy	15.0	12	MTU-7029	5247	45357	66857	21500	1.47
				MTU-1061	5975	40892	76867	35975	1.88
				MTU1064	5905	39462	81112	41650	2.06
	Paddy	15.0	12	MTU-1140	6000	44500	84800	40300	1.91
				MTU1064	5737	42500	77256	34756	1.82
Telangana									
Khammam	Paddy	1.2	06	BPT-5204	5580	52000	70875	14960	1.36
				Siddi (WGL44)	6120	52000	73440	21440	1.41
Maharashtra									
Amravati	Soybean	24.8	62	JS-335	1835	33250	66060	32810	1.98
				JS-9305	2560	37240	92160	54920	2.47

Aurang-abad	Pigeonpea	12.0	30	Non descriptive variety	1000	33292	60000	26708	1.80
				BDN-711	1150	33685	69000	35315	2.04
	Soybean	12.0	30	JS -335	1010	28020	35350	7330	1.26
				MAUS-71	1140	29001	39900	10899	1.38
	Green gram	8.0	20	Kopargaon	1000	22500	50000	27500	2.22
				BM-2003-2	1250	23400	62500	39100	2.67
	Chickpea	8.0	20	Non descriptive variety	1475	29645	44250	14605	1.49
				Akash	1625	31362	48750	17388	1.55
	Rabi sor-ghum	24.0	60	Non descriptive variety	250	6550	5000	-1550	0.76
				Parbhani Moti	450	7610	9000	1390	1.18
	Wheat	8.0	20	Lok-1	1950	30965	40950	9985	1.32
				NIAW-1415	2375	32000	49875	17875	1.56
Nandurbar	Maize	3.0	12	Non descriptive variety	1830	13050	37705	24655	2.89
				GM-6	2167	13630	42254	28624	3.10
	Desi cotton	2.0	10	Non descriptive variety	905	13150	37105	23955	2.82
				Improved varieties	1043	11800	44849	33049	3.80
Pune	Chickpea	2.6	10	Non descriptive variety	6550	16125	21615	5490	2.04
				Wilt resistant variety Vijay	1125	18125	37125	19000	1.34

Table 16: Yield and economics as influenced by sole and inter cropping systems

Name of the centre	Cropping system	Area (ha)	No of Demon-strations	Technology demonstrated	Yield (kg/ha)	Costof cultivation (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B:C ratio
Kurnool	Seteria+ pigeonpea	13.6	34	Sole Seteria	2108	14065	40061	25996	2.85
				Sole pigeon pea	1086	25202	62988	37786	2.50
				Seteria +Pigeon pea	1956+488	17428	65468	48040	3.76
Ahmedna-gar	Pearl millet+ mothbean	4.0	10	Sole Pearl millet	390	12383	6930	- 5453	0.56
				Pearl millet + moth bean	410	12493	7290	- 5203	0.58
Amravati	Soybean + pigeon pea	13.2	33	Sole Soybean	1800	31250	64800	33550	2.07
				Sole Pigeon pea	1100	21350	44000	22650	2.06
				Soybean + pigeon pea	1750+350	35000	78000	43000	2.22
Aurangabad	Bt cotton + green gram	8.0	30	Sole cotton	1550	30500	62000	31500	2.03
				Bt cotton + green gram	1340+600	38500	83600	45100	2.17
				Bt cotton + blackgram	1200+575	38500	76750	38250	1.99
	Soybean + pigeon pea	4.0	10	Sole soybean	1200	23760	42000	18240	1.77
				Soybean + pigeon pea	1000+600	24100	56000	31900	2.32
	Pearlmillet + pigeon pea	4.0	10	Sole Pearlmillet	1600	14800	16000	1200	1.08
				Pearlmillet + pigeon pea	1300+700	15450	37500	22050	2.43
	Rabi sorghum + safflower	4.0	10	Sole rabi sorghum	280	5150	5600	450	1.09
				Rabi sorghum+safflower	190+100	5400	7600	2200	1.41

4.3 Nutrient Management

Indiscriminate use of chemicals is leading to the deterioration of soil fertility, productivity and microbial population and causing multiple nutrient deficiencies of soils. Hence there is need to demonstrate the climate resilient sustainable nutrient management practices for long term sustainability of soils. Hence there is need to integrate traditional and modern nutrient management technologies to achieve stability and sustainability of production against climate risks.

Andhra Pradesh and Telangana

In Chamaluru of Anantapur, the practice of sheep penning was demonstrated in the farmers fields with groundnut as a test crop. The results indicated that the practice of sheep penning marginally increased the pod yield (35 kg/ha) and net income of 520 Rs/ha in harsh arid environment of the district. Recently the concept of soil test based nutrient recommendation is gaining importance to reduce the cost of production. In this context, use of nutrients on soil test basis (150:60:75 NPK/ha) in cotton gave higher yield of cotton (170 kg/ha) and net income (5310 Rs/ha) in project village of Nalgonda district. In West Godavari district, soil test based nutrient application to paddy reduced the excess use of complex fertilizers there by reduced the cost of cultivation by 3000 Rs/ ha. Vermi compost 2.5/ha+soil test based fertilizers in chillies at Nalgonda district of Telangana state increased the fruit yield of chillies (1250 kg/ha) as compared to recommended dose of nutrients (6250 kg/ha) (Table 17).

Maharashtra

Foliar application of plant nutrients (19:19:19 @2.5 kg/ha at 25-30 DAS and 13:00:45 @ 2.5 kg/ha at flowering) in soybean in NICRA village of Ahmednagar enhanced the seed yield by 9.2 percent over farmers method. During this year because of continuous drought, 24 demonstrations out of 50 were completely wilted. Similarly foliar application of plant nutrients 19:19:19 @2.5 kg/ha at 25-30 DAS in pearl millet gave higher grain yield by 14 percent over farmers practice (367 kg/ha). At Amravati, Improved technology i.e., Nutrient management through application of FYM 10-15 tons/ha and seed treatment with PSB, rhizobium along with recommended dose of fertilizers i.e., 30:75:00 with the use of straight fertilizers or 18:18:10 with the use of complex fertilizers at the time of sowing and spray micro nutrients and soluble fertilizer like 19:19:19 or 12:61:00 in soybean gave higher seed yield (685 kg/ha) than farmers method (25 kg N+100 kg SSP) (Table 17).

Table 17: Effect of Integrated Nutrient Management practices on productivity and income in different crops

Name of the centre	Crop/ varieties	Area (ha)	No of Demon-strations	Technology demon-strated	Yield (kg/ha)	Cost of produc-tion (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
Andhra Pradesh									
Anantapur	Ground-nut	0.4	01	No sheep penning	210	20750	23420	2670	1.13
				Sheep penning	245	22050	25240	3190	1.14
West Godavari	Paddy	6.0	15	Farmers method	5450	45167	69820	24653	1.55
				Soil test based nutrient management	5580	42167	70560	28393	1.67
Telangana									
Nalgonda	Cotton	12.0	30	Farmers method	1635	32750	62130	29380	1.90
				Soil test based nutrient management	1805	33900	68590	34690	2.02
Maharashtra									
Ahmednagar	Soybean	20.0	50	Basal application of nutrients	380	22695	10640	-12055	0.47
				Foliar application of nutrients	415	23420	11831	- 11588	0.51
	Pearl millet	20.0	50	Basal application of nutrients	367	11718	6638	-5080	0.57
				Foliar application of nutrients at CGS	418	12081	7538	-4544	0.62
Amravati	Soybean	10.0	25	Farmers method	1150	24375	37750	13375	1.55
				Nutrient Management	1835	26500	44250	17750	1.67
	Cotton	10.0	25	Farmers method	1500	38200	60000	21800	1.57
				ICM Package	2750	56500	110000	53500	1.95

4.4 Crop diversification and Real time contingency measures

Drought

Farmers in the NICRA village of Kurnool district of Andhra Pradesh normally grow desi cotton if the onset of monsoon is in time. During last three years due to late receipt of rains the yields of traditional crop cotton are declining. Sometimes crop failures were also noticed. Seteria (Fox-tail millet) and castor hybrid i.e. PCH-111 were introduced as alternate crops in place of desi cotton as part of assessment studies. The results indicated that the alternate crops of foxtail millet (Setaria) and castor recorded the net income of 25987 Rs/ha and 20799 Rs/ha respectively as against traditional crop of cotton, which gave the net income of 5280 Rs/ha under late onset of monsoon. Hence, the crop area under seteria (fox-tail millet) was increased from 40 to 360 acres in the village during *kharif* 2014. The adoption of seteria crop on large scale by the farmers was due to its suitability to delayed monsoon, its duration and additional benefit of fodder. The market price of seteria is also catching the attention of the farmers. Similarly hybrid castor (PCH-111) was accepted by the farmers as alternative crop for cotton under delayed sowing conditions. Farmers in the project village and other parts of Anantapur are adopting mono-cropping of groundnut. The sowing of groundnut crop was taken up by the farmers starting from July to the end of August during rainy season. Delay in sowing of groundnut in last week of August results in low yield or leads mostly to crop failures. Foxtail millet is shorter in duration, drought resistant and it can be used as fodder as it is having good market. Similarly cluster bean is drought tolerant and can be grown in harsh conditions. The pods can be used for industrial purpose like preparation of gums. Hence demonstrations were organized in project village with foxtail millet under delayed sowing conditions of groundnut. In 2014-15, new crops of cluster bean and greengram recorded net returns of 19250 and 10500 Rs/ha as against traditional crop of groundnut (3220 Rs/ha).

Farmers are growing pulses in rice fallows and getting low yields due to low temperatures during crop season in NICRA village and other areas of Srikakulam district. Hence alternate crops like mustard and chickpea were demonstrated in rice fallows for getting high profitability. On an average the alternate crop chickpea recorded 1995 kg/ha as against traditional crop of blackgram (494 kg/ha). The new crop chickpea gave higher net returns of 36425 Rs/ha than traditional black gram in rice-fallows (13400 Rs/ha).

Cotton is one of the important crops grown in black and red soils of Nalgonda district. The productivity of cotton many times fluctuates due to low and erratic distribution of rainfall. The alternate crop of sorghum was demonstrated in NICRA village in place of traditional cotton grown in red soils. Under delayed on set of monsoon, sorghum recorded the yield of 450 kg/ha. Farmers in project village of Baramati in Pune district are growing pearl millet fallows as fodder during rainy season and also rabi sorghum, The fodder yields under both the situations are low and unstable. Hence demonstrations were conducted with African

Tall (Maize) in place of pearl millet fallows under limited irrigation and yield of fodder gave 39 t/ha in pearl-millet fallows.

The farmers in Nandurbar district and also in the NICRA village grow black gram under delayed on set of monsoon. It often results in low yields/crop failures. Under this situation horsegram is better suited than black gram. The assessment studies showed that horse gram as contingent crop gave additional net returns (8125 Rs/ha) than black gram, which gave the net returns of 2249 Rs/ha under delayed on set of monsoon (Table 18).

