Towards Climate Resilient Villages -
Evidences from participatory technology demonstrations

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Back Cover: Landscape of a climate resilient village

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PREFACE

Technology Demonstration Component (TDC) under the NICRA (National Innovations in Climate Resilient Agriculture) project is in operation in 15 climatically vulnerable districts in the states of Andhra Pradesh, Telangana and Maharashtra (Zone-V). Innovative practices to address major climatic vulnerabilities such as drought, flood, heat stress and other extreme weather events were demonstrated during 2016-17 in participatory mode in farmers' fields in representative village clusters. Technology interventions in natural resource management, crop production, livestock and fisheries production systems were assessed for imparting resilience to climate vulnerabilities faced by the farmers in the adopted villages.

During 2016-17, the operational sites located in Anantapur, Chittoor, Khammam and Aurangabad experienced deficit seasonal rainfall from south-west monsoon (June-September) ranging between -19.9 to -40.6%. Monthly rainfall was either deficit or scanty in Anantapur, Chittoor, Nalgonda and Khammam, Ahmednagar, Aurangabad and Jalna districts. In-situ soil moisture conservation practices and ex-situ rainwater harvesting and recharging of wells for supplemental micro irrigation enhanced resilience with higher productivity in groundnut, cotton, pigeonpea, soybean, maize, vegetable crops and sweet orange. Tank silt application, soil test based fertilizer application, mulching aand green manuring and recycling of crop residues through composting enhanced soil quality, water holding capacity and fertility.

Drought tolerant and short duration varieties in rainfed crops such as groundnut, pigeonpea, bengal gram, millets and flood tolerant varieties of paddy in West Godavari gave stable yields. Intercropping systems of millets, cotton and soybean with pulses gave higher returns over sole crops under deficit rainfall conditions. IPM practices in cotton, tomato, paddy and onion crops reduced cost of crop protection and increased profitability. Improved breeds, fodder, feed and shelter management practices in livestock, poultry, captive rearing of fish seed enhanced productivity and resilience. Capacity development and skill trainings in climate smart agricultural practices and technologies were imparted to 8862 farmers, farm women, youth and extension personnel. Extension activities were taken up in all the districts for awareness and wider adoption of climate resilient agricultural practices covering 23152 farmers.

This publication documents farm innovations and evidences of resilient practices and technologies in predominantly rainfed districts in the three states of Andhra Pradesh, Telangana and Maharashtra. We gratefully acknowledge the guidance and constant support received from Dr. Trilochan Mohapatra, Secretary, DARE & DG, ICAR; members of the High Level Monitoring Committee (HLMC) and Director, ICAR-CRIDA. We appreciate the valuable contributions of farmers and KVK project scientists for contributing to the practice of climate resilient agriculture in this zone.

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Executive Summary

National Innovations in Climate Resilient Agriculture (NICRA) is a multi-institutional and 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 was implemented through Krishi Vigyan Kendras (KVKs) during 2016-17 in 15 climatically vulnerable districts located in the states of Andhra Pradesh, Telangana and Maharashtra under ATARI, Hyderabad. These include KVKs of Anantapur, Chittoor, Kurnool, Srikakulam and West Godavari in Andhra Pradesh. Khammam and Nalgonda in Telangana and Ahmednagar, Amravati, Aurangabad, Buldhana, Jalna, Nandurabar, Pune and Ratnagiri in Maharashtra.

Under the project, the KVKs implemented NRM, crop production, livestock and fisheries, institutional interventions, capacity building and extension activities with the involvement of 1829, 1620, 1137, 886, 7458 and 14577 farmers respectively. Under the project demonstrations were organized covering an area of 1558 ha under NRM and 588 ha under crop production modules.

Rainfall Pattern

The NICRA centers located at Srikakulam of Andhra Pradesh, Nalgonda of Telangana, Amravati, Jalna and Ratnagiri districts of Maharashtra received excess rainfall compared to the normal during 2016. Whereas, the NICRA centers located at Anantapur, Kurnool and West Godavari of Andhra Pradesh, Khammam in Telangana and Ahmednagar, Aurangabad, Buldhana, Nandurbar and Pune districts of Maharshtra received deficit rainfall. The rainfall in the districts of Srikakulam, Nalgonda, Amravati, Jalna and Ratnagiri exceeded to the extent of 111.34, 116.25, 103.37, 108.34 and 117.26 percent respectively compared to the normal rainfall.

Natural Resource Management

Under natural resource management interventions, desilting of village tank in Chittoor district resulted in increased water levels in the borewells located in the vicinity. Renovation of Errakunta and strengthening of bund facilitated cultivation of paddy, tomato and fodder crops as a result of water recharge in the borewells located in the vicinity in Chittoor district. Renovation of percolation tank (Jagannadha Naidu tank) helped to overcome the water scarcity at early and later stages of the crop growth resulting in cultivation of maize,

green gram, blackgram, chickpea, sesamum and other vegetable crops in tankfed areas of Srikakulam. Desilting of nala and construction of cement plug was done at NICRA village of Aurangabad district to improve the productivity of rainfed crops through supplemental irrigation. Destilting of water stream at NICRA village of Pune resulted in increased water level of wells in the vicinity by 4.5 ft.

Conservation of rainwater was achieved through *in-situ* moisture conservation technologies like conservation furrows in groundnut (Anantapur), cotton (Nalgonda), in cotton and pigeonpea (Aurabgabad), soybean (Buldhana), sub soiling in pigeonpea (Anantapur)**,** plastic mulching in tomato (Chittoor) and organic mulching in sweet orange (Jalna), ridges and furrows in brinjal (Srikakulam), cotton (Amravati) and in maize (Nandurbar). Broad bed furrow method of sowing in soybean at Jalna, sowing across the slope in soybean, ridge and furrow planting in maize at Nandurbar, compartmental bunding in rabi sorghum at Pune resulted in enhanced yields over no conservation furrows. Micro irrigation systems i.e., drip irrigation in cotton and pigeon pea at Amravati and in cashew at Ratnagiri not only improved the water use efficiency but also productivity and profitability of the crops. Supplemental irrigation in cotton at NICRA villages of Khammam and Aurangabad and in groundnut using sprinklers and raingun in chittoor district resulted in higher yield due to provision of irrigation at critical stages of crop growth. Various soil quality management practices through tank silt application, soil test based fertilizer application in Anantapur and Nalgonda and sheep penning at Anantapur, green manuring in paddy with dhaincha and sunhemp, application of bio organic slurry, recycling of organic matter through vermicompost resulted in improvement of soil quality and fertility along with increased yields.

Crop Production

Improved drought tolerant varieties Dharani (Groundnut), SIA-3085 (Foxtail millet) and K-6 (Groundnut) at Anantapur, Dharani (Groundnut) at Chittoor, LRG-41 (Pigeonpea), NBeG-3 (Chickpea) at Kurnool, MTU-1121 and MTU-1156 (Paddy) at West Godavari, PRG-176 and WGG-42 (Pigeonpea), MGG-295 (Greengram) at Nalgonda, BDN-711 and MAUS-71 (Pigeonpea) at Aurangabad, JAKI-9218 (Bengal gram), Digvijay (Bengal gram) at Jalna, GM-6 (Maize) at Nandurbar gave stable yields under different climatic vulnerabilities. In NICRA village of West Godavari district flood tolerant variety MTU-1064 performed best followed by MU-1061 in flood prone area.

Among cropping systems, intercropping systems of foxtail millet+pigeonpea (5:1) at Kurnool and Nalgonda, cotton+pigeonpea (6:1) intercropping system at Nalgonda, Khammam and Srikakulam, soybean+pigeonpea (4:2), Bt cotton+greengram (1:1), Bt cotton+blackgram

(1:1) and rabi sorghum+safflower (3:3) and pearl millet+pigeonpea (3:3) systems in Aurangabad ensured stable income over sole crops.

Direct sowing of paddy with fertilizer cum seed drill at Srikakulam, weeding using power weeder at Chittoor, improved seed drill in Bengal gram and jowar at Kurnool, mechanical transplanting of paddy at West Godavari not only saved the cost of labour but also increased area of operation over traditional practices.

Water saving technologies viz., SRI cultivation in paddy at Anantapur, direct seeding with drum seeder at Nalgonda and Chittoor, irrigation based on soil moisture condition and zero tillage maize cultivation in Srikakulam not only improved the water use efficiency but also productivity and profitability of the crops.

Crop diversification with short duration variety suryanandi of foxtail millet can be a profitable alternative to *desi* cotton at Kurnool and Anantapur under rain fed situation. Sericulture was found more profitable compared to cultivation of cotton. Similarly crop diversification with pea (Malav) and potato (Kufri Jyothi) at Nandurbar was found beneficial compared to traditional crops.

To economize the cost of plant protection in tomato, adoption of IPM practices was taken up resulting in increased yields at NICRA village of Chittoor district. Stem application with imidacholprid and monocrotophos at 20, 40 and 60 DAS and installation of yellow sticky traps @ 25/ha and spraying of acetamiprid @ 0.5g/l with Neem oil @ 0.03% (5 ml/l) checked the incidence of sucking pests in Bt cotton in the demonstrations resulting in healthy plants compared to farmers practice in NICRA village of Kurnool district. Biotic stress management in flood prone area for management of paddy sheath blight, blast and brown plant hopper reduced the yield loss due to disease incidence during floods in Srikakulam. Application of azoxystrobin @ 0.5 ml/l of water along with soil application of *Trichoderma* @ 5 l/ha resulted in reduced disease incidence in onion.

Livestock and Fisheries

In livestock based interventions, improved fodder varieties (APBN-1) at Nalgonda, fodder sorghum variety (Phule Govardhan) at Ahmednagar, MP chari, Yeshwant grass and African tall (fodder maize) at Amravati, African tall (fodder maize) at Jalna recorded promising results in terms of fodder yields.

Calf registration reduced the calf mortality and improved growth rate in calves in Kurnool district of Andhra Pradesh. Silage making intervention made available the green, nutritious

fodder during off season and registered higher milk productivity than farmers practice in dairy animals at NICRA village of Ahmednagar. Introduction of superior breeding ram helped in achieving 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 breed at Khammam. Feed enrichment through azolla enhanced the milk productivity and fat content of milk. Supplementation of protein and energy through mineral block increased the milk yield at NICRA villages of Kurnool, Khammam, Ahmednagar, Jalna and Ratnagiri.

Improved poultry breeds viz., Rajashree (Khammam & Nalgonda), Grampriya (Aurangabad), Satpuda (Nandurbar), and Kaveri (Pune) were found superior to desi breeds in terms of bird weight, number of eggs and net income. Captive rearing of fish seed from fry stage to fingerling stage reduced the cost of fish production in Srikakulam. Optimization of stocking density of IMC culture resulted in higher yield and net income over the farmers method of stocking. Water quality management in fish ponds viz., dissolved oxygen (DO), ammonia content and pH in fish ponds and adoption of correction measures on need basis resulted in 5.9% increase in yield in West Godavari.

Capacity Building

319 need based training programmes were organized with the participation of 8862 farmers by NICRA KVKs of Zone-V. The farmers in NICRA villages of Andhra Pradesh underwent 130 training programmes with the participation of 4050 farmers. In Telangana farmers were imparted skills through 21 training programmes with the participation of 494 farmers and 63 farm women. In Maharashtra the NICRA farmers underwent168 training programmes with active participation of 4255 farmers. The training programmes included natural resource management, resource conservation technologies, cropping systems, crop diversification, integrated pest and disease management, soil health improvement, water saving technologies, farm implements and machinery, livestock management etc.

Extension Activities

626 extension activities were conducted across the zone with active participation of 23152 farmers. Among these 221 activities were conducted with the participation of 6327 farmers in Andhra Pradesh. 1687 farmers and 703 farm women participated in 109 extension activities in Telangana State. About 296 extension activities were conducted with the involvement of 14435 farmers in Maharashtra.

कार्यकारी सारांश

राष्ट्रीय जलवायु समुत्थान कृषि में नवप्रवर्तन (निक्रा) सन् 2011 में भारतीय कृषि अनुसंधान परिषद द्वारा आरंभ की गई एक बहु-संस्थागत एवं बहु-विषयक नेटवर्क परियोजना है। इस परियोजना का मुख्य उद्देश्य अनुकूल अनुसंधान एवं प्रौद्योगिकी के प्रदर्शनों द्वारा जलवायु परिवर्तन एवं जलवायु विविधता से भारतीय कृषि के समुत्थान में वृद्धि करना है। निक्रा का आधार प्रौद्योगिकी प्रदर्शन अवयव है जिसे अटारी हैदराबाद, के अंतर्गत आंध्र प्रदेश, तेलंगाना एवं महाराष्ट्र के राज्यों में स्थित 15 जलवायुवीय रूप से अतिसंवेदनशील जिलों में वर्ष 2016-17 के दौरान कृषि विज्ञान केंद्रों द्वारा कार्यान्वित किया जा रहा है। इनमें आंध्रप्रदेश के अनंतपुर, चित्तूर, कर्नूल, श्रीकाकुलम एवं पश्चिम गोदावरी, तेलंगाना के खम्मम एवं नलगोंडा एवं महाराष्ट्र के अहमदनगर, अमरावती, औरंगाबाद, बुलदाना, जालना, नंदुरबर, पुणे तथा रत्नगिरी जिले शामिल हैं।

कृषि तकनीकी अनुप्रयोग संस्थान (अटारी) हैदराबाद के अंतर्गत निक्रा कृषि विज्ञान केंद्रों द्वारा आंध्र प्रदेश, तेलंगाना एवं महाराष्ट्र के तीन राज्यों में जलवायु समुत्थान हस्तक्षेपों को कार्यान्वित किया गया। परियोजना के अंतर्गत, कृषि विज्ञान केंद्रों ने प्राकृतिक संसाधन प्रबंधन, फसल उत्पादन, पशुपालन एवं मछलीपालन, संस्थागत हस्तक्षेपों, क्षमता निर्माण में क्रमश: 1829, 1620, 1137, 886, 7456 तथा 14577 किसानों को शामिल कर प्रसार गतिविधियों को शामिल किया गया। इस परियोजना ने प्राकृतिक संसाधन प्रबंधन के अंतर्गत 1558 हेक्टेयर एवं फसल उत्पादन मापदंड के अंतर्गत 588 हेक्टेयर क्षेत्र में प्रदर्शनों का आयोजन किया।

वर्षा पैटर्न

वर्ष 2016 के दौरान आंध्र प्रदेश के श्रीकाकुलम, तेलंगाना के नलगोंडा, महाराष्ट्र के अमरावती, जालना एवं रत्नगिरी जिलों में सामान्य की तुलना में अतिरिक्त वर्षा हुई। जबकि, आंध्र प्रदेश के अनंतपुर, कर्नूल एवं पश्चिम गोदावरी; तेलंगाना के खम्मम एवं महाराष्ट्र के अहमदनगर, बुलदाना, नंदुरबर एवं पुणे जिलों में स्थित निक्रा केंद्रों में कम वर्षा हुई। श्रीकाकुलम, नलगोंडा, अमरावती, जालना एवं रत्नगिरी जिलों में सामान्य की तुलना में क्रमश: 111.34, 116.25, 103.37, 108.34 एवं 117.26 प्रतिशत अधिक वर्षा हुई।

प्राकृतिक संसाधन प्रबंधन

प्राकृतिक संसाधन प्रबंधन हस्तक्षेपों के अंतर्गत, चित्तूर जिले में गांव के तालाब से गाद निकालने से समीपवर्ती बोरवेलों के जलस्तर में वृद्धि हुई। एर्रकुंटा के नवीकरण एवं मेढ़ों के सशक्तिकरण से चित्तूर जिले के समीपवर्ती बोरवेलों के जलस्तर में वृद्धि से धान, टमाटर एवं चारा फसलों को उगाने सहायता मिली। अंतस्रवण तालाब (जगन्नाथ नायुडु तालाब) के नवीकरण से श्रीकाकुलम में तालाब पर आधारित क्षेत्रों में मक्का, मूंग, उड़द, चना, तिल एवं अन्य सब्जिदार फसलों को उगाने में आने वाली जल की अनुपलब्धता की कमी को दूर किया गया। औरंगाबाद जिले के निक्रा गांवों के नालों से गाद निकालने एवं सीमेंट प्लग कर अतिरिक्त सिंचाई द्वारा वर्षा आधारित फसलों की उत्पादकता को

सुधारा गया। पुणे के निक्रा गांवों के तालाबों से गाद निकालने से समीपवर्ती बोरवेलों के जलस्तर में करीब 4.5 फीट की वृद्धि हुई।

मूंगफली(अनंतपूर), कपास (नलगोंडा), कपास एवं अरहर (औरंगाबाद), सोयाबीन (बुलदाना) में संरक्षण कूंडों, अरहर (अनंतपूर) में मिट्टी चढाने, टमाटर (चित्तूर) में प्लास्टि पलवार, माल्टा (जालना) में जैविक पलवार, बैंगन (श्रीकाकुलम), कपास (अमरावती) एवं कपास (नंदुरबर) में मेंढ एवं कूंड जैसे स्व-स्थाने नमी संरक्षण प्रौद्योगिकियों द्वारा वर्षाजल का संरक्षण किया गया। जालना के सोयाबीन में चौडी क्यारी कूंड, नंदुरबर में ढलान के विपरीत सोयाबीन की बोवाई, मेढ़ एवं कूंड रोपण, पुणे के रबी ज्वार में उपखंडीय मेंढ से संरक्षणरहित कूंडों की तुलना में अधिक उत्पादन हुआ। अमरावती के कपास एवं अरहर तथा रत्नगिरी के काजू में सूक्ष्म सिंचाई प्रणालियां यानि ड्रिप सिंचाई से न केवल जल उपयोग क्षमता में वृद्धि हुई बल्कि फसलों की उत्पादकता एवं लाभ में भी वृद्धि हुई। खम्मम एवं औरंगाबाद के निक्रा गांवों के कपास में अतिरिक्त सिंचाई, फसल के क्रांतिक स्तरों पर मूंगफली में छिडकाव एवं रेनगन का उपयोग कर अतिरिक्त सिंचाई से फसल में वृद्धि हुई। तालाब गाद प्रयोग से विभिन्न मृदा गुणता प्रक्रियाएं, अनंतपूर एवं नलगोंडा में मृदा जांच आधारित उर्वरकों का प्रयोग, अनंतपूर में भेड विष्टा का प्रयोग, चावल में धैंचा एवं सनई सहित हरा खाद का प्रयोग, जैविक गारा का प्रयोग एवं वर्मीकंपोस्ट द्वारा जैविक पदार्थ का पुन:चक्रण से उत्पादन में वृद्धि सहित मृदा गुणता एवं उर्वरता सुधार हुआ।