Crop diversification with Seteria (Kurnool), Crop diversification horsegram (Nandurbar)

Crop diversification with sorghum (Nalgonda)

Floods

Contingency crop Management against climate risks

Cotton is one of the important crop grown in project village and also in other parts of flood prone coastal district of Srikakulam in Andhra Pradesh. It is being affected due to unexpected rains and cyclone as at bole formation and different growth stages. The recommended contingency measures to save cotton after floods are: Drain off excess

water, Spray with COC 3g+ Streptocycline 0.1 gm /lt and spray 19:19:19, 10 gm /lt water, 4 days after Fungicide spray., During this year, the crop experienced floods during boll formation stage in cotton. The recommended contingency measures were implemented as real time contingency measures in 5 ha area with involvement of 10 farmers. The crop was rejuvenated in plots where contingency measures were implemented and the yield of cotton was increased by 33 per cent over control plots (1460 kg/ha).

Table 18: Crop diversification and Contingency strategies for higher yield and income in different NICRA villages

Name of the centre	Area (ha)	No of Demonstrations	Technology demonstrated	Yield (kg/ha)	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C Ratio
Andhra Pradesh								
Anantapur	2.0	05	Groundnut	235	21500	24720	3220	1.15
			Castor	225	10000	10125	125	1.01
	2.0	05	Cluster bean	625	7500	28125	19250	3.75
			Greengram	275	8750	20625	10500	2.36
Kurnool	12.0	30	Desi Cotton	485	13150	18430	5280	1.40
			Seteria (SIA-3085)	2108	14065	40052	25987	2.85
			Castor (PCH-111)	1140	22521	43320	20799	1.92
Srikakulam	2.0	10	No contingency measures in cotton	1460	40100	54020	13920	1.35
			Contingency measures in cotton	1950	45950	72150	26200	1.57
	1.0	05	Blackgram	494	11300	24700	13400	2.19
			Chickpea	1995	20000	69825	49825	3.49
Telangana								
Khammam	1.0	06	Greengram (MGG-347)	9000	8000	28000	24900	3.50
			Blackgram	7500	9600	22500	18900	2.34
Maharashtra								
Ahmedna-gar	2.3	0.9	Pearl millet	367	11718	6638	-5080	0.57
			Soybean	380	22695	10640	-12055	0.47
			Drumstick	2431	76147	97222	21075	1.28
Nandurbar	2.0	10	Blackgram	242	6100	8349	2249	1.37
			Horsegram	373	5300	15694	10374	2.96

4.5 Farm Mechanization

Timely sowing and precision in sowing is important to achieve optimum plant stand and higher yields in rainfed dominated production system. In this context, demonstrations were organized in different NICRA centers. At Kurnool, tractor drawn improved seed drill gave 8 per cent increase in yield in pigeon pea and reduced the cost of production by 1137 Rs/ha than bullock drawn gorru (1260 kg/ha) (Table 19).

Mechanized inter cultivation (8-tyned tractor drawn inter cultivator with slim tyres) in groundnut was done at 40-45 days after sowing in Chamaluru village of Anantapur district. Due to this every furrow acts as conservation furrow and pod yield was 310 kg/ha in mechanized intercultivation and 245 kg/ha in farmers practice. Highest B:C ratio was realized with mechanized cultivation (1.30), compared to farmers practice (1.13).

NICRA Matsyapuri village is a tail end area and due to late release of canal water, the practices of sowing and harvestings are getting late and coinciding with rains so, to overcome this problem by direct sowing of paddy is adopted. Due to direct sowing the time for nursery raising and transplanting is saved. In direct sown paddy fields the harvest was 15 days earlier than the normal transplanted paddy this facilitated the crop to escape from rains at the time of threshing. The yield was 15.4 percent more than normal transplanted paddy and the cost of cultivation was reduced @ 6250 Rs/ha.

Mechanised intercultivation in Groundnut

Among various seeding devices tested in Amravati, improved tractor drawn seed drill and BBF planter showed superior performance in terms of seed yield and labour saving as compared to the traditional practice of seeding.

S. No	Measurable indicators	Tractor drawn	Bullock drawn	BBF planter
1	Time taken to cover/ha or unit area	2.30 hrs	4.50 Hrs	2.45 hrs
2	No. of labours used for each treatment	02	10	02
3	Total cost of seeding	1750	2250	1800
4	No. of plants germinated/sq.m.	80	95	85
5	Plant population/sq.m at harvest	76	90	75

Table 19: Influence of farm implements on yield and economics of groundnut

Name of the centre	Crop	Area (ha)	No of demonstrations	Technology demonstrated	Yield (kg/ha)	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
Anantapur	Groundnut	1.0	02	Bullock drawn Intercultivation	245	21250	24044	2794	1.13
				Mechanised intercultivation	310	22000	28620	6620	1.30

Mechanized intercultivation in groundnut

Direct seeding in paddy Drum seeder

4.6 Crop protection

Andhra Pradesh

Under late sown conditions, groundnut crop can be subjected to Late Leaf Spot (LLS) due to more humidity at pod initiation stage in Chamaluru village of Anantapur district. Hence demonstrations were organized in farmers fields with improved technology (Spraying with carbendazim + mancozeb at pod development stage. Spraying of carbendazim+mancozeb at pod development stage in groundnut gave higher pod yield (258 kg/ha), net returns (3816 Rs/ha) and BC ratio (1.17) compared to control fields (205 kg/ha, net returns (2210 Rs/ha).

The yield of castor is reducing drastically due to heavy incidence of pests and diseases. The cost of plant protection is increasing alarmingly. Demonstrations were organized on weather based IPM technologies in castor at NICRA village of Kurnool district. Based on the agro advisories given during the season, prophylactic spray of Carbendazim 0.1% was taken up against botrytis in castor followed by repetition of spray (Chlorophyriphos@ 2.5 ml) after rain, gave 12.9% more yield in demonstration compared to farmers practice (1650 kg/ha). Similarly the weather based advisories studies in pigeonpea were conducted, due to dry spell prevailed during September and October, incidence of *Maruca* was at rise during the season. With pro active management of *Maruca*, the yields in demonstration were improved by 8.4% over farmer practice in pigeonpea. Demonstrations on Bt cotton on IPM technology (Stem application at 20, 40 and 60 DAS with Mono or Imidacloprid, Instlling Yellow Sticky Traps @ 25/ha, Need based spraying of Imidacloprid @ 0.25 ml/lt) were organized along with control in 10 ha area along with control . During the season the incidence of Aphids and Whiteflies were observed in Bt cotton, due to dry spells prevailed. Stem application with Imidacloprid and Monocrotophos at 40 and 60 DAS, effectively managed aphids and spraying of Triazophos at 90 DAS checked the incidence of whiteflies effectively in the demonstration, which resulted in 5.6% increased yield.

The Yield loss of paddy is very high due to incidence of pests and diseases in flood prone paddy at Srikakulam district. Demonstrations were organized to educate the farmers

about timely and proper application of pesticides for control of pest and diseases. IPM technologies (Seed Treatment, Alleyways formation, need based chemical spray for BPH, blast and sheath rot) were compared with farmers practice (No plant protection against pest and diseases in flood prone paddy immediately after floods). IPM technologies (Acephate @ 200 gm, copper oxychloride @600 gm, Streptomycin sulphate 18 gm, Trycyclazole @ 120 gm and Propiconazole @ 200 ml/acre) increased yield of paddy by 9.7 per cent over control because of spraying of plant protection chemicals after cyclone. Spraying of post emergence herbicides (Bispyriback sodium @80 ml/acre at 20-25 days after sowing and 2,4-D sodium salt @ 500 gm/acre at 45-50 DAS) in paddy increased the net returns (Rs 3575/ ha) compared to the farmers practice of manual weeding (26603 Rs/ha) (Table 20).

Maharashtra

Improved Wheat PKV-Washim (WSM-1472) with Propiconazole (Tilt) increased the grain yield by 500 kg/ha and also net returns (8500 Rs/ha) compared to the local wheat Lok-1 (1750 kg/ha). Late onset of monsoon in NICRA villages and other places of Nandurbar district results the incidence of shoot fly in sorghum. Hence demonstrations to control shoot fly in sorghum was taken up since there was delay in onset of monsoon**.** Spraying of Imidachloprid 17.8 SL as per recommendation of SAU showed higher grain yield in sorghum 192 kg/ha and also higher net returns (1934 Rs/ha) compared to control (2584 kg/ha). Dead hearts (%) in farmers practice were 9.58 as against 2.66 in improved practice of controlling shoot fly in sorghum. The yield of soybean is reducing drastically due to heavy incidence of *Spodoptera* in continuous rainfall situation. Spraying of quinolphos as per recommendation of SAU in soybean resulted in increasing seed yield by 169 kg/ha than control (938 kg/ha). Before spraying, the attack of *Spodoptera* was 4.61 larvae/m row and it was 2.16 larvae/m row after treatment (Table 20).

Documentation of pests and disease dynamics (Srikakulam)

An attempt was made to document pest and disease dynamics in different crops in Sirsuwada village of Srikakulam district. During the month of August and September, the observed pests and diseases were leaf folder, Bacterial leaf blight (BLB) and sheath blight due to incidence of floods and heavy rain. During the months of October and November Brown plant hopper (BPH) incidence was noticed in paddy. Due to fluctuations in day and night temperatures and also due to low temperatures, incidence of thrips and whitefly was observed in the months of January and February. The diseases of powdery mildew in greengram and YMV in black gram were observed during the same period. Incidence of yellow stem borer was observed due to low temperature in rabi paddy. Incidence of fruit and shoot borer and whitefly and diseases little leaf disease were observed in brinjal. Fog during the months of January and February caused the incidence of pests like fruit borer, leaf minor, whitefly and diseases like *Cercospora* leaf spot in Tomato. Cloudy weather during the months of June to September results heavy incidence of white fly and jassids and diseases like Leaf spots and bacterial leaf blight in cotton.

Table 20: Effect of crop protection measures on productivity and profitability of different crops

Name of the centre	Crop	Area (ha)	No of Demonstra-tions	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	5.0	10	Without spray	205	20950	23160	2210	1.10
				Carbendazim + Mancozeb	258	22100	25916	3816	1.17
Kurnool	Castor	10.0	25	Without spray	1650	29625	62700	33075	2.12
				IPM Package	1863	27675	70794	43119	2.56
	Pigeonpea	4.0	10	Indiscriminate use of pesticides	1450	29875	84100	54225	2.82
				IPM Package	1572	28125	91350	63225	3.25
	Bt Cotton	10.0	25	Indiscriminate use of pesticides	2320	36500	88160	51660	2.42
				IPM Package	2450	38750	68928	30178	2.64
Srikaku-lam	Paddy	2.0	10	Manual weeding	5385	35250	93100	57850	1.61
				Use of Herbicide	5510	43925	70528	26603	1.78
	Paddy	2.0	10	Indiscriminate use of pesticides	4729	35000	14647.5	20352.5	1.58
				IPM Package	5188	38750	15727.5	23022.5	1.59
Maharashtra									
Amravati	Wheat	2.0	05	No fungicides	1750	16875	29750	12875	1.76
				Use of fungicides	2250	16875	38250	21375	2.27
Nandurbar	Soybean	4.8	12	Indiscriminate use of pesticides	938	13500	26264	12764	1.94
				Use of quinolphos	1107	14250	30996	16746	2.17
	Soybean	2.0	10	No weedicide	976	13850	27328	13478	1.97
				Use of weedicide	1084	14300	30352	16052	2.12
	Sorghum	5.2	13	No Plant Protection Measures	2584	16250	37468	21218	2.30
				Use of Imidachloprid	2776	17000	40252	23152	2.36

5. Livestock and Fisheries

Climate change poseses a great formidable challenge to the development sector in India. The anticipated rise in temperature between 2.3 to 4.7°C over the entire country together with increased precipitation resulting from climate change can aggrevate the heat stress in dairy animals, adversely affecting their productive and reproductive performance.The predicted negative impact of climate change on agriculture affect the feed and fodder availability. Hence there is need to asses the avaialble technologies related to livestock for stabilizing the yeilds of feed and fodder resources, health and nutrition of livestock among the farming community for their quick spread.

5.1 Performance of improved fodder varieties

Andhra Pradesh and Telangana

Among the fodder varieties tested in project village of Anantapur, Improved variety, Co-4 recorded higher fodder yield (150 t/ha), followed by Co-1 (85 t/ha). In Khammam district, improved multicut variety sweet sorghum (Sugar Graze) recorded additional fodder yield (8 t/ha) compared to the local sorghum variety (10 t/ha) and additional net returns (11750 Rs/ha) than local sorghum (8550 Rs/ha). In Nalgonda district of Telangana state, improved fodder variety of APBN-1 recorded 180 t/ha as compared to SSG-1(60 t/ha). These demonstrations were conducted in 1.8 ha area with 12 farmers.

Maharashtra

Improved fodder variety Sugar graze gave 50% higher fodder yield compared to single cut fodder sorghum variety (30 t/ha) in project village of Ahmednagar district. At Amravati, improved fodder variety Yashwant grass recorded fodder yield ranging from 29 t/ha as against to the fodder maize (23 t/ha). The local fodder variety of sorghum (MP Chari) gave the fodder yield ranging from 19 t/ha. In Nandurbar district, improved variety of Lucerne RL-88 recorded additional fodder yield of 9 t/ha than local fodder maize (18 t/ha).

Cultivation of improved drought and salinity tolerant fodder variety Marvel (Phule Govardhan) in the project village of Baramati gave 87.50 M t/ha where as local gave the fodder yield of 38.5 Mt/ha (Table 21).

Sweet sorghum-Sugar graze (Khammam)

APBN-1 (Nalgonda)

Multicut fodder pearl millet (Ahmednagar)

Lucern (Nandurbar)

Fodder maize (Amravati)

Yeshwant grass (Amravati)

Table 21: Performance of fodder crops and varieties on yield and economics in different NICRA centers

Name of the centre	Crop	Area (ha)	No of Demonstrations	Technology demonstrated	Fodder Yield (t/ha)	Cost of production (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
Telangana									
Nalgonda	Sorghum and Napier	1.8	12	SSG-1 (Sorghum)	60.0	40875	180000	139125	4.40
				APBN-1 (Hy. Napier)	180.0	72000	540000	468000	7.50
Khammam	Sweet Sorghum	1.2	06	Non descriptive variety	10.0	8500	20000	11500	2.35
				Sugar graze	18.0	12750	36000	23250	2.82
Maharashtra									
Ahmedna-gar	Pearl millet	3.7	25	Single cut fodder	24.3	18515	48600	30085	2.62
				Multicut fodder	30.5	22324	61000	47588	2.73
	Sorghum	15.0	30	Single cut fodder	30.0	16625	60000	43375	3.6 0
				Multicut fodder	45.0	21746	90000	68254	4.14
Amravati	Sorghum, Maize and Yashwant grass	2.0	10	MP Chari (Sorghum)	19.0	5600	16700	11100	2.98
				African Tall (Maize)	23.0	6750	22500	15750	3.33
				RBN-9 (Yashwant grass)	29.0	7500	28750	21250	3.83
Pune	Sorghum and Marvel grass	1.6	05	M-35-2 (Sorghum)	38.5	17500	53900	36400	3.08
				Phule Govardhan (Marvel)	87.5	39500	122500	83000	3.10
Nandurbar	Maize and Lucern	0.3	10	African Tall (Maize)	18.0	14500	36000	21500	2.48
				Lucern (RL 88)	27.0	21500	81000	59500	3.77

5.2 Use of Mineral mixture

Andhra Pradesh

At Kurnool, Use of mineral mixture (80 g/animal/day) along with farmer's method of feeding to the milch animals having post partumanoestrum condition, 11 (44%) animals exhibited heat during the period. Use of mineral mixture also increased in milk yield (19.48%) was observed over farmers practice. (4.72 lit/day/animal).

Feeding mineral mixture to cow

Farmers in the project village of Srikakulam district are using paddy straw only as cattle feed which is having less nutritive value, resulting in lower milk yield. Use of Azolla and mineral mixture as supplementary feed for cattle increased in milk yield by (6.2%) as compared to use of paddy straw (373 lit.) during period of five months (Table 22).

Table 22: Use of mineral mixture on productivity of milk in Srikakulam district

Name of the farmer	Milk yield (lit)/ 5 months		% increase in milk yield
	Demo	Check	
Sri Karri Raja Rao	405	375	8.0
Sri Barika Gangayya	315	300	5.0
Sri Chekka Appa Rao	315	270	16.7
Sri Thutha Guravayya	465	450	3.3
Sri Karri Bhaskara Rao	435	420	3.6
Sri Majji Appalaswami	465	450	3.3
Sri Seetharam Pathro	375	345	8.7
Mean	**396**	**373**	**6.2**

Maharashtra

Demonstrations on feeding of area specific mineral mixture in cows were organized in Nandurbar district of Maharashtra (Table 23) covering 20 cows with 20 farm families. Area specific mineral mixture in gave 97.2 lit. of milk as against without use of mineral mixture (73.5 lit/cow).

Table 23: Feeding of Area specific mineral mixture to pregnant cow

Treatment	Average milk yield/ animal (L/day)	Total milk yield per animal (L/60days)	Cost of feeding (Rs/animal)	Gross return (Rs/animal)	Net return (Rs/animal)
Without Mineral Mixture	1.23	73.5	20	36.75	16.75
Mineral mixture	1.62	97.2	23	48.6	25.6

5.3 Silage making

Availability of green fodder is a great problem in all villages dominated with rainfed ecosystem. Keeping this limitation in view demonstration was conducted with 10 farmers at Yagantipalle village of Kurnool district. Maize green fodder was preserved in silage bags of 500 kg capacity. The silage was fed to milch animals @ 5 kg per day along with farmers practice of Sorghum straw and regular feed during fodder scarcity period. The results indicated that 15.5% increase in milk yield compared to farmers practice. Silage bags were introduced for the first time in the village. The technology was well demonstrated by KVK to the dairy farmers. The technology was well received by the farmers as it was feasible and cost effective more over the silage was more palatable than the conventional fodder. The farmers opined that with the use of silage, cost of milk production can be reduced.

Assessment of silage technology was also implemented with 150 farm families in Ahmednagar district of Maharashtra. The cost of green fodder with silage making was reduced 216 Rs/animal/month besides increasing income by 816 Rs/cow/month (Table 24).

Table 24: Benefits of silage making on productivity and profitability of milk

Treatments	Av. green fodder kg/animal	Green fodder cost (Rs/kg)	Green fodder cost (Rs/month)	Milk production (lit/day/animal)	fat %	milk rate based on fat (Rs/lit.)	Ava. Income from milk Rs/cow/month
Purchasing green fodder from market	18	3.15	1701	13.96	3.55	21.8	9129
Silage making	18	2.75	1485	14.67	3.78	22.6	9945

5.4 Fodder production by Hydroponics

Another promising technology (Hydroponics) to reduce the severity of green fodder during summer was demonstrated with 3 farmers in the project village of Ahmednagar district. Green fodder cultivation by hydroponic method reduced the cost of production by 717 Rs/ animal/month than purchasing fodder from outside (1557 Rs/animal/day/month) (Table 25).

Table 25: Mitigation of scarcity of fodder through hydroponic method

Treatments	Av. green fodder / animal (kg)	Av. green fodder cost/ kg/anima (Rs)	Green fodder cost (Rs/animal/month)	Green fodder cost (Rs/animal/ 3 month) during Scarcity period
Purchased green fodder from market	15	3.46	1557.0	4671.0
Green fodder cultivation by hydroponic method	14	2.00	840.0	2520.0

Silage making (Bag method)

Hydroponic method of fodder production (Ahmednagar)

5.5 Improved Nutrition

In crossbred cows digestive disorder was observed during summer due to excess heat causing declining milk productivity and also poor health. The assessment studies with improved practice (Conventional concentrate feed 2-3 kg/cow/day + Probiotics powder @ 20 gm/cow/day) were implemented in 50 farm families in Ahmednagar district of Maharashtra (Table 26). The results showed that improved practice of feeding gave higher gross income of 681 Rs/cow/month as compared to the farmers practice of feeding conventional concentrate feed of 2-3 kg/cow/day (8883 Rs/cow/month).

Table 26: Benefits of Probiotics feeding in cows

Treatments	Ave. milk production (lit./day/cow)	Fat %	Milk rate based on fat % (Rs/lit)	Ave. gross income of milk /month/cow (Rs.)
Conventional concentrate feed 2-3kg/cow/day	13.84	3.41	21.4	8883.0
Conventional concentrate feed 2-3kg/cow/day + Probiotics powder (20 gm/cow/day)	14.30	3.72	22.3	9564.0

5.6 Backyard poultry

Andhra Pradesh

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 different NICRA centers. In this context, the interventions on backyard poultry were implemented to supplement income of small and marginal farmers at Anantapur in 20 farm families covering 2 units for each family. The results showed that egg laying capacity of Rajasree birds were 120 per year, whereas, desi birds was 35 per bird per year. Higher body weight (4.5 kg/bird/year) was recorded with Rajasree poultry birds, whereas, in desi birds average body weight was 2.75 kg/bird/year (Table 27).

Table 27: Performance of poultry breed in augmenting farm income

Particulars	Initial (4wk)wt. (g)	Weight of bird (Kg) after one year	No. of eggs/ year	Total expenditure (Rs)	Income from eggs (Rs)	Income from meat (Rs)	Total income (Rs)
Non descriptive breed	25	2.75	35/bird	120/bird	105	450	435
Rajasree breed	35	4.50	140/bird	180/bird	420	700	940

At Srikakulam, rearing of Vanaraja poultry birds improved the growth, egg laying capacity and increased the weight of Male (67.0) and female (75.0) percent than locals. But Vanaraja breeds are low in movement and they easily caught by predatory animals. Hence Vanaraja breeds must be grown in protected conditions.