फसल उत्पादन

अनंतपुर में धरणी (मूंगफली), एसआईए-3085 (कंगनी) एवं के-6 (मूंगफली); चित्तूर में धरणी (मूंगफली); कर्नूल में एलआरजी-41 (अरहर), एनबीईजी-3 (चना); पश्चिम गोदावरी में एमटीयू-1121 एवं एमटीयू-1156 (चावल); नलगोंडा में पीआरजी-176 एवं डब्ल्यूजीजी-42 (अरहर); औरंगाबाद में बीडीएन-711 एवं एमएयूएस-71 (अरहर); जालना में जेएकेआई-9218 (चना), दिगविजय (चना); नंदुरबर में जीएम-6 (मक्का) के उन्नत सूखा सहीष्णु किस्मों ने विभिन्न जलवायुवीय असंवेदनशीलताओं के अंतर्गत स्थिर उत्पादन दिया। पश्चिम गोदावरी जिले के निक्रा गांव में बाढ सहीष्णु किस्म एमटीयू-1064 ने श्रेष्ठ निष्पादन दिया इसके बाद बाढग्रस्त क्षेत्र के लिए एमयू-1061 का स्थान था।

सस्ययन प्रणालियों में, कर्नूल एवं नलगोंडा में कंगनी (सेटेरिआ) + अरहर का अंतरासस्ययन प्रणाली; नलगोंडा, खम्मम एवं श्रीकाकुलम में कपास+अरहर (6:1) अंतरासस्ययन प्रणाली; औरंगाबाद में सोयाबीन+अरहर (4:2), बीटी कपास+मूंग (1:1), बीटी कपास+उड़द (1:1), रबी ज्वार+कुसुंभ (3:3) एवं बाजरा+अरहर (3:3) के अंतरासस्ययन प्रणालियों ने एकल फसल की तुलना में सुनिश्चत एवं स्थिर आय प्रदान किया।

श्रीकाकुलम में फर्टीलाइज़र कॉम सीड ड्रील से धान की सीधी बोवाई, चित्तूर में पावर वीडर से निकौनी, कर्नूल में चना एवं ज्वार में उन्न्त सीड ड्रिल, पश्चिम गोदावरी में धान का यांत्रिक रोपण ने न केवल श्रम की लागत में बचत की बल्कि पारंपरिक प्रक्रिया की तुलना में प्रचालन क्षेत्र में भी वृद्धि हुई।

अनंतपुर के धान में एसआरआई कृषि, नलगोंडा एवं चित्तूर में ड्रम सीडर से सीधी बोवाई, श्रीकाकुलम में मृदा नमी परिस्थिति के आधार पर सिंचाई एवं शून्य कर्षण मक्का से न केवल जल उपयोग क्षमता में सुधार हुआ बल्कि फसलों की उत्पादकता एवं आय में भी वृद्धि हुई।

कर्नूल एवं अनंतपुर के वर्षा आधारित परिस्थिति के अंतर्गत देसी कपास का विकल्प कंगनी (सेटेरिआ) का लघु अवधि किस्म की फसल विविधता से लाभदायक हो सकता है। कपास की खेती की तुलना में रेशम उत्पादन अधिक लाभदायक पाया गया। इसी प्रकार नंदुरबर में पारंपरिक फसलों की तुलना में मटर (मालव) एवं आलू (कुफरी ज्योती) की फसल विविधता लाभदायक पाई गई।

टमाटर में पादप संरक्षण की लागत को कम करने के लिए अपनाई गई समेकित नाशीजीव प्रबंधन की प्रक्रियाओं से चित्तूर जिले के निक्रा गांवों में टमाटर के उत्पादन में वृद्धि हुई। कर्नूल जिले के निक्रा के गांवों में किसानों की प्रक्रियाओं की तुलना में बीटी कपास की बोवाई के 20, 40 एवं 60 दिनों पर इमीडाक्लोप्रिड (Imidacholprid) एवं मोनोक्रोटोफास (Monocrotophos) का तना पर प्रयोग, 25 हेक्टेयर की दर से पीत रंग के चिपकने वाले ट्रेप्स (Yellow sticky traps) की स्थापना एवं 0.03 प्रतिशत (5 मिली प्रति लीटर) की दर से नीम तेल सहित 0.5 ग्राम प्रति लीटर ऐसीटेमीप्रीड (Acetamiprid) के छिडकाव से चूशक नाशीजीवों के आपतन में कमी आई जिसके परिणामस्वरूप सवस्थ पौधे प्राप्त हुए। श्रीकाकुलम में बाढ़ों के दौरान धान मुतान ब्लाइट (Paddy sheath blight), धान का प्रध्वंश रोग(Blast) एवं भूरा पादप हॉपर रोग (Brown plant hopper) आपतन के कारण होने वाले धान की फसल की हानि को जैविक दबाव प्रबंधन के द्वारा कम किया गया। प्याज में 5 लीटर प्रति हेक्टेयर की दर से ट्राइकोडेरमा (Trichoderma) का मृदा प्रयोग सहित पानी में 0.5 मिली प्रति लीटर की दर से एजोक्सिट्रोबिन (Azoxystrobin) मिलाकर प्रयोग करने से प्याज में आने वाले रोगों में कमी आई।

पशु एवं मछली पालन

पशु पालन आधारित हस्तक्षेपों में, चारा उत्पादनों के मामले में नलगोंडा का उन्नत चारा किस्म (एपीबीएन-1), अहमदनगर का चारा ज्वार किस्म(फूले गोवर्धन), अमरावती का एमपी चारी, यशवंत घास एवं अर्फीकन लंबा (चारा मक्का), जालना का अर्फीकन लंबा (चारा मक्का) अधिक आशाजनक पाए गए।

आंध्र प्रदेश के कर्नूल जिले में बछडों के पंजीकरण से बछड़ों के मृत्यु दर में कमी आई। अहमदनगर के निक्रा गांव के डेरी पशुओं के लिए अपनाई जाने वाली किसानों की प्रक्रिया की तुलना में ऑफ सीजन के दौरान सीलेज निर्माण हस्तक्षेप से हरा एवं पोषक चारा उपलब्ध हुआ एवं अधिक दूध का उत्पादन दर्ज किया गया। श्रीकाकुलम में बेहतर प्रजनन भेड़ों के प्रस्तुति से अधिक उंची, लंबी एवं अधिक भार वाले भेड़ों की संख्या में वृद्धि हुई। खम्मम की स्थानीय किस्मों की तुलना में उन्नत प्रजनन वाले भेड़ों को झुंड में रखने से भेड़ों के उत्पादन में वृद्धि हुई एवं उनके मृत्यु दर में कमी आई। एजोला घास के समृद्ध चारे से दूध का उत्पादन एवं दूध में वसा की मात्रा में वृद्धि हुई। कर्नूल, खम्मम, अहमदनगर, जालना एवं रत्नगिरी के निक्रा के गांवों में खनिजों द्वारा अतिरिक्त प्रोटीन एवं ऊर्जा प्रदान करने से दूध के उत्पादन में वृद्धि हुई।

उन्नत मुर्गी नस्ल जैसेकि राजश्री (खम्मम एवं नलगोंडा), ग्रामप्रिया (औरंगाबाद), सतपुडा (नंदुरबर) एवं कावेरी (पुणे) में पक्षी भार, अंडों की संख्या एवं कुल आय के मामले में देसी किस्मों से बेहतर पाए गए। मछलियों के कैप्टिव पालन से फ्राइ स्तर से फिंगरलिंग स्तर तक के मछलियों के उत्पादन लागत में कमी आई। किसानों के भंडारण पद्धत्ति की तुलना में आईएमसी संवर्धन के भंडारण घनत्व की अधिकता के परिणामस्वरूप अधिक उत्पादन एवं कुल आय प्राप्त हुआ। मछली के तालाबों में जल गुणता प्रबंधन जैसेकि घुलनशील ऑक्सीजन, अमोनिया की मात्रा एवं मछली के तालाबों में pH एवं आवश्यकतानुसार सुधार उपायों को अपनाने से उत्पादन में 5.9 प्रतिशत की वृद्धि हुई।

क्षमता निर्माण

क्षेत्र-V के निक्रा के कृषि विज्ञान केंद्रों द्वारा 8862 किसानों की भागीदारी से 319 आवश्यकता आधारित प्रशिक्षण कार्यक्रमों का आयोजन किया गया। आंध्र प्रदेश के निक्रा गांवों के 4050 किसानों ने 130 प्रशिक्षण कार्यक्रमों में भाग लिया। तेलंगाना में 21 प्रशिक्षण कार्यक्रमों द्वारा 494 किसानों एवं 63 महिला किसानों को प्रशिक्षण प्रदान किया गया। जबकि महाराष्ट्र के निक्रा गांव के किसान 168 प्रशिक्षण कार्यक्रमों में 4255 किसानों ने सक्रिय रूप से भाग लिया। इन प्रशिक्षण कार्यक्रमों में प्राकृतिक संसाधन प्रबंधन, संसाधन संरक्षण प्रौद्योगिकियां, सस्ययन प्रणालियां, फसल विविधता, समेकित नाशीजीव एवं रोग प्रबंधन, मृदा स्वास्थ्य सुधार, जल बचत प्रौद्योगिकियां, फार्म उपकरण एवं यंत्र, पशु पालन प्रबंधन आदि विषय शामिल थे।