No. of birds	Avg. wt. of the Vanaraja bird in 5 months		Avg. wt. of the Vanaraja bird in 5 months		% increase in weight	
	Male	Female	Male	Female	Male	Female
10	2.64	2.18	1.58	1.24	67.0	75.8

Telangana

At Gangula Nacharam village of Khammam district rearing of improved breed Vanaraja produced higher weight (2.7 kg/bird), increased number of eggs (58/year) and income (686 Rs/bird) than local which produced 2.0 kg weight, 52 eggs and income of Rs 710 (Table 28).

Table 28: Performance of poultry breeds in augmenting farm income

Particulars	Initial wt.(g)	Weight of bird (Kg) /year	No. of eggs/ year	Total expenditure (Rs)	Income from eggs (Rs)	Income from meat (Rs)	Total income (Rs)
Non descriptive breed	650	2.0	52	615	260	450	710
Vanaraja breed	650	4.7	110	925	550	846	1396

Backyard poultry (Nalgonda)

Giriraja birds (Khammam)

5.7 Calf registration and healthy calf programme

The Calf registration and healthy calf programme were implemented in project village of Kurnool district covering 25 farm families. The results indicated that Calf registration (Monthly de-worming + Vitamin A+ B-complex supplementation and feeding of calf starter for 5 months @ 500 g/day) 31.19% increase in body weight gain was noticed in the registered calves over un registered (Table 29).

Table 29: Calf registration programme (2014-15)

Particulars	Farmers practice*	Treated
	Buffalo calves	Buffalo calves
Initial body weight	30.8	27.3
Final body weight	66.7	74.4
Body weight gain	35.9	47.1
Increase percentage	31.19%	
Calf mortality (%)	12%	0.0
Total Gross returns (Rs)	5385.0	7065.0
Total cost (Rs)	520.0	1000.0
Net returns (Rs)	4865.0	6065.0

5.8 Fisheries

Srikakulam

Captive rearing of Fish seed (Rearing of fish fry up to fingerling size in nursery pond) to stock in village tank

This intervention was implemented in 0.1ha with involvement of farmers in Sirsuwada village in Srikakulam district of Andhra Pradesh. About 28,000 fish fry was released into the water tank. Rearing of fish fry up to fingerling stage costs about Rs11400; while the gross income generated with rearing in pond was Rs 25500. Thus Rs 14110 can be saved with this technology in one month (Table 30).

Table 30: 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 28,000	No. of finger-lings (5-8cm) available to stock	17,000	Cost at market at fish fry stage- Rs.1.50	
	Cost of Cultivation		Gross input (Rs.) 17,000*Rs 1.50 ps	25,500.00
	Cost of fish fry (Rs.)	9,400.00		
	Feed Cost for 30 days (Rs.)	1,000.00		
	Labour Charges	1,000.00		
	Total	11,400.00		
	Amount saved in 30 days Period (Rs.)	**14,100.00**		
	Expenditure incurred for each finger ling in captive rearing	Rs 0.67		

Performance of Indian major carps in Grama Panchayat tank

The studies on performance of Indian major carps in village Panchayat tank were implemented with involvement of 4 farmers covering 13. 8 ha each. In order to optimize stock densities the fish species of Catla, Rohu, Mrigala, and Grass carp were released in ratio of 3:3:1:3. The result revealed that yield of different fishes in pond was 625 kg. The net come generated from fish rearing was Rs 28750 (Table 31).

Table 31: The economics of fish rearing in village Panchayat tank

Fish harvested (Kg/ ha)	625
Cost of cultivation (Rs.)	8750
Gross returns	37500
Net returns	28750
B:C ratio	4.28:1

Captive rearing offish

Releasing fishfry to nursery pond Fingerlings

Sampling of fibngerlings by trial netting Transfer of fingerlings to maintank

West Godavari

In fish ponds the water quality parameters (Dissolved oxygen, p^H, ammonia etc) were influenced by climate. Particularly the dissolved oxygen levels will be low during cloudy days and at the time of low and high temperature fluctuations. Sometimes the sudden change in climate leads to heavy mortality of fish and increases susceptibility to diseases due to reduction in immunity of fish. Keeping this as backdrop, demonstrations on water quality management in fish ponds was taken up in five farmers' fields (Table 32). Improved management and management of water quality parameters in fish ponds benefited to get additional income of Rs 29250/ha as compared to the farmers practice (Rs 42000/ha).

Table 32: Influence of water quality management on yield and income in fish rearing

Treatments	Yield (kg/ha)	Gross Income (Rs/ha)	Cost of Cultivation (Rs/ha)	Net Income (Rs/ha)	B:C
Farmers Management	4200	315000	273000	42000	1.15
Improved Management	4750	356250	285000	71250	1.25

Telangana

Traditionally farmers in Nacharam cluster and surrounding villages of Khammam rear traditional species of fish. Generally farmers rear *Ciprinus carpio* species, but they have burrowing nature and less growth compared to Indian major fish. So the yields were reduced. Hence improved species- Rohu was introduced (2000 fisher lings) to get higher productivity and income. The species gave the yield of 500 kg/unit of pond and also got the net income of Rs 18,800.

Release of fingerlings by KVK (Khammam)

Murrel culture in farm pond (Nalgonda)

Murrel culture in small seasonal tanks and check dams

Small seasonal tanks and check dams are normally not utilized for fish culture because of short period availability ie. 6-7 months period only. Hence efforts were made to grow murrel in small seasonal tanks which are most common in Nalgonda district of Telangana state. This intervention was implemented with 46 farmers with unit size of 0.6 ha area. About 2500 fingerlings were introduced with species of *Channa striatus*. The average weight of fish is about 1000-1250 g.

5.9 Up Grading of Breed

Andhra Pradesh

Performance of genetically superior breeding lambs

The small ruminants in the project village of Srikakulam district are locals. Efforts were made to improve genetic potentiality of the local sheep by replacement of local rams with genetically superior breeding rams. Release of genetically superior breeding lambs improved the height (8 cm), length (4.2 cm) and weight (4.4 kg/lamb) of lamb produced by breeding of improved breed than lambs produced by breeding of local lamb at 35days age (Table 33). Similarly after 60 days the lams produced by breeding of superior breeding lambs gained the weight of 15.24 kg as against lambs produced by breeding of local lambs (10.3 kg/lamb).The percentage of weight gained from the lams produced with breeding of superior ones was over lambs produced by breeding local ones at 35 and 60 days (54.32 and 48.00).

Table 33: Performance of lambs produced due to release of elite breeding rams in sheep flock compared to local lambs

Age of the lamb	Number of lambs	Local lambs			Lambs produced from breeding rams		
		Height (cm)	Length (cm)	Weight (kg)	Height (cm)	Length (cm)	Weight (kg)
35 Days	1	34.0	45.0	8.0	47.0	50.0	12.0
	2	40.0	47.0	8.2	45.0	49.0	12.9
	3	38.0	45.0	7.9	47.0	50.0	12.3
	4	37.0	45.0	8.1	45.0	50.0	12.1
	5	43.0	47.0	8.3	46.0	51.0	13.2
	Average	**38.4**	**45.8**	**8.1**	**46.0**	**50.0**	**12.5**
60 Days	1	46.5	48.0	9.5	52.0	55.0	15.0
	2	48.0	50.0	11.0	52.0	52.0	15.2
	3	47.0	49.5	10.5	53.0	57.0	15.4
	4	47.5	49.0	10.0	53.0	59.0	15.5
	5	48.5	50.5	10.5	52.0	54.0	15.1
	Average	**47.5**	**49.4**	**10.3**	**52.0**	**55.4**	**15.2**
% increase at 35 days over local lambs					**19.8**	**9.2**	**54.3**
% increase at 60 days over local lambs					**10.3**	**12.1**	**48.0**

Telangana

Mortality and morbidity losses due to abiotic stresses in livestock is biggest constraint in rainfed areas , small and marginal farmers have sheep/dairy animals to maintain their daily needs. There is need to supplement the superior breeding ram for improvement of sheep with grading ones and to gain income. The intervention was covered with two units. Maintaining Superior breeding rams in herd increased production of lambs, increased income by selling of sheep (Rs 330000) and reduced the mortality (2.2%) compared to local breed (Table 34).

Table 34: Performance of Superior breeding rams in augmenting farm income

Particulars	No. of breeding 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)
Local Breeding ram	01	8000+4500	26	15	45000	4	2.09	32500
Superior breeding ram	01	9850+5500	42	26	78000	16	0.7	62650

Maharashtra

Introduction of improved Konkan Kanyal goat breed

Semi intensive goat farming (Ratnagiri)

Continuous heavy rainfall leads to mortality of goat and incidence of pneumonia disease in Ratnagiri district of Maharashtra. Demonstration was conducted with Konkan Kanyal breed, which is tolerant to heavy rains compared with local breed to minimize mortality of goat due to continuous heavy rain. Five female and two goats were provided for each family. Improved breed mortality reduced due to heavy rains occurred during the season and increased herd size compared to local breed (Table 35).

Table 35: Performance of goat breed Konkan Kanyal compared to local breed

Particulars	Treatment	
	Local breed	Konkan Kanyal breed
Initial size of herd	7+1	5+1
Mortality due to heavy rains	3	-
Present size of herd	11+3	16+6
No. of males sold	4	7

6. Institutional Interventions

6.1 Custom hiring center

Indian agriculture is undergoing a gradual shift from dependence on human and animal power to mechanical power because of increasing cost for upkeep of animal and growing scarcity of human labour. Further, use of mechanical power has a direct bearing on the productivity of crops apart from reducing the drudgery and facilitating timeliness of agricultural operations. Mechanical power is largely consumed in big land holdings and is still beyond the reach of small/marginal holdings which constitute around 80% of the total land holdings. This is due to the fact that the small/marginal farmers, by virtue of their economic condition are unable to own farm machinery on their own or through institutional credit. Therefore in order to bring farm machinery available within the reach of small/marginal holdings, collective ownership or Custom Hiring Centres (CHC) needs to be promoted in a big way.

CHCs are basically a unit comprising a set of farm machinery, implements and equipment meant for custom hiring by farmers. Though certain implements and equipment are crop specific, the traction units like tractors, power tillers etc and self-propelled machinery like combined harvesters etc., are used in common. Therefore, an ideal model envisaged in this project comprise farm machinery that are commonly used for tillage operations for all crops, multi crop equipment and a minimum of crop specific machinery. Keeping the backdrop, 100 CHC units were established in all NICRA centers of the project in the country.

Objectives:

- ✓ To make available various farm machinery/equipments to small and marginal farmers.
- ✓ To offset the adverse economies of scale due to high cost of individual ownership.
- ✓ To improve mechanization in places with low farm power availability.
- ✓ To provide hiring services for various agricultural machinery/implements applied for different operations.
- ✓ To expand mechanized activities during cropping seasons in large areas especially in small and marginal holdings.
- ✓ To provide hiring services for various high value crop specific machines applied for different operations.

Operationalization of Custom hiring centers in NICRA villages

For implementing climate resilient technologies, interventions proposed in various NICRA villages in 100 vulnerable districts, the suitable farm implements were made available in the Custom Hiring Centers depending upon the need of the farmers for various farm operations. The custom hiring centre's will give farm machinery on rental basis to farmers who cannot afford to purchase high-end agricultural machinery and equipment apart from servicing old machinery.

A committee of farmers nominated by the gram sabha is managing the custom hiring centre in each project village. The rates for hiring the machines/implements were decided by the committee itself depending upon the socio economic condition and cropping intensity of the village. Every farmer in the village can hire the machines from these centers; The modalities can be decided by the committee members and amended from time to time as per the local situation and needs. This committee also uses the revenue generated for repair and maintenance of the implements and remaining amount goes into revolving fund. The main objective in selecting particular farm implement in CHCs is to enable any farm operation timely without losing a favourable window of rainfall or soil moisture available. The VCRMC has decided the price of hiring of each farm implement on consensus basis, it was displayed at the CHC shed below in figure. Registers are maintained for each farm implement for recording number of hours, farmers benefitted, amount paid towards hiring. The income generated out of CHCs goes to common account.

Progress of NICRA centers

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 center was provided with financial support of the project during 2012-13, the centre provided the services 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 Rs14500. 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 (VCRMC). In 2014, center provided hiring services to 25 ha. of groundnut and realized the service charges to the extent of Rs 3900. Thus the center generated Rs 23000 by providing services to105 ha from 2011 to 2014.

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 center provided hiring services for various operations in crops of pigeonpea, 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 85.4 ha and realized the income of Rs12772. 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 centre procured following equipment for providing services to the farmers of NICRA village. The progress of the centre was monitored by the VCRMC of the village. During 2014-15, center provided the hiring services to the crops of pigeonpea, castor, chickpea and sorghum to the extent of 62.4 ha and realized Rs 8300 as hiring charges.

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 centre on 20th November, 2011. The project supported the center with the investment of 6.25 lakhs. The committee assessed the needs of mechanization for different crops before finalizing action plan in each year.

The center provided the hiring services to the crops of paddy, cotton, vegetables in *kharif*, pulses, maize and vegetables during rabi season covering 20 ha area during 2012. The center realized the net amount of Rs12180 during 2013. The center provided hiring services to the crops of paddy (7.0 ha), Cotton (2 ha), vegetables (3.0 ha) in *Kharif* season and Pulses (3.0 ha), vegetables (2.0 ha) and maize (0.5 ha) in *rabi* season. The center realized the net amount of Rs 8300 during 2013. The VCRMC suggested for proper utilization of the equipments, prompt collection of services charges and timely repairs of the equipments.

During 2014-15, the center provided need based hiring services in the crops of paddy, pulses, groundnut and vegetables and collected the rental charges of Rs7405. Among the equipment power sprayer was used in 150 ha and winnowing fan for 25 ha and sprinkler unit was used in 85 ha. Among the various constrains, frequent repair of power tiller, non-utilization of paddy reaper due to advent of combined paddy harvester, use of power operated winnowing fan only in places where power is available, lack of skill power for repairs at village level and village level political system.

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 3000 during 2013. The centre is operated under the guidance of village climate risk management committee. The committee meetings were held for every month to monitor the progress of the work and performance of the centre. During 2014-15, the center preceded hired services paddy (29 ha) and realized the net income of Rs 3140.

Telangana

Khammam

The centre was established in Nacharam village (NICRA village) of Khammam district during 2010-11 with the investment of Rs 55047 for providing the 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 VCRMC 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/-. During 2013, the centre provided hiring services for paddy, cotton, chilies and maize covering 18, 2 ha and realized the amount of Rs 3400. In 2014-15, the center provided the equipment on rent basis in 26 ha area covering the crops of paddy.

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. 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.

During 2014-15, custom hiring center provided services to the village farmers covering 80.0 ha and collected the amount of Rs 42000/year as servicing charges. The net amount realized from this centre for the current year was Rs. 31000.

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 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 (18.2 ha), Lucerne (17.8 ha) and fodder maize (2 ha). It realized the net amount of Rs 64140 by covering 145.6 ha. During 2014-15, the center helped in giving hiring services with various farm tools to the crops of soybean (17.8 ha), pearl millet (12 ha), fodder sorghum (19 ha), chickpea (7 ha) and pomegranate (3.0 ha).The center generated the net income of Rs 31740/year.

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. During 2012, the centre provided services for various agricultural operations to the crops of soybean, cotton and chickpea. It covered the total area of 633.7 ha 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. In 2014-15, the custom hiring center helped the farmers in serving the people in raising cotton, (256 ha), soya bean (290 ha), chickpea (220 ha) i.e., total 765 ha during the year. The centre realized the amount of Rs 40750/year and incurred the expenditure of Rs17249/year. Among various equipments, the center has more demand for seed drills, Rotavator, BBF planter and sprinkler sets. The center earned the net amount of Rs17429/ year with custom center.

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 Rs1200 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 Rs1630 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 CHC gave hiring services for the crops maize, sorghum and soya bean in *kharif* and chickpea, wheat and garlic in rabi and also mango, groundnut and vegetables in summer. Thus the center covered the total area of 16 ha and earned the net profit of Rs1070 besides earning total gross income of Rs 5480/year.

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 Rs10090, 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 810 in 2013, the center hired the services for 36.1 ha area and realized the amount of Rs 6960.The CHC established project village provided hiring services in 33.4 ha covering the crops of pearlmillet, onion, rabi sorghum, chickpea and maize. In 2014-15, The center realized an amount of Rs 5130/year with custom hiring services. An amount of Rs 2700/year was incurred as expenditure to maintain the center.

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 6.25 lakhs. About 13 VCRMC members are engaged in running the center. The center helped in providing hiring services for paddy for 170 ha 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 172 ha. An amount of Rs 4000 was incurred for repairing the tools of the center.

During 2014-15, CHC helped in providing hiring services to 19 ha area and realized the income of Rs14560/year. The important crops covered with hiring services were paddy (14.0 ha), cowpea (1ha) and cashew (5 ha). The center realized the amount of Rs12080/year due to custom hiring services (Table 36).

Table 36: Performance of custom hiring centers in different NICRA villages

Year	Crops in demand for servicing custom hiring center	Area covered with hiring services (ha)	Amount realized due to services with custom hiring services (Rs)	Amount spent on contact service personnel For running the center	Amount incurred in maintenance of tools and center	Net amount realized due to custom hiring center
Anantapur	Groundnut, Chilli, Tomato	24.5	3900	-	-	3900
Kurnool	Pigeonpea, Castor, Chickpea, Sorghum	62.4	8300	-	1500	8300
Srikakulam	Paddy, pulses, vegetables, Groundnut	18.0	7405	-	-	7405
West Godavari	Paddy	29.0	3140	-	-	3140
Khammam	Paddy, Chilli, Cotton, Maize	26.0	2900	-	-	2900
Nalgonda	Paddy, cotton, pigeonpea, vegetables	80.0	4200	-	11000	31000
Ahmednagar	Soybean, Rabi sorghum, Pearl millet, Chickpea, Pomogranate	58.7	31740	-	-	31740
Amravati	Soybean, Cotton, Chickpea	765.0	40750	-	23501	17249
Aurangabad	Soybean, cotton, chickpea	52.0	95000	-	-	95000
Nandurbar	Maize, Sorghum ,Soybean, Chickpea, Wheat, Garlic	168.0	5480	2400	1070	2010
Pune	Onion, pearl millet, Gram, Maize, rabi sorghum	33.4	5130		2700	2430
Ratnagiri	Paddy, Cowpea, Cashew	19.10	14560		2480	12080
Total		**1311.6**	**218605**	**2400**	**42251**	**213254**

6.2 Seed Bank

A seed bank (also seed bank or seeds bank) stores seeds as a source for planting in case seed reserves elsewhere are destroyed. Storing seeds also guards against catastrophic events like natural disasters, outbreaks of disease and war.

Seed saving is a practice that farmers and their families have been engaged in for millennia. It has allowed them to cultivate a large number of different local varieties, which have been able to adapt to different environmental conditions and changes, such as to the shortages of water, strong winds, limited soil nutrients and so on. Setting up community seed banks may help farmers to acquire varieties that are adapted to local conditions. One of the purposes of a community seed bank is to serve as an emergency seed supply when farmers experience a shortage of seeds, due to failure or destruction of crops as a result of floods, droughts, pests and diseases. The community seed bank plays a very important role in maintaining the availability of quality seed because it reduces the risk of total production failures and contributes to strengthening community's resilience.

Community seed banks store and manage seeds that aim to provide community members with seeds to use. Seeds are obtained from the farmers in the community and are selected and stored depending on the agreed storage system. Once the seeds are collected from the farmers, they are stored in a community seed bank until they are needed.

All farmers and other community members should be involved when setting up a community seed bank. They should agree on the establishment of the bank and as well as the objective(s) of the bank: for example, whether it is primarily to act as a supply seed stock in times of crises or to conserve indigenous seed varieties and/or to earn income through the sale of seeds to neighbouring communities. Once they have agreed on how they want the bank to be run, the set up needs to be prepared. The community should operate within their budget and should make use of the available material and storage items. It is recommended to establish a community management committee. This committee can consist of different community members who can each take up different activities related to the management of the bank, including collection, selection, cleaning and storing of seeds, as well as record keeping.

Progress of seed banks in NICRA villages

Andhra Pradesh

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 University/ 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.

During 2014-15 seed production activities were initiated with improved varieties of Groundnut (K-6, K-9 and Dharani) in 2.5 ha with involvement of 9 farmers. Improved variety foxtail millet (SI-3085), cluster bean (Pusa Navbahar), paddy (NLR-34449), horsegram and fodder sorghum were produced to the extent of 100.100, 350,100 and 100 kg as a part of seed production activity. The seed production activity was done with the involvement of 44 farmers in 21.5 ha during 2014-15 (Table 37).

Table 37: Progress of seed production of different crops in Anantapur

Name of crops		Quantity (Kg)	No. of farmers	Area (ha)
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. Seteria		100kg	02	1.5
3. Clusterbean		100kg	02	0.4
4. Paddy (NLR 34449)		350 kg	05	2.0
6. Horse gram		100 kg	14	10.0
7. Fodder Sorghum		100 kg	10	5.0

Kurnool

Quality seed of improved varieties is an important basic input for enhancing productivity of any crop species. The existing mechanisms are not adequate to meet the seed requirements of small-scale farmers and have serious limitations. Particularly to small holder farmers at affordable prices and at the right time to enhance crop productivity and household food security.