प्रसार गितिविधियां

संपर्ण क्षेत्र में 23152 किसानों की सक्रिय भागीदारी से 626 प्रसार गतिविधियों का आयोजन किया गया। इनमें से 221 गतिविधियों आंध्र प्रदेश में 6327 किसानों की भागीदारी से आयोजित किया गया। तेलंगाना में 1687 किसानों एवं 703 महिला किसानों की भागीदारी से 109 प्रसार गतिविधियों का आयोजन किया गया। महाराष्ट्र में 14435 किसानों की भागीदारी से करीब 296 प्रसार गतिविधियों का आयोजन किया गया।

1. INTRODUCTION

Climate is the primary determinant of agricultural productivity which directly impacts food production across the globe. Agricultural sector is the most sensitive sector to climate change because the climate of a region/country determines the nature and characteristics of vegetation and crops. Food security is both directly and indirectly linked with climate change. Any alteration in the climatic parameters such as temperature, humidity and rainfall which govern crop growth will have a direct impact on quantity of food produced. Increase in the mean seasonal temperature can reduce the duration of many crops and hence reduce final yield. Food production systems are extremely sensitive to climate changes like changes in temperature and precipitation, which may lead to outbreaks of pests and diseases thereby reducing harvest ultimately affecting the food security of the country. Indian agriculture too faces such challenges which have become all the more daunting due to extreme weather situations like droughts and incessant rains, frequency of which has been on a raise. The major impacts of climate change will be mainly on rainfed or un-irrigated crops, which are cultivated on nearly 60 percent of crop land. Farmers dependent on rainfed agriculture being less endowed in terms of financial, physical, human and social capital have limited capacity to adapt to the changing climate. Delayed onset of monsoon, mid-season and terminal droughts in rainfed areas are causing huge losses to agriculture and livestock production.

Coping with the impact of climate change on agriculture will require careful management of resources like soil, water and biodiversity. By incorporating various adaptation measures in agricultural systems, one can increase the resilience and adaptive capacity of the small land holders. To sustain the productivity of crops and allied enterprises in the context of increasing climatic vulnerabilities, climate resilient technologies that would increase production and productivity need to be evolved, assessed and demonstrated. Keeping this in view,National Innovations in Climate Resilient Agriculture (NICRA) is implemented as a network project of Indian Council of Agricultural Research (ICAR) and was 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

In order to deal with climatic change under technology demonstration component of NICRA, extensive demonstrations of location-specific best bet practices contributing to climate resilience were organized in 15 districts in Andhra Pradesh, Telangana and Maharashtra. The

project is implemented in these districts by respective Krishi Vigyan Kendra (KVK) located in the district.

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 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 regard 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 (PRA) in selected villages was organized to understand major farming systems, resource situation, socio-economic, institutional and infrastructural status.

6. The multidisciplinary team in each KVK analysed the constraints related to climatic variability and identified the points of intervention focusing largely on resource poor groups addressing resource conservation which gives 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 ownership of the programme.

The technological interventions were implemented in 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 villages namely Chamaluru, Chakrayapeta and Peravali**.** The village Chamaluru has the population of 2790 with 519 households. This cluster has 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. 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 of 180 with 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, pigeon pea 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 an annual rainfall of 498 mm. 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 constitutes dairy animals and poultry. Mortality and morbidity losses due to biotic and abiotic stress, fodder scarcity and poor access to live stock services are major livestock problems in this village.

Chittoor

The village selected for implementing NICRA Project activities is Chittecherla belonging to Chinnagottigallu Mandal. The major climatic vulnerability of the village is drought. The normal annual rainfall of the village is 774 mm. Agriculture in this area is mainly rainfed and main sources of irrigation are tanks and bore wells. There are 10 tanks and 16 small percolation tanks in Chittecherla gram panchayat. The major soil types are red loamy soils and red sandy soils. The main crops in the selected village are paddy, groundnut, tomato, pigeon pea , mango and vegetables.

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. Sorghum and pigeonpea are important crops grown in this village. The village on an average receives a rainfall of 633 mm annually. The major source of irrigation is bore wells. Most of the crops are affected by late onset of monsoon followed by dry spells during critical crop growth periods, which in turn is severely affecting the yield of these crops. Water scarcity, poor soil health, frequent droughts and losses due to pest and diseases are major climatic vulnerabilities faced by the farming community. The major livestock in this village are cattle (12), buffaloes (1154), sheep and goat (570). 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 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. The normal annual rainfall received in the district is 1162 mm. But, the rainfall distribution is quite erratic. Annampeta, Thimadam and Adduripeta villages in Burja mandal are selected for implementing the project activities during first year. 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 soil types are red sandy and red sandy loams with clay base. The mean annual rainfall received is about 982 mm. The major cropping systems in this village include 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 Jagannatha Naidu 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. 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 under 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 to the crop productivity in this village. The major livestock in this village are ruminants (1103). 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. 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 (Nacharam and Cluster villages; Gangulanacharam, colony nacharam, Ramatanda, Bhadrutanda, Muniya tanda and Bheemlatanda) situated in Enkoor mandal of Khammam district is selected for implementing the project activities. The village has 749 households with a population of 3246. The village receives an annual rainfall of 1054 mm with uneven distribution. Seasonal drought and heat waves are the major climatic vulnerability of this cluster. The total cultivated area is about 1382 ha. Paddy, cotton, chilli and sugarcane are the major crops grown in the project village. The major soil types are black and red soils. Major sources of irrigation include streams and bore wells. The major component of livestock constitutes white cattle-897, black cattle-928, sheep-913 and goat-1614.

Nalgonda

Nalgonda district falls under Southern Telangana region. The villages Nandyalagudem and Boring Thanda of Atmakoor (S) Mandal were selected for implementing 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 are the major soil types in this village. The average annual rainfall is 804 mm. 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. 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 quality 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 soils in the selected village are medium in nitrogen, low in phosphorus and high in potassium. The EC and pH of soil ranges between 1-2 and 8.3-9.0 respectively. The soils in the village have 1-3m depth and have low infiltration capacity. Hence water stagnation and soil erosion are major problems in the village. The soils are deficient in micro nutrients (Fe and Mn). The village has 859 cows, 454 goats, 6 buffaloes and 53 bullocks. Low rainfall, frequent droughts, and fodder scarcity during summer are major constraints that limit the living standards of farmers in this 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

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 rainfed. 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 production in live stock. Low seed replacement, poor access to improved seeds, farm machinery and livestock services are limiting the standards of living of the farmers.

Buldhana

Village Girda of District Buldhana was selected for implementing NICRA project activities. The village has the population of 940 with 230 total households. This village is having 1352.17 ha of geographical area and out of this 404.90 ha area is under cultivation. The village Girda receives an average rainfall of 853 mm from June to September. The village has black soils (light to medium). The area experiences frequent droughts and water scarcity. The village has 15 bore wells and 18 open wells. Predominant crops grown in this village are soybean in kharif season and chickpea in rabi. Live stock is an important component in the village. The village has 65 cows, 45 buffaloes, 200 goats, 23 pairs of bullocks and 320 poultry birds. The important livestock enterprises 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.

Jalna

Jalna is the most drought affected district in Marathwada region of Maharashtra. NICRA project is launched in Kadegaon village of Badnapur Tehsil in Jalna district. Total population of village is 3150 with 355 households. It has literacy rate of 84.50% for male and 70.50% for females. The village Kadegaon has total 876.61 hectares of cultivable area. The average rainfall of Kadegaon village is 703 mm. The soils are medium deep to shallow. Most of the crops are grown under rainfed situation with protective irrigation. Major source of irrigation is open wells and very few bore wells (Tube wells). It has more than 150 open wells. Only 22 ha area is under perennial irrigation and 350 ha under seasonal irrigation. The micro-irrigation system has 22 sprinkler sets and 75 drip irrigation systems. The major crops grown in project village are cotton, pigeon pea, maize, pearl millet and soybean in *kharif* season and sorghum, chick pea and wheat in rabi season. The major economy of the village depends on

cotton production. Rabi sorghum is a major food crop which also provides fodder to animals. Sweet orange is the pre-dominant horticultural crop with 21 ha of area. Limited area is under vegetables like chilli, ginger and cauliflower. The village is having 372 bullocks, 180 desi cows, 06 crossbred cows, 210 buffalos, 360 goats and 550 hens under livestock. The village has good market facilities.

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 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 and 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 814 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 major crops grown in the village are pearl millet, rabi sorghum, maize, onion and wheat. Drought is the major climatic vulnerability in this area. 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.

Ratnagiri

Ratnagiri district of Maharashtra is a high rainfall area with scarcity of water during winter months. 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. Mean annual rainfall of the village is 3375 mm. High rainfall with scarcity of water as a result of runoff is a major climatic vulnerability in this village. 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 horticultural crops in this village. Sheep, goat, and dairy are important livestock enterprises in this village. Farmers are mostly dependent on agriculture for their livelihood and very few are engaged in agro enterprises.

The Basic information regarding NICRA centers is given below (Table 1).

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

Selected District	Name of NICRA village/ villages	Actual rainfall (mm) 2016	Soil type	Major climatic vulnerability
Andhra Pradesh				
Anantapur	Chamaluru, Chakrayapeta and Peravali	328	Red soils	Drought
Chittoor	Chittecharla	553	Red soils	Drought
Kurnool	Yagantipalle	617	Black soils	Drought
Srikakulam	Sirusuwada	1426	Red sandy soils	Floods
West Godavari	Matsyapuri and Veeravasaram	963	Alluvial soils	Floods
Telangana				
Khammam	Nacharam	862	Black, red soils	Drought, Heat stress
Nalgonda	Nandyalagudem and Boring Thanda	960	Black soils	Drought, Heat stress
Maharashtra				
Ahmednagar	Nirmal Pimpri, Pimprilokai	395	Black soils	Drought
Amravati	Takali BK	950	Black soils	Drought
Aurangabad	Shekta	516	Black soils	Drought
Buldhana	Girda	713	Black soils	Drought
Jalna	Kadegoan	767	Medium black soils	Drought
Nandurbar	Umarani	740	Red & Black soils	Heat stress, drought
Pune	Jalgoan KP	497	Black soils	Drought
Ratnagiri	Haral	4079	Red & Lateritic soils	Floods

2.1 Rainfall pattern in different 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.

The NICRA centers located at Srikakulam of Andhra Pradesh, Nalgonda of Telangana, Amravati, Jalna and Ratnagiri districts of Maharashtra received excess rainfall compared to the normal during 2016. Whereas, the NICRA centers located at Anantapur, Kurnool and West Godavari of Andhra Pradesh, Khammam in Telangana and Ahmednagar, Aurangabad, Buldhana, Nandurbar and Pune districts of Maharshtra received deficit rainfall. The rainfall in the district of Srikakulam, Nalgonda, Amravati, Jalna and Ratnagiri deviated to the extent of 12.82, 19.40, 3.48, 9.10 and 17.25 percent respectively compared to the Normal rainfall (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 2016 (mm)	Excess/deficit rainfall (mm)	% deviation of rainfall from the normal i.e., $\frac{\text{Actual} - \text{Normal}}{\text{Normal}} \times 100$
Andhra Pradesh				
Anantapur	552	328	-224	-40.57
Chittoor	774	553	-221	-28.55
Kurnool	633	617	-16	-2.50
Srikakulam	1264	1426	162	12.82
West Godavari	1077	963	-114	-10.58
Telangana				
Khammam	1161	862	-299	-25.75
Nalgonda	804	960	156	19.40

Name of the centre	Normal annual rainfall (mm)	Rainfall during 2016 (mm)	Excess/deficit rainfall (mm)	% deviation of rainfall from the normal i.e., $\frac{\text{Actual – Normal}}{\text{Normal}} \times 100$
Maharashtra				
Ahmednagar	457	395	-62	-13.56
Amravati	918	950	32	3.48
Aurangabad	644	516	-128	-19.87
Buldhana	853	713	-140	-16.41
Jalna	703	767	64	9.10
Nandurbar	814	740	-74	-9.09
Pune	505	497	-8	-1.58
Ratnagiri	3375	4079	704	17.25

2.2 Rainfall distribution in different NICRA centers

The rainfall distribution in NICRA villages of Andhra Pradesh, Telangana and Maharashtra during the cropping season i.e during South-West monsoon season and North-East monsoon season is presented in Tables 3 & 4. Data regarding dry spells and continuous wet spells observed during the cropping season in various NICRA centers are given in Table 5.

Table 3: Rainfall distribution at different NICRA sites during South West monsoon season during 2016.

Centre	June			July			August			September			Total		
	Normal	Actual	Dev (%)	Normal	Actual	Dev (%)	Normal	Actual	Dev (%)	Normal	Actual	Dev (%)	Normal	Actual	Deviation
Andhra Pradesh															
Anantapur	64	109	**70.31**	67	43	**-35.82**	89	28	**-68.54**	118	38	**-67.80**	338	218	**-35.50**
Chittoor	81.2	139.8	**72.17**	98.4	152	**54.47**	114.3	59	**-48.38**	128.3	17.8	**-86.13**	422.2	368.6	**-12.70**
Kurnool	65	125.1	**92.46**	107	105.2	**-1.68**	115	101.6	**-11.65**	120	129.7	**8.08**	407	461.6	**13.42**
Srikakaulam	146	186	**27.40**	239	266	**11.30**	205	219.5	**7.07**	188	392.7	**108.88**	778	1064.2	**36.79**
West Godavari	115	318.6	**177.04**	265	118.6	**-55.25**	190	172.2	**-9.37**	178	205.4	**15.39**	748	814.8	**8.93**
Telangana															
Khammam	131	270.8	**106.72**	304	96.2	**-68.36**	300	158.6	**-47.13**	151	197	**30.46**	886	722.6	**-18.44**
Nalgonda	102.5	235.4	**129.66**	185.2	223	**20.41**	194.7	32	**-83.56**	151.1	365	**141.56**	633.5	855.4	**35.03**
Maharashtra															
Ahmednagar	95.4	49	**-48.64**	69.4	110	**58.50**	56.9	32	**-43.76**	133.1	143	**7.44**	354.8	334	**-5.86**
Amravati	146	119.2	**-18.36**	276.5	460.6	**66.58**	219.8	238.7	**8.60**	172.2	199.7	**15.97**	814.5	1018.2	**25.01**
Aurangabad	131.8	55.5	**-57.89**	101	199.5	**97.52**	133.3	125.5	**-5.85**	172.2	89	**-48.32**	538.3	469.5	**-12.78**
Buldhana	158.1	142	**-10.18**	202.6	264	**30.31**	211.8	114	**-46.18**	147.8	152	**2.84**	720.3	672	**-6.71**
Jalna	163.7	58	**-64.57**	202.3	415.9	**105.59**	144.2	101	**-29.96**	134.2	212	**57.97**	644.4	786.9	**22.11**
Nanadurbar	120.1	69	**-42.54**	256	158	**-38.28**	198	264	**33.33**	187.6	200	**6.61**	761.7	622	**-18.34**
Pune	78.5	79	**0.64**	56.7	72	**26.98**	67.4	59	**-12.46**	150.1	262	**74.55**	352.7	472	**33.82**
Ratnagiri	817.9	723.2	**-11.58**	1239.8	1664.6	**34.26**	829	974.5	**17.55**	359.7	603.8	**67.86**	3246.4	3966.1	**22.17**

Green	Normal Rainfall (-19 to +19%)
Red	Deficit Rainfall (>-19 to <-60%)
Blue	Excess rainfall (+19%)
Yellow	Scanty Rainfall (>-60)

Table 4: Rainfall distribution at different NICRA sites during North East monsoon season during 2016.

Centre	October			November			December			Total		
	Normal	Actual	Dev (%)	Normal	Actual	Dev (%)	Normal	Actual	Dev (%)	Normal	Actual	Dev (%)
Andhra Pradesh												
Anantapur	111	0	-100.00	35	0	-100.00	10	0	-100.00	156	0	-100.00
Chittoor	116.2	0	-100.00	120.9	2.2	-98.18	52.5	182.6	247.81	289.6	184.8	-36.19
Kurnool	117	18.8	-83.93	26	0	-100.00	8	0	-100.00	151	18.8	-87.55
Srikakaulam	177	198.6	12.20	60	0	-100.00	1	0	-100.00	238	198.6	-16.55
West Godavari	190	10	-94.74	65	0	-100.00	15	4	-73.33	270	14	-94.81
Telangana												
Khammam	114	98.2	-13.86	25	0	-100.00	3	0	-100.00	142	98.2	-30.85
Nalgonda	114.1	16	-85.98	33.9	0	-100.00	3.5	0	-100.00	151.5	16	-89.44
Maharashtra												
Ahmednagar	58.1	61	4.99	9.1	0	-100.00	5.3	0	-100.00	72.5	61	-15.86
Amravati	46.4	51.6	11.21	20.5	0	-100.00	8.6	0	-100.00	75.5	51.6	-31.66
Aurangabad	69	46.5	-32.61	22.8	0	-100.00	11.1	0	-100.00	102.9	46.5	-54.81
Buldhana	49.8	41	-17.67	24.3	0	-100.00	11.1	0	-100.00	85.2	0	-100.00
Jalna	40.4	10	-75.25	18.1	0	-100.00	0	0	-100.00	58.5	10	-82.91
Nanadurbar	51.8	49	-5.41	0	0	-100.00	0	0	-100.00	51.8	49	-5.41
Pune	72.2	24.2	-66.48	32.1	0	-100.00	5.3	0	-100.00	109.6	24.2	-77.92
Ratnagiri	128.4	105.4	-17.91	0	0	-100.00	0	0	-100.00	128.4	105.4	-17.91

Green	Normal Rainfall (-19 to +19%)
Red	Deficit Rainfall (>-19 to <-60%)
Blue	Excess rainfall (+19%)
Yellow	Scanty Rainfall (>-60)

Table 5: Dry spells and continuous wet spells observed in NICRA centers during 2016