The baseline studies in the project area identified key problems related to seed supply system. Lack of timely availability of good quality seeds of high-yielding varieties is one of the major constraints contributing to stagnant yields of crops in the project area.

The project devised alternate seed systems, which ensure availability of quality seed of improved varieties at local level. The concept of village seed banks was promoted and successfully validated in the project village. It not only ensured timely availability of quality seed of farmer-preferred varieties at affordable prices at local level but also enhanced crop productivity and local seed enterprises leading to higher incomes to farmers. During this *kharif* seed production in Paddy (BPT-5204) pigeonpea (Asha-87119) and Seteria (SIA-3088) and Chickpea (NBeG-1) was taken up to establish seed bank in the village.

During 2014-15, the improved seeds of seteria (Suryanandi) and Pigeonpea (Asha) were produced to the tune of 5.0 and 2.0 t respectively with involvement of 16 members. The bank has generated the income of Rs175000 and 150000 by producing the improved varieties of fox-tail millet and pigeon pea respectively (Table 38).

Table 38: Activities of seed bank in Kurnool

Crop and variety	Quantity of storage (t)	Unit cost (Rs.)	No. of units	Amount (Rs.)	(No. of beneficiaries & Period of use)
Seteria (Suryanandi)	5.0	175000	1	175000	6-8 months 10 members
Pigeonpea (Asha)	2.0	150000	1	150000	10 -15 farmers

Maharashtra

Timely availability of good quality improved seed is great problem in villages/rural areas of Maharashtra. In this context, seed production of different crops was stared in the project village of Amravati. During this year, improved seed of soya bean JS-9305 and Jaki-9218 (Chickpea) of 26.4 and 28.05 t were produced respectively with active participation of 40 farmers.

Crop	Variety	Qty. procured (tonnes)
Soybean	JS-9305	26.40
Chickpea	Jaki-9218	

6.3 Fodder Bank

Fodder bank was established in project village of Amravati to mitigate the problem of fodder scarcity to livestock in the village. Committee was formed to manage the activities of fodder bank at village level on 7th November, 2013. The village has 318, 309, 126 and 2000 number of cross bred cattle, buffaloes, goat and poultry population respectively. The demand of fodder requirement in the village was estimated 757.5 tonnes. On average, the village is producing 469 t/year. The members of the committee identified the deficit of 288.43 t of fodder to meet the fodder needs of cattle in the NICRA village .

7. Capacity Building

The NICRA centers working in the states of Andhra Pradesh, Telangana and Maharashtra organized 226 need based training programmes with active participation of 4614 farmers during 2014-15. Among the states Andhra Pradesh organized 57 need based skill oriented training programmes of 1-2 days duration with involvement of 1618 male and 236 female farmers. The farmers of 585 farmers were imparted training skills in climate resilient agriculture by conducting17 training programmes in Telangana state. The NICRA centers in the state of Maharashtra organized 152 training programmes with active participation of 2513 male and 652 female farmers (Table 39).

Andhra Pradesh

The farmers of Chamaluru village of Anantapur district were trained in skill oriented training programmes on production technologies of cluster bean for gum, paddy, groundnut, castor and pigeonpea in Reddipalli farm of KVK. Farmers in NICRA village were trained in 10 programmes covering 434 farmers.

479 farmers were trained in16 programmes of one day duration in Banganpalle, KVK, Kurnool during this year. The farmers were imparted the skills on resource conservation technologies, crop diversification, feed and fodder management, nursery raising, pest and disease management of cotton, pigeonpea, chickpea, micro-irrigation, drudgery reduction , mango production and livestock management.

The KVK, Srikakulam district organized 19 training programmes to 601 farmers of selected village for implementing NICRA programmes. The focused topics included during training programmes were: Azolla production technology, contingency crop planning/ management, risk management strategies : flood and cyclone affected agriculture, backyard poultry, drum seeding technology in paddy, zero tillage in maize, trellis system of tomato, crop diversification, micro nutrient management in vegetables and vegetable production technologies.

The farmers of Mattsyapuri and Veeravarsum in West Godavari were trained in 13 skill oriented programmes where 340 members were participated. The topics for training of farmers were: green manuring in paddy, soil test based nutrient management in paddy, pest and disease management in paddy nurseries, fish culture management during rainy season, kharif paddy production technology and rabi paddy production technologies.

Telangana

The farmers in project village of Khammam district were trained in 7 training programmes with active participation of 274 male and 37 female farmers. The skills pertaining to soil and water conservation methods, fisheries production, pest and disease management in chilli and YMV management in green gram were imparted to the farming community.

The KVK, Nalgonda district organized 9 programmes to 274 farmers of the project village. These farmers were trained in skills of soil health management, farm mechanization, Integrated pest management, resource conservation technologies and water management and animal health management.

Maharashtra

The farmers in Ahmednagar district received the training programmes on integrated crop management in pomegranate, bacterial blight management in pomegranate, contingency crop planning under delayed monsoon, integrated fodder management in livestock, fodder management by silage making, goat management, protective cultivation-poly house and use of evaporation retardant in plastic lined farm pond. The farmers were trained in 9 training programmes where 272 farmers were participated.

The farmers in Amravati district underwent 54 training programmes during this year. About 880 male and 274 female farmers were participated in various training programmes. The skills imparted during various programmes include: Crop management, farm implements and machinery, fodder and feed management, natural resource management, organic farming and livestock management.

The farmers of NICRA project in Aurangabad district were trained in 23 training programmes. About 928 farmers were participated in various training programmes. The topics included in training programmes were: efficient utilization of wheat straw by enriching with urea treatment, cultivation of green folder, feeding management of goat, sustainable livelihood through Integrated farming, bahar management in sweet orange, production technology in onion, cultivation of turmeric and ginger, commercial cultivation of dry land horticultural crops, nursery management in fruit crops, protective cultivation of vegetables & flower crops, soil test based INM in cotton and training and pruning in pomegranate.

The farmers in Nandurbar district were received 42 training programmes. About 759 farmers were participated in various training programmes. The farmers underwent training programmes in the fields of natural resource management, crop diversification, livestock management, farm implements and machinery and crop residue management etc.

KVK, Baramati (Pune) trained 67 farmers in 23 training programmes. They received skills in in-situ moisture conservation technologies, fodder production and other need based skills in VCMRC meetings. The farmers of the project in Ratnagiri were trained in management of Giriraja poultry birds, covering 25 farmers.

Table 39: Capacity building activities of NICRA project During 2014-15

Centre	Title of the training programmes	Duration in days	No.of programmes organized	No. Of participants		
				Male	Female	Total
Andhra Pradesh						
Anantapur	Prospects of guar crop in Ananthapur district	1	1	25	03	28
	Focused group training programme on paddy	1	1	25	--	25
	Low cost production technologies in groundnut	1	1	30	09	39
	ICAR Foundation day	1	1	123	32	155
	Focused group training programme on groundnut	1	1	25	02	27
	Focused group training programme on paddy	1	1	25	01	26
	Improved production technologies in castor	1	1	23	02	25
	Basic Orientation in Agricultural practices	1	1	30	12	42
	Production technologies in castor hybrids	1	1	25	07	32
	Improved Production technologies in pigeonpea 1	1	1	35	--	35
	Total	**10**	**10**	**366**	**68**	**434**
Kurnool	Resource conservation technologies	1	2	46	15	**61**
	Crop diversification	1	2	31	12	**43**
	Fodder & feed management	1	2	30	9	**39**
	Nursery raising	1	1	22	12	**34**
	Nutrient management	1	1	20	-	**20**
	Pest& disease management	1	1	19	-	**19**
	Livestock management	1	2	85	37	**122**
	Drudgery reduction with farm implements for women	1	1	-	33	**33**
	Crop management	1	2	64	6	**70**
	Weed control	1	1	10	3	**13**
	Home science	1	1		25	**25**
	Total	**11**	**16**	**327**	**152**	**479**

Srikakulam	Farmer scientist interaction meeting	1	1	38	0	38
	Azolla production technology at farmer's level	1	1	40	0	40
	Method demonstration on Ring method of Azolla production	1	1	10	0	10
	Animal health camp	1	1	40	0	40
	Contingency measures and Risk management strategies flood and cyclone affected agriculture	1	1	30	5	30
	Farmer scientist interaction	1	1	45	0	45
	Contingency measures in major field and horticultural crops	1	1	20	0	20
	Rearing of Vanaraja birds and Azolla cultivation	1	1	15	5	20
	Interaction meeting on Drum seeding production technology of paddy	1	1	19	0	19
	Method demonstration on zero tillage method sowing and herbicide application.	1	1	50	0	50
	Skill demonstration on trellis system of tomato cultivation	1	1	13	0	13
	Crop diversification in *rabi* and management of ID crops	1	1	21	0	21
	Management of pest and disease in rice fallow pulses	1	1	20	0	20
	Direct sowing of paddy with drum seeder.	1	1	20	0	20
	Zero tillage maize production technology.	1	1	35	0	35
	Awareness programme	1	1	100	0	100
	Micronutrient management in vegetable cultivation"	1	1	30	0	30
	Summer Vegetable Cultivation Technology	1	1	30	5	35
	Total	**18**	**18**	**586**	**15**	**596**

West Godavari	Importance of Green manuring and soil testing in Paddy crop	1	1	15	-	15
	Soil sampling and Soil test based nutrient management in paddy	1	1	20	-	20
	Pest and disease management in paddy nurseries	1	1	17	-	17
	Weed management in paddy	1	1	10	-	10
	Fish culture management during rainy season	1	1	10	-	10
	Kharif paddy production technology	1	1	99	1	100
	Nutrient management in paddy	1	1	22	-	22
	Pest and disease management in kharif paddy	1	1	24	-	24
	Fish culture management during winter season	1	1	20	-	20
	Nutrient management in rabi paddy	1	1	23	-	23
	Weed control n direct seeded paddy	1	1	32	-	32
	Pest and disease management in rabi paddy	1	1	22	-	22
	Rabi paddy production technology	1	1	25	-	25
	Total	**13**	**13**	**339**	**1**	**340**
Andhra Pradesh Total		**52**	**57**	**1618**	**236**	**1849**
	Telangana					
Khammam	ICAR foundation day and contingency crop plan	1	01	57	03	60
	Soil and water conservation methods	1	01	40	05	45
	Sustainable agriculture	1	01	41	08	49
	Nutrition and disease management in fish culture	1	01	36	04	40
	Seasonal pest and disease management in agricultural crops	1	01	40	02	42
	Pest and disease management in chilli	1	01	42	09	51
	YMV management in green gram	1	01	18	06	24
	Total	**07**	**07**	**274**	**37**	**311**