Centre	Rainfall during cropping season (mm)	Dry spells (more than 10-20 days)	Continuous wet spells (more than 100 mm)
Andhra Pradesh			
Anantapur	218	28th June- 25th July (29 days), 1st- 11th September (11 days), October (31 days)	No wet spells were observed.
Chittoor	369	10th -19th June (10 days), July 1st -15th (15 days), 1st-29th August (29 days), 4th-7th September	No wet spells were observed.
Kurnool	462	1st-16th July (16 days), July 18th- 9th September (15 days), 10th -31st October (22 days)	No wet spells were observed.
Srikakaulam	1064	5th-17th June (13 days), 10th-31st October (22 days)	27th-30th June (122.8 mm), 19th-27th September (198.4 mm)
West Godavari	815	12th -23rd August (12 days), 11th-30th October (21 days)	23rd-30th June (144.6 mm), 24th 26th August (109 mm)
Telangana			
Khammam	723	8th-22nd August (15 days), 11th -29th October (19 days)	21st-28th September (110.8 mm)
Nalgonda	855	1st-25th August (25 days), 9th-31st October (23 days)	27th-30th June (112.9 mm), 17th-23rd July (131.6 mm)

Centre	Rainfall during cropping season (mm)	Dry spells (more than 10-20 days)	Continuous wet spells (more than 100 mm)
Maharashtra			
Ahmednagar	334	1st-18th June (18 days), 13th-22nd July (10 days), 3rd August -14th September (42 days)	No wet spells were observed
Amravati	1018	3rd-13th September (11 days), 7th-31st October (25 days)	19th-27th July (171.4 mm), 1st-9th July (181.4 mm)
Aurangabad	470	1st-19th June (19 days), 13th-25th July (13 days), 6th August-14th September (40 days), 9th-31st October (23 days)	No wet spells were observed
Buldhana	672	7th-9th June (130days), 3rd-15th September (13 days), 10th-31st October (22 days)	8th-13th July (126 mm)
Jalna	787	1st-19th June (19 days), 12th-21st July (10 days), 3rd-27th August (25 days), 3rd-14th September (12 days), 4th-31st October (28 days)	22-27th July (250.9 mm)
Nanadurbar	622	1st-21st June (21 days), 8th-26th October (19 days)	6th-12th August (105 mm), 16th-20th September (122 mm)
Pune	472	21st-30th June (10 days), 3rd-27th August (23 days), 1st-12th September (12 days), 9th-31st October (23 days)	22nd-26th September (172 mm)
Ratnagiri	3966	13th-31st October (19 days)	9th June – 4th September (3404.3 mm), 12th-27th September (523.6 mm)

3. Natural Resource Management

3.1 Ex-situ water harvesting and efficient use

Chittoor

Desilting of village tank

The irrigation tank (Rayavarapukunta) situated near NICRA village (Chittecharla) was renovated under NRM activity. The unwanted vegetation in the tank was removed and the bund of the tank was strengthened by using the silt removed from the tank. The capacity of the tank before desilting was 2532 m^3 and it was increased up to 3280 m^3 after renovation. Bore wells in the vicinity of the tank were recharged and the farmers have taken up paddy and tomato crops.

Desilting of village tank, Rayavarapukunta

Renovation of Errakunta and strengthening of bund

KVK also undertook renovation work in Errakunta in which unwanted vegetation was removed and bund was strengthened with silt removed from the tank. The capacity of the tank which was 3.59 lakh liters earlier, was increased up to 9.24 lakh liters after renovation. Farmers have taken up paddy, tomato and fodder crops under the tank and bore wells located in the vicinity were recharged.

Desilting and strengthening of bund of Errakunta

Srikakulam

Renovation of Jagannadha Naidu Tank

Renovation of Jagannadha Naidu tank was initiated during the year 2011-12 to improve its storage capacity, repair the weakened sluices and bunds which would prevent water over flow and damage to the crops during heavy rains in tank fed areas. The water collected in the tank was utilized to overcome water scarcity at early and later stages of the crop during kharif. The impact of renovation of the tank is presented in Table 6, 7, 8 and 9.

Table 6. Impact of renovation of Jagannadha Naidu tank on Kharif paddy

Particulars	Before renovation	After renovation		
		2013-14	2014-15	2015-16
Area (ha)	120	130	130	130
Yield (q)	48	53.50	51.83	55.85
% Yield improvement after renovation	---	11.45	7.97	16.35
Cost of cultivation	28500	30910	38750	34438
Gross Returns	48000	53500	66410	78906
Net Returns	19500	22590	27660	44468
B:C Ratio	1.68	1.73	1.71	2.29
Total income from total area	2340000	3388500	4149000	6670200

Table 7: Impact of renovation of Jagannadha Naidu tank on Rabi crops

Crop	Before renovation	After renovation					
	Area (ha)	Area (ha)	Cost of cultivation (Rs./ha)	Yield (q/ha)	Price (Rs./q)	Gross income (Rs./ha)	Net income (Rs./ha)
Maize	1	8	31250	67.5	1400	94500	63250
Greengram	3	10	12500	5.5	6000	33000	20500
Blackgram	3	5	13000	4.0	7500	30000	17000
Chick pea		4	18750	12.5	4000	50000	31250
Sesamum	3	4	9000	5.0	8500	42500	33500
Vegetables	2	7.5	45000	150.0	800	120000	75000
Total	**12**	**38.5**	**129500**	**244.5**	**28200**	**370000**	**240500**

Table 8.Impact of renovation of Jagannadhanaidu tank on fisheries

S.No.	Particulars	Before	After	Impact
1	Area under fish culture (ha)	10	10	Though area remained the same water depth increased due to desilting.
2	Culture period	Up to January	Up to March	Culture period increased by 2 months
3	Cost of cultivation	Rs.170000	Rs. 182500	Cost of cultivation increased by Rs.12500
4	Fish production (kg/ha)	7.38 tonnes @ 738	9.0 tonnes @ 900	Fish production increased by 1.62 tonnes/ ha.
5	Gross returns	442800 (Rs. 60/kg)	630000 (Rs. 70/kg)	Gross returns increased by Rs. 187200
6	Net Returns	272800	447500	Net income increased by Rs.174700 after the intervention

By extending culture period by two months the average weight of the harvested fish increased resulting in yield increase by 162 kg/ha and enhanced price by Rs.10/- per kg.

Table 9: Impact of renovation of Jagannadhanaidu tank on flood mitigation

Season	Impact parameter	2011-12 & 2012-13	2013-14 & 2014-15	2015-2016	2016-17
Kharif (June to Oct)	Rain fall	1287.6 mm (57) & 1134.1 mm (78)	1613.4 mm (51) & 1337.5 (77)	806.2 mm (33).	1262.8 mm(60)
	Reduced flood intensity	Due to low tank capacity weakened sluices and bunds water had flown over the crops during rains in tank fed areas affecting the crop yields.	Flood intensity reduced at the time of heavy rains in 20 ha of tank fed area. Due to improvement of storage capacity of the tank strengthening of bunds and also because sluices repairs flood intensity was reduced in the tank fed area when compared to previous years.	Due to improvement of storage capacity of the tank strengthening of bunds and also because of sluice repairs flood intensity was reduced in the tank fed area.	Due to improvement of storage capacity of the tank strengthening of bunds and also because of sluice repairs flood intensity was reduced in the tank fed area.
	Water storage	55531m^3	138575 m^3 (25 acres in 4.5 feet depth).	138575 m^3 (25 acres in 4.5 feet depth) upto October first fort night. Later 47500 m3 due to dry spell. The water stored in the Jagannadha naidu tank is being utilized to give life saving irrigation to standing paddy crop thus the volume of storage water has got reduced.	182880 m^3 (25 acres in 6 feet depth) up to end of October. Due to the desilting operation taken through the programme "Neeru-Chettu"organized by Govt. of A.P the storage capacity of this tank was increased.
	Area covered in kharif	120ha	150ha	150 ha	150 ha

Digging of drainage channel

Due to water stagnation and improper drainage in flood prone area, most of the paddy crop was damaged. To minimize the period of water stagnation in flood prone area and for letting off the excess rain water stagnated through the drainage, digging of drainage channel was taken up.

Aurangabad

Desilting of Nala and construction of cement plug

To improve the productivity of rainfed crops through supplemental irrigation, desilting of nala (500 m x 10 m width x 3 m depth: Storage capacity= 5 TMC) and construction of cement plug was taken up. This resulted in increase in ground water table by 21 feet which helped in giving protective irrigation to 42 ha area in kharif covering Bt cotton, soybean, green gram, black gram, pomegranate and sweet orange crops with increased yield up to 22%. Moreover two protective irrigations in rabi season to bengal gram and wheat resulted in 14% higher yield over the rainfed cultivation (Table 10, 11 and 12).

Table 10: Impact of Desilting of nala on water level of open well

Month	Water level of well before monsoon (from bottom) in feet	Water level of well after monsoon (from bottom) in feet	Rainfall (mm)
June	08	41	131.8
July	10	30	101.0
August	06	22	133.3
September	11	35	172.2
October	09	36	69.0

Table 11: Water table depth in artificial well recharge in NICRA Village

Type of well	Total depth of well (feet)	Depth of water from bottom (feet)				
		131.8mm	101.0mm	133.3mm	172.2mm	69.0 mm
		June	July	August	Sept	Oct
1. Open well	70	28	29	32	38	33
2. Open well	65	36	38	40	42	35
3. Open well	60	20	25	29	30	26
4. Open well	55	30	32	35	32	27
5. Open well	50	24	30	34	34	24

Pune

De silting of water stream at NICRA village

In order to increase the water harvesting capacity of the check dam and for ground water recharge, desilting of water stream was done benefiting 126 farmers. The farmers in the vicinity have sown sorghum, gram and wheat and they could give 1-2 protective irrigations by utilizing the harvested rain water. Water level of wells in the vicinity increased by 4.5 feet after desilting.