Nalgonda	Soil health management	01	01	22	08	30
	Farm mechanisation	01	02	48	13	61
	Integrated Pest Management	01	01	21	09	30
	Water Management	01	01	25	05	30
	Weed Management	01	01	23	07	30
	Animal Health Management	01	01	25	05	30
	Resource conservation technologies	01	02	45	18	63
	Total	**07**	**09**	**209**	**65**	**274**
Telangana Total		**14**	**16**	**483**	**102**	**585**
Maharashtra						
Ahmednagar	Integrated crop management in pomegranate	1	1	20	0	20
	Bacterial blight management in pomegranate	1	1	35	0	35
	Contingency crop planning under delayed monsoon	1	1	32	0	32
	Integrated fodder management in livestock	1	1	23	0	23
	Fodder management by silage making	1	2	82	0	82
	Goat management	1	1	0	35	35
	Protective cultivation-poly house	3	1	4	0	4
	Use of evaporation retardant in plastic lined farm pond	1	1	41	0	41
	Total	**10**	**9**	**237**	**35**	**272**
Amravati	Crop Management	1	7	204	40	254
	Employment generation	1	4	32	15	47
	Farm implements and machineries	1	6	63	20	83
	Fodder and Feed management	1	6	146	34	180
	Live stock management	1	4	88	12	100
	Natural resource management	1	4	84	15	99
	Women awareness	1	4	89	32	121
	Nutritional gardening	1	5	70	28	98
	Organic farming	1	6	68	21	89
	Pest and Disease management	1	4	36	17	53
	Total	**10**	**54**	**880**	**234**	**1124**

Aurangab-ad	Efficient utilization of wheat straw by enriching with urea treatment	1	1	29	11	40
	Importance of vaccination in livestock	1	1	30	05	35
	Cultivation of green folder	1	1	35	10	45
	Feeding management of goat	1	1	30	10	40
	Back yard poultry management	1	1	30	10	40
	Sustainable livelihood through Integrated farming	1	1	28	9	37
	Bahar management in sweet orange	1	1	30	13	43
	Production technology in onion	1	1	30	10	40
	Cultivation turmeric and ginzer	1	1	30	10	40
	Commercial cultivation of dry land horticultural crops	1	1	34	14	48
	Training and pruning in pomegranate	1	1	41	03	44
	Nursery management in fruit crops	1	1	29	07	36
	Protective cultivation of vegetables &flower crops	1	1	30	10	40
	Package & practices of soybean	1	1	30	10	40
	Soil test based INM in cotton	1	1	30	10	40
	Weed management of kharif crops	1	1	27	07	34
	Improved technology for higher production of maize & bajara	1	1	36	10	46
	Modern cultivation practices in gram and wheat	1	1	30	10	40
	Advance water management practices for rabi crop for increasing water use efficiency	1	1	30	10	40
	Weed management of rabi crops	1	1	35	06	41
	Production of vermicompost by different method	1	1	25	05	30
	Importance of micronutrient	1	1	31	08	39
	Seed production technology in Soybean & Bengalgram	1	1	36	14	50
	Total	**23**	**23**	**716**	**212**	**928**

Nandurbar	Natural resource management	1	1	17	0	17
	Resource conservation technologies	1	3	39	18	57
	Crop diversification	1	2	23	10	33
	Crop management	1	1	16	0	16
	Nutrient management	1	2	18	02	20
	Pest and disease management	1	2	18	02	20
	Weed control	1	1	13	08	21
	Live stock management	1	1	20	06	26
	Fodder and feed management	1	1	21	07	28
	Farm implements and machineries	1	1	13	08	21
	Natural resource management	1	3	40	5	45
	Crop diversification	1	3	62	12	74
	Crop management	1	1	16	0	16
	Nutrient management	1	1	10	2	12
	Live stock management	1	3	68	9	77
	Fodder and feed management	1	2	24	12	36
	Farm implements and machineries	1	2	13	30	43
	Nutrient management	1	1	15	7	22
	Pest and disease management	1	2	28	0	28
	Weed control	1	1	15	7	22
	Live stock management (Control of ticks in cattles)	1	1	17	10	27
	Feed management in poultry	1	1	10	02	12
	Farm implements and machineries	1	2	27	0	27
	Natural resource management	1	2	37	0	37
	Crop residue management	1	2	22	0	22
	Total	**25**	**42**	**602**	**157**	**759**
Pune	VCMRC meeting and discussion on intervention to carried out in the Year 2014-2015	1	20	20	-	20
	In Situ soil moisture conservation and NICRA project Evaluation	1	1	15	-	15
	Cultivation of fodder maize as contingency crop in the NICRA village	1	1	22	-	22
	NICRA intervention and Economic analysis	1	1	10	-	10
	Total	**4**	**23**	**67**	**-**	**67**
Ratnagiri	Management of Giriraj poultry unit	4	1	11	14	25
	Total	**4**	**1**	**11**	**14**	**25**
Maharashtra Total		**76**	**152**	**2513**	**652**	**3175**
Grand Total		**142**	**225**	**4614**	**3990**	**5609**

Training Programme (Anantapur)

ICAR Foundation day (Anantapur)

ICAR Foundation day (Kurnool)

Method demonstration (Srikakulam)

Training Programme (Anantapur)

Method demonstration on Silage making (Khammam)

Training on hydroponics (Ahmednagar)

Training programme (Aurangabad)

8. Extension Activities

The NICRA centers located in Zone-V, organized various extension activities during 2014-15. The NICRA centers in the states of Andhra Pradesh, Telangana and Maharashtra organized 456 extension activities with involvement of 22832 male and 3163 female farmers. Among the states, NICRA centers located in Maharashtra organized 177 extension activities with involvement of 3824 farmers and in Andhra Pradesh with 21755 farmers (Table 40).

Details of extension activities implemented in NICRA centers

Andhra Pradesh

The KVK, Anantapur, organized the extension activities of method demonstration of seeding methods, field days and group discussions with the farmers on performance of various climate resilient technologies (102 programmes) to the famers of Chamaluru during 2014-15. Similarly KVK Kurnool extended their services in transferring technologies related to climate resilient agriculture. During 2014-15, KVK organized 114 programmes covering 18317, male farmers and 2019 female famers. The activities include group dynamics, method demonstration, seeding devices, awareness programmes on climate resilient agriculture. Agro advisory services through mobile alert systems, exposure visits and kisan melas etc. KVK Kurnool organized ICAR Foundation Day on 16th July at NICRA village i.e Yagantipalle in Kurnool district. Nearly 120 farmers and farm women were participated in the occasion. The scientists addressed the gathering about Contingent crop planning and agronomic measures in standing crops in view of prevailing drought situation in the village. Chief guest sri Nagaraju, AD, ground water dept., Dr. M.R. Sreenivasulu, Special officer, SHE &CS and Programme co-ordinator distributed the certificates to the 100 smart farmers in the village. The NICRA KVK located in Srikakulam extended their services in transferring technologies to the farmers related to climate resilient agriculture. During 2014-15, KVK organized 12 programmes covering 105 male farmers and 25 female farmers. The activities includes: group dynamics, method demonstration, Nursery raising vegetables in portrays. Direct seeding of paddy with drum seeder, Zero tillage maize and etc., KVK located in West Godavari district extended their services in transferring technologies related to climate resilient agriculture. During 2014-15, KVK organized 9 programmes covering 91 farmers. The activities includes: Method demonstration, Field days, awareness programmes on climate resilient agriculture etc.,

Telangana

KVK, Khammam organized 8 programmes covering 102 male farmers and 16 female farmers. The activities includes: group dynamics, on climate resilient agriculture, stem application methods on cotton, discussion on custom hiring centre, Alternaria leaf spots and sucking pest control in cotton, Azolla production uses and utilization in animals, paddy seed protection, Improvement of the und water levels and water conservation etc.,

The scientists of KVK Nalgonda organized 34 programmes of extension covering 298 farmers (254 male farmers and 44 female famers of NICRA village. The activities implemented were: method demonstrations, agro advisory Services, field days, diagnostic visits, E -TV Jai-Kisan programme and press notes.

Maharashtra

KVK, Ahmednagar organized four extension activities in the project village covering 724 male farmers and 152 female farmers. The activities implemented in the village were field days on production technology in various crops, seminars, exposure visits and agro advisory services through mobile SMS alert systems. KVK, Amravati organized 50 programmes with active participation 555 male farmers and 157 female farmers of adopted village. The activities implemented in the village were: group dynamics, method demonstration, seeding devices, awareness programmes on climate resilient agriculture. Agro advisory services through mobile alert systems, exposure visits and kisan melas etc. KVK Aurangabad organized 52 extension activities with participation of 1247 farmers in NICRA villages. The extension activities implemented in the village were: Field Days, *Kharif* & *Rabi* Melawa, Exposer visits and kisan divas etc.

KVK Nandurbar organized 66 programmes involving 663 male farmers and 186 female farmers of the project village. The activities includes: group dynamics, method demonstration, (Maize Sheller, Sickles, Groundnut Stripper, Groundnut Decorticator, Mango Zela, Hand Operated rider cum bund former) awareness programmes on climate resilient agriculture. Agro advisory services, ICAR foundation day, field days (Onion Seed, Potato). The NICRA centre popularized climate resilient technologies through publication of leaf lets. The scientists working in KVK, Pune, (Baramati) has organized one exposure visit to CRIDA campus for NICRA Village farmers to see different technologies related to climate resilient in Agriculture. During 2014-15 KVK organized grain festival on 10 to 13th April, 2015 3 farmers from NICRA village participated in the Grain festival and sold 15 quintals Sorghum 40 quintals. Wheat and moth Bean 100 Kg. Agro advisory services through mobile alert system, exposure visits and Kisan Melas etc. KVK located in Ratnagiri district organized 2 programmes covering 72 male farmers and 55 female farmers. The activities include: method demonstration and kisan mela etc.