3.2 In-situ moisture conservation technologies

Andhra Pradesh

Anantapur

The NICRA village experiences uncertainty in productivity due to recurrent intermittent drought or erratic rainfall**.** The soils are slopy (2-4%) and shallow in depth (10-15 cm) with low water holding capacity. Sub soiling was practiced in groundnut to conserve soil moisture and for improving the productivity. This practice helps in better exploitation of stored soil moisture and applied nutrients from the soil profile.

Conservation furrows in groundnut

The practice of sub-soiling resulted in 16.07% higher yield compared to farmers practice with additional net returns of Rs.3738/ha. In-situ moisture conservation through adaption of conservation furrows at an interval of 3.6 m was taken up in an area of 20 ha covering 12 farmers. An additional yield of 72 kg/ha was recorded with conservation furrows than the farmers practice (Table 12).

Chittoor

Mulching is an effective method of manipulating crop growing environment to increase yield and improve product quality by controlling weed growth, ameliorating soil temperature, conserving soil moisture, reducing soil erosion, improving soil structure and enhancing organic matter content. Plastic mulching in tomato resulted in higher yield of 75.87 t/ha whereas farmers practice (no mulching) resulted in 63.58 t/ha. Use of plastic mulching reduced weed growth at critical stages of crop growth and also helped in moisture conservation. Number of irrigations required under farmers practice were 27 whereas it was only 17 in the demonstration. Number of irrigations was reduced in plastic mulching due to availability of soil moisture for a longer period (Table 12).

Plastic mulching in mango also recorded an additional yield of 15.30 t/ha. Mulching helped in prevention of evaporation losses from the soil and weed growth and improved yield as the water was readily available at the root zone. The returns obtained in plastic mulching were Rs.65420/ha, whereas the returns obtained in the farmers practice were Rs.53060/ha (Table 12).

Plastic mulching in tomato for moisture conservation

Kurnool

In-situ conservation practices through sub soiling in pigeonpea (ICPL-87119) were taken up in NICRA village of Kurnool district. Sub soiling gave additional yield (147 kg/ha) which was 15% higher than the farmers practice in medium black soils. In-situ moisture conservation measures by formation of conservation furrows between rows of pigeonpea during kharif in an area of 6 ha covering15 farmers at NICRA village of Kurnool district recorded 17% increase in yield over the farmers practice (Table 12).

Sub-soiling in pigeonpea

Srikakulam

Demonstration of brinjal on ridges and furrows was taken up in 2 ha area covering 10 farmers at Sirusuwada of Srikakulam district. Ridges and furrows in brinjal yielded higher yield and income of 53.7% and Rs.50000/ha respectively.

Nalgonda

Conservation furrows in cotton yielded 257 kg/ha higher yield over farmers practice of no conservation furrows with additional net income of Rs.1058/ha and BC ratio of 2.80.In-situ moisture conservation in pigeonpea through conservation furrows in an area of 12 ha covering 12 farmers was taken up in NICRA village of Nalgonda district. This practice resulted in higher net returns of Rs.5563/ha over farmers practice with a benefit cost ratio of 2.73 (Table 12).

Conservation furrows in cotton

Amravati

In-situ conservation measures i.e., sowing across the slope in soybean and ridges and furrows in cotton resulted in increased yields of 250, 149 kg/ha with higher net returns of Rs. 8325 and 14205/ha respectively.

Aurangabad

Opening of conservation furrows in cotton and pigeonpea in an area of 20 ha covering 50 farmers enhanced the productivity by 149 kg/ha and 270 kg/ha compared to farmers practice with additional net returns of Rs.8221, 19482/ha respectively. This practice helped in obtaining sustainable yields in pigeon pea by moisture conservation in rainfed areas (Table 12).

Buldhana

Opening of conservation furrows in soybean in an area of 1.2 ha covering 3 farmers resulted in an additional yield of 267 kg/ha and additional net income of Rs.10511/ha over the farmers practice. Broad bed furrow system followed in chickpea resulted in increased net income of Rs. 9512/ha compared to the farmers practice without any conservation measures with a benefit cost ratio of 3.42.

Jalna

Broad bed furrow method of sowing in soybean in an area of 4 ha covering 10 farmers resulted in improved yield of 210 kg/ha than the farmers practice without BBF. Similarly conservation furrows in cotton recorded Rs.8010/ha higher net income compared to no conservation furrows.

Nandurbar

Ridge and furrow planting in maize resulted in 412 kg/ha higher yield over no conservation measures with a benefit cost ratio of 2.94.

Pune

Compartmental bunding in *rabi* sorghum in an area of 22.5 ha covering 45 ha area resulted in 365 kg/ha increased yield in *rabi* sorghum. Plastic mulching in watermelon resulted in higher yield advantage of 41.12% over farmers practice with higher net returns of Rs.10320/ha (Table 12).

Ridges and furrows in maize (Nandurbar)

Conservation furrows in cotton (Aurangabad)

3.3 Micro Irrigation Systems

Micro irrigation in cotton enhanced the cotton productivity by 115.38 % over rain fed cotton cultivation with higher net returns of Rs. 97120/ha over farmers practice at Amravati district of Maharashtra. Fertigation in pigeonpea in 2 ha covering 5 farmers resulted in an yield advantage of 2360 Rs/ha compared to conventional method of irrigation. Drip irrigation in cashew resulted in an yield advantage of 705 kg/ha over farmers practice of flood irrigation associated with reduction in number of irrigations (Table 13).

Table 12: Effect of *in-situ* moisture conservation practices on productivity and profitability of different crops

KVK	Crop	Intervention	No. of demon-strations	Area (ha)	Yield (kg/ha)	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	BC ratio
Anantapur	Groundnut	No conservation furrows	12	20.0	361	20618	22689	-2071	0.90
		Conservation furrows in groundnut			433	28498	27127	1371	1.05
Anantapur	Groundnut	Sub-soiling with chisel plough	8	12.0	523	38394	31577	6817	1.27
		No sub-soiling			607	46870	36315	10555	1.41
Chittoor	Groundnut	No conservation furrows	20	12.0	361	24760	22689	-2071	0.91
		Conservation furrows in groundnut			433	25760	27127	1317	1.05
Chittoor	Tomato	Without mulch	5	1.0	63580	233844	370666	136822	1.37
		Plastic mulching in tomato			75870	327156	442322	115166	1.45
Chittoor	Mango	Without mulch	5	1.0	7430	36100	89160	53060	1.47
		Plastic mulching in mango			8960	42100	107520	65420	1.56
Kurnool	Pigeonpea	No conservation furrows	15	6.0	810	19720	40500	20780	2.05
		Conservation furrows in pigeonpea			1045	20020	52300	32280	2.63
Kurnool	Pigeonpea	No conservation measures	15	6.0	977	19720	48850	29153	2.48
		sub soiling with subsoiler			1124	20970	56200	35278	2.68

KVK	Crop	Intervention	No. of demon-strations	Area (ha)	Yield (kg/ha)	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	BC ratio
Srikakulam	Maize	Zero tillage maize	15	8.0	6995	136084	87437	48647	2.26
		Farmers practice			7350	150000	91875	58125	2.72
Srikakulam	brinjal	Ridge and furrows in brinjal	10	2.0	22350	203200	134100	69100	2.10
		No conservation measures			34350	325200	206100	119100	2.40
Nalgonda	Cotton	No conservation furrows	12	12.0	2725	51875	141808	89933	2.73
		Conservation furrows in cotton			2468	49500	139072	78875	2.80
Nalgonda	Pigeonpea	No conservation furrows	8	5.0	13.96	25406	65603	40196	2.58
		Conservation furrows in pigeonpea			14.98	26343	72103	45759	2.73
Ahmednagar	Rabi sorghum	No conservation furrows	10	4.0	1650	24725	42900	18175	1.74
		Broad bed furrow sowing in soybean			1707	24765	44362	19598	1.79
Amravati	Soybean	No conservation measures	25	15.0	2050	27375	56050	32675	2.04
		Sowing across the slopes			2450	32500	73500	41000	2.26
Amravati	Cotton	No conservation measures	35	14.0	2250	58275	101250	42975	1.73
		Sowing on ridge and furrows			2500	62320	119500	57180	1.91
Aurangabad	Cotton	No conservation measures	50	20.0	1480	26879	85840	58961	3.19
		Opening of furrows in Bt cotton			1629	27300	94482	67182	3.46
Aurangabad	Pigeonpea	No conservation measures	50	20.0	1644	22384	83022	60638	3.71
		Opening of furrows in pigeonpea			2079	24900	104990	80090	4.22
Aurangabad	Soybean	Flat bed method of sowing	10	4.0	2647	29740	65910	36170	2.30
		Broad bed furrow method of sowing			2965	28922	73829	44907	2.50