Table 40: Extension activities of NICRA project

Name of the centre	Title of the activity	No.of programmes organized	No. of participants		
			Male	Female	Total
Andhra Pradesh					
Anantapur	Method demonstrations	11	123	26	149
	Agro advisory services	79	552	172	724
	Field days	04	117	12	129
	Group discussions	08	69	25	94
	Total	**102**	**861**	**235**	**1096**
Kurnool	Method demonstrations	2	76	17	**93**
	Agro advisory	96	17950	1937	**19887**
	Awareness	4	106	24	**130**
	Exposure visits	2	15	4	**19**
	Field days	1	8	3	**11**
	Group discussions	5	101	29	**130**
	Diagnostic visits	4	61	5	**66**
	Total	**114**	**18317**	**2019**	**20336**
Srikakulam	Training programme	7	80	25	105
	Technology week	5	25	0	25
	Total	**12**	**105**	**25**	**130**
West Godavari	Method demonstration on soil sample collection	2	15	-	**15**
	Method demonstration – On seed treatment in paddy	1	16	-	**16**
	Seed treatment in paddy	1	23	-	**23**
	Feld day on Soil test based nutrient management	2	48	-	**48**
	Seed treatment in paddy	1	26	--	**26**
	Drum seeder in paddy	1	30	--	**30**
	Weedicide application in direct seeded paddy and Demonstration on Machine transplanting in paddy	1	35	--	**35**
	Total	**9**	**193**	**0**	**193**
Andhra Pradesh Total		**237**	**19476**	**2279**	**21755**

Telangana					
Khammam	Salinity tolerant paddy variety(Siddi-WGL-44)	01	22	04	26
	Mobile vermin beds for preparation of vermicompost	01	14	03	17
	Trisodium orthophosphate in chilli for seed treatment	01	07	04	11
	Stem application method in cotton for control of sucking pest	04	44	02	46
	Rodent control in paddy	01	15	03	18
	Total	**08**	**102**	**16**	**118**
Nalgonda	Method Demonstrations	02	35	05	40
	Agro Advisory Services	12	72	06	78
	Field Day	01	27	05	32
	Group Discussions	04	32	16	48
	Diagnostic visits	03	21	03	24
	E TV Jai-Kisan programme	01	-	-	-
	Press notes	10	-	-	-
	ICAR day celebrations	01	67	09	76
	Total	**34**	**254**	**44**	**298**
Telangana Total		**42**	**356**	**60**	**416**
Maharashtra					
Ahmedna-gar	Field days on silage making	1	84	0	84
	Mobile alert system		530	121	651
	Exposure visits	3	26	31	57
	seminar on fodder management under drought condition by silage making	1	84	0	84
	Total	**5**	**724**	**152**	**876**
Amravati	Group dynamics	3	100	21	121
	Method demonstration	12	85	44	129
	Exposure Visit	20	139	29	168
	Field day	3	35	7	42
	Kisan Melas	1	35	14	49
	Technology Week	11	161	42	203
	Total	**50**	**555**	**157**	**712**

Aurangab-ad	Field Day	4	34	-	34
	Method Demonstrations	21	69	-	69
	Kharif & Rabi Melawa	2	122	20	142
	ExposerVisit	1	1	10	11
	Krishi Din	1	58	13	71
	Trainings	23	690	230	920
	Total	**52**	**974**	**273**	**1247**
Nandurbar	Method demonstration	10	100	100	200
	Agro advisory service	20	35	00	35
	Pre-kharif planning meet	1	29	8	37
	Awareness	03	36	08	44
	Farmers Meet	2	34	00	34
	ICAR Foundation Day	1	66	12	78
	VCRMC meeting	12	12	3	15
	Exhibition on drudgery reducing equipments	1	77	21	98
	Commodity group	01	10	02	12
	Group discussion	14	144	25	169
	Exposure visit	02	52	00	52
	Field day	02	28	05	33
	Diagnostic visit	03	40	02	42
	Total	**66**	**663**	**186**	**849**
Pune	Exposure Visit to CRIDA	1	10	0	10
	Participation in grain festival	1	2	1	3
	Total	**2**	**12**	**1**	**13**
Ratnagiri	Method demonstrations	1	18	9	27
	Kisan mela	1	54	46	100
	Total	**2**	**72**	**55**	**127**
Maharash-tra Total		**177**	**3000**	**3824**	**3824**
Grand Total		**456**	**22832**	**3163**	**25995**

Exposure visit (Anantapur)

Visit of DDE, ANGRAU (Anantapur)

Field visit (Aurangabad)

Group Discussion (Aurangabad)

Weekly agro advisory Service (Aurangabad)

Diagnostic visit (Srikakulam)

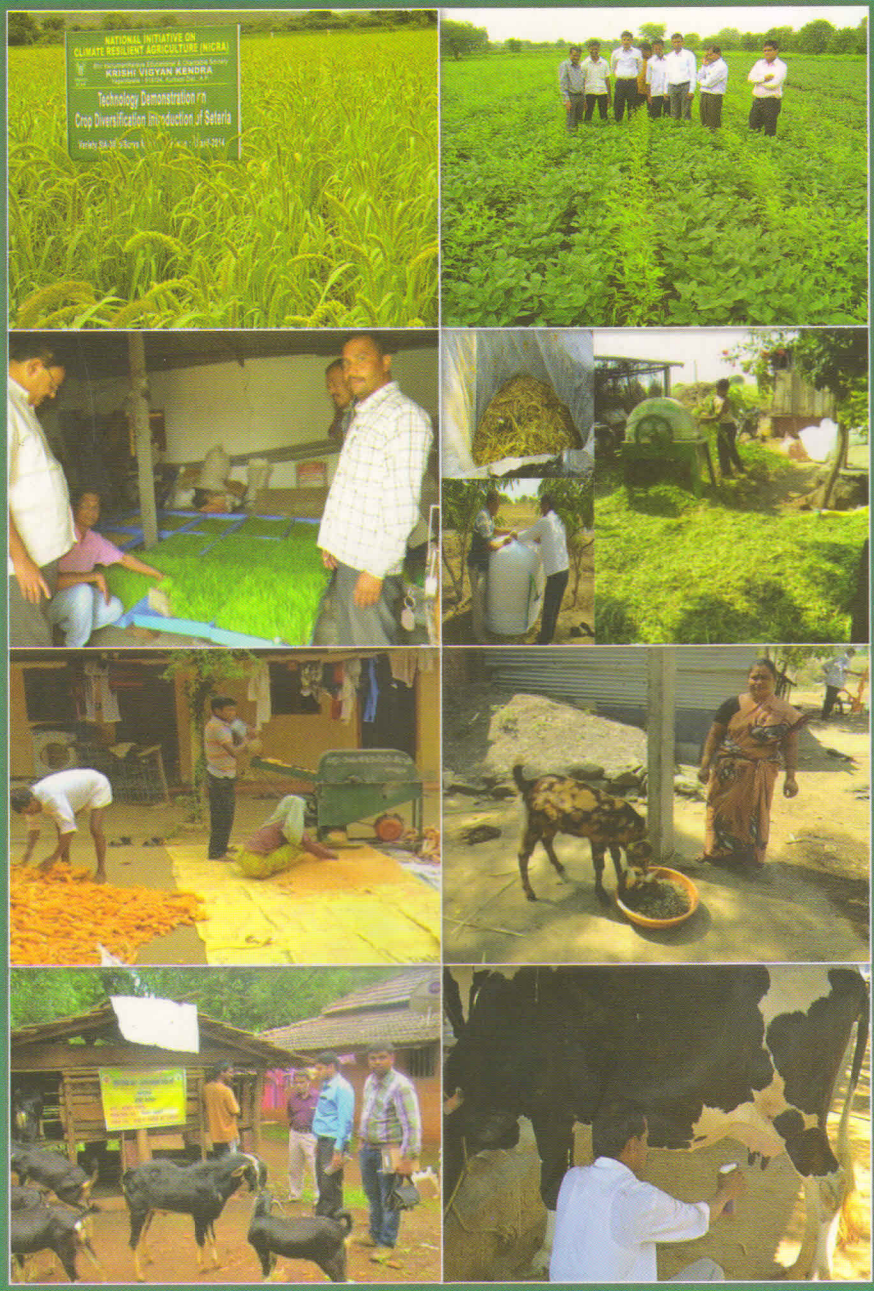
Group discussion (Nandurbar)

Farmer & Scientist interaction (Nandurbar)

List of Contributors

Sl.No	KVK	PI	Co PI	Address
			Andhra Pradesh	
1	Anantapur	Dr. P. Lakshmi Reddy	Mr. A. Malliswara Reddy	Krishi Vigyan Kendra, B.K. Samudram (M) Reddipalli - 515 701, Anantapur (Dist.) Tel: 08554-200418 E-mail: pc.atp@yahoomail.com
2	Kurnool	Mrs. G. Dhanalakshmi	Mr. M. Sudhakar	Krishi Vigyan Kendra, PO:Yagantipalli, Via: Banaganapalli, Distt. Kurnool – 518124 Tel: 08515 200340 Email: pendekantikvk@rediffmail.com
3	Srikakulam	Dr. D. Chinnam Naidu	Mr. Balakrishna	Krishi Vigyan Kendra, Agril. Research Station, Amdalavalsa, Distt. Srikakulam-532185 Tel: 08942286210 E-mail: kvk_adv2006@yahoo.co.in
4	West Godavari	Dr. C. Venkata Reddy	Mr. A. Srinivasa Rao	Krishi Vigyan Kendra Opp:Civil Supply Godowns, Post: Undi, Distt. West Godavari – 534199 Tel: 08816 228322 E-mail: kvkundi@yahoo.co.in
			Telangana	
5	Khammam	Dr. N. Mallikarjuna Rao	Dr. M. Srinivasa Rao	Krishi Vigyan Kendra, ARS Wyra Distt. Khammam - 507165 Tel: 08749-251803 E-mail: kvkwyra@yahoo.co.in
6	Nalgonda	Dr. R. Veeraiah	Mr. T. Yadagiri Reddy	Krishi Vigyan Kendra, PO:Gaddipalli GaredapalliMandal, Distt. Nalgonda -508201 Tel: 08683-237443 E-mail: saird_gaddipalli@yahoo.com
			Maharashtra	
7	Ahmednagar	Dr. Bhaskar Gaikwad	Mr. Shailesh Deshmukh	Krishi Vigyan Kendra, PO: Babhaleshwar Tal: Rahata, Dist: Ahmednagar-413 737 Tel: 02422 252414 E-mail: kvkahmednagar@yahoo.com
8	Amravati	Dr. K.A. Dhapke	Mr. P. S. Jayle	Krishi Vigyan Kendra (Durgapur), PO: Badnere Dist. Amravati– 444 701 Tel: 0721 2580606 E-mail: pc_kvka@yahoo.co.in
9	Aurangabad	Dr. S.B. Pawar	Dr. K.K. Zade	Krishi Vigyan Kendra, Paithan Road Dist: Aurangabad – 431517 Tel: 0240 2376558 E-mail: pckvkmau@rediffmail.com

10	Nandurbar	Dr. R.S. Dahatonde	Mr. J.N. Uttarwar	Krishi Vigyan Kendra,A/P : Kolde, Tal & Dist. Nandurbar – 425 412 Tel: 02564 240544 E-mail: kvk_ndb@yahoo.com
11	Pune	Dr. Sayed Shakir Ali	Dr. R.S. Jadhav	Krishi Vigyan Kendra Sharadanagar, Dist: Baramati Pune-413115, Maharahstra Tel: 02112 255227 E-mail: kvkbmt@yahoo.com
12	Ratnagiri	Mr. Sudesh Kumar Chavan	Dr. Sandeep S. Patil	Krishi Vigyan Kendra, Post- Deodhe Tal. Lanja, Dist. Ratnagiri- 416712 Tel: 02351-231361 E-mail: kvkratnagiri@rediffmail.com



ICAR-Agricultural Technology Application Research Institute (ATARI)

CRIDA Campus, Santhoshnagar, Hyderabad-500059 Telangana, India.