KVK	Crop	Intervention	No. of demon-strations	Area (ha)	Yield (kg/ha)	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	BC ratio
Buldhana	Soybean	No conservation measures	3	1.2	1809	27377	67058	39681	2.43
		Opening of furrows in soybean			2076	29683	79875	50192	2.70
Buldhana	chickpea	No conservation measures	5	2.0	1680	22713	73852	51139	3.25
		Broad bed furrow method of sowing			2052	24996	85446	60651	3.42
Jalna	Cotton	No conservation measures	20	8.0	1142	46460	57100	10640	1.23
		Conservation furrows			1320	47350	66000	18650	1.39
Jalna	Soybean	No conservation measures	10	4.0	1375	26925	36438	9513	1.35
		Broad bed furrow method of sowing			1585	27755	42002	14251	1.51
Nandurbar	Maize	No conservation measures	13	5.2	2650	16250	45125	28875	2.78
		Ridge and furrows in maize			3062	17100	50275	33175	2.94
Pune	Greengram	Flat bed method of sowing	10	4.0	680	18210	15600	28560	1.83
		Broad bed Furrow method of sowing			815	17180	17050	34230	2.00
Pune	Rabi sorghum	No conservation measures	45	22.5	1231	20650	38860	18210	1.88
		compartmental bunding			1596	21350	50540	29190	2.36
Pune	Watermelon	Plastic mulching in watermelon	10	4.0	856	35400	68480	33080	1.93
		No mulching			1208	41200	96640	55440	2.34
Ratnagiri	Watermelon	Polyethylene mulching in water melon	4	5.0	9450	70000	113400	43400	1.62
		No mulching			15400	80200	184800	104600	2.30

3.4 Water harvesting and recycling through supplemental irrigation

Chittoor

Supplemental irrigation in groundnut using sprinklers resulted in higher productivity of 795 kg/ha compared to the rainfed crop with higher net returns of Rs.31870/ha at Chittoor district of Andhra Pradesh. Rain gun technology was demonstrated in 2 ha to provide supplemental irrigation to groundnut crop during dry spell. Farmers recorded an average pod yield of 1385 kg/ha in the demonstration. Whereas in the farmers practice it was 825 kg per ha. Higher yield in the demonstration was due to provision of irrigation at critical stages of groundnut crop growth (Table 14).

Raingun technology

Khammam

Supplemental irrigation in cotton at NICRA village of Khammam covering 3.2 ha area in 4 farmers fields recorded 522 kg/ha yield advantage over farmers practice with higher net returns of Rs.19079/ha (Table 14).

Aurangabad

Water harvesting and recycling of rainwater in Bt cotton through farm ponds and irrigation at critical stages of crop growth resulted in higher yield of 925 kg/ha with a benefit cost ratio of 4.26 (Table 14).

3.5 Soil Quality and fertility Management

Anantapur

Tank silt application in groundnut was demonstrated in Anantapur district as a measure to improve soil quality. In the demonstration plot applied with tank silt, highest pod yield (615 kg/ha) was recorded, where as in farmers practice, lowest pod yield (430 kg/ha) was recorded. Highest net returns (Rs.4265/ha) were recorded with tank silt applied plot compared

to farmers practice (Rs.1360/ha). This is due to increase in moisture holding capacity and nutrient availability to plants (Table 15).

Tank silt application

Soil test based fertilizer application in groundnut was demonstrated in 6 ha area covering 15 farmers resulting in an increase in net income of Rs.3039/ha.

Sheep penning is one of the traditional methods of enhancing soil fertility. Sheep penning in groundnut resulted in improved productivity of 105 kg/ha over no sheep penning with a benefit cost ratio of 1.22 (Table 15).

Chittoor

Green manuring with sunhemp in 16 ha area covering 40 farmers was demonstrated as a remedy to high weed infestation, loss of nutrients and soil due to soil erosion in mango orchards. Sunhemp seed was supplied to all the farmers and the same was sown in the orchards. The crop was trampled in the field itself at the time of flowering. *In-situ* green manuring adds organic matter to the soil there by increased nutrient levels. The practice resulted in higher yield of 7570 kg/ha in the demonstration compared to farmers practice (6580 kg per ha).

Green manuring with sunhemp in mango

Khammam

Green manuring in paddy with Dhaincha was practiced for the reclamation of problematic soils in an area of 30 ha covering 50 farmers. The Nitrogen fertilizer application was reduced by 20-25% with green manuring with an additional net income of Rs.5670/ha.

Incorporation of Green manure

Nalgonda

Soil test based nutrient application in cotton was demonstrated to avoid imbalanced use of fertilizers by farmers in 40 farmers fields covering an area of 10 ha. By soil test based fertilizer application the cost of fertilizer was reduced by Rs.1171/ha with an additional yield advantage of 85 kg/ha over the farmers practice.

Ahmednagar

Bio organic slurry was prepared by adding 100 liters of water + 15 liters cow urine + 30 kg cow dung + 1kg Azatobacter + 1kg PSB + 1kg *Trichoderma* + 1kg *Paecelomyces* and stirring daily. The mixture was fermented for 15 days. At the time of usage 100 liters of water was added to the mixture. Bio organic slurry was applied at a rate of 1 l /plant near root zone for four months at an interval of one month after flower initiation. Bio organic slurry helped in improving soil water holding capacity and organic carbon content besides improving soil physical, chemical and biological properties. Application of bio organic slurry resulted in improved yield of 840 kg/ha and net income of Rs.63950/ha (Table 15).

Application of bio organic slurry

Aurangabad

Recycling of organic matter through vermicompost preparation and its application for improving soil fertility was demonstrated in an area of 4 ha covering 10 farmers with 26% increase in net income with a benefit cost ratio of 3.33 (Table 15).

Jalna

Organic mulching in sweet orange with pearl millet, wheat straw and sorghum stalks to minimize evaporation and to develop micro climate favourable for increased production of fruits was demonstrated in NICRA village. Thus fruit production obtained was about 15700 kg/ha in demonstration against 12800 kg in farmers practice. Higher net income of Rs.39540/ha was obtained with a higher B:C Ratio of 7.32 (Table 15).

Vermicompost preparation in mobile vermin bed at Aurangabad

Table 13: Enhanced water use efficiency through micro irrigation systems in NICRA villages

KVK	Intervention	No.of demon-strations	Area (ha)	Yield (kg/ha)	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	BC ratio
Amravati	Drip Irrigation in cotton	20	20	1950	51500	93600	42100	1.81
	Rainfed cotton			4200	70780	210000	139220	2.96
Jalna	Conventional irrigation	05	2	1050	29125	45150	16025	1.55
	Fertigation in redgram			3410	51625	146630	95005	2.84
Ratnagiri	Flood irrigation	01	2	805	60500	112700	52200	0.86
	drip irrigation in cashew			1510	95000	211400	116400	1.23

Table 14: Enhanced performance of crops provided with supplemental irrigation using harvested water

KVK	Intervention	No. of demon-strations	Area (ha)	Yield (kg/ha)	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	BC ratio
Anantapur	Rainfed cultivation	7 ponds	-	800	70580	47680	22900	1.92
	Supplemental irrigation through farm pond in groundnut			1300	128360	76960	51400	3.01
Chittoor	No supplemental irrigation	15	6.0	750	29125	33750	4625	1.16
	Supplemental irrigation in groundnut using sprinklers			1620	36495	77900	36495	1.88
Chittoor	Rain fed farming	05	2.0	825	30220	37125	6905	1.23
	Supplemental irrigation using rain gun in groundnut			1385	37670	62325	24655	1.65
Khammam	Farmers practice	04	3.2	1880	51228	90240	39012	1.76
	Supplemental Irrigation in cotton			2402	57229	115320	58091	2.01
Khammam	Tank fed	05	2.0	1880	53143	81290	28146.8	1.52
	Supplemental Irrigation in paddy			2402	54913	89175	34262.5	1.62
Khammam	Tank fed	05	2.0	1880	33750	52500	18750	1.55
	Supplemental Irrigation in fodder grass			2402	34510	64000	29490	1.85
Aurangabad	Without supplemental irrigation	07	2.8	1825	35489	105850	70361	2.98
	Supplemental irrigation through farmpond water in Bt cotton			2750	37456	159500	122044	4.26
Amravati	Without supplemental irrigation	20	20	1950	51500	93600	42100	1.81
	Supplemental irrigation to cotton			4200	70780	210000	139220	2.96

Table 15: Soil quality and fertility management in different NICRA centers

KVK	Intervention	No. of demon-strations	Area (ha)	Yield (kg/ha)	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	BC ratio
Anantapur	No STBF application	15	6	430	27000	25880	1120	1.04
	STBF application in groundnut			445	30934	26775	4159	1.18
Anantapur	Without green manuring	5	1	6667	52381	114291	61791	2.20
	Green manuring with dhaincha			7228	52500	123806	71306	2.40
Anantapur	Sheep penning in groundnut	5	10	425	26498	25629	869	1.03
	No Sheep Penning			530	37840	32050	5790	1.22
Anantapur	No tank silt application in groundnut	4	4	430	24760	26120	1360	1.05
	Tank silt application			615	32260	36525	4265	1.13
Chittoor	Without green manuring	40	16	6580	24375	210560	186185	5.04
	Green manuring in mango			7570	36875	242240	205365	5.57
Khammam	Without green manuring	50	30	6250	51210	90625	39415	1.76
	Green manuring with dhaincha			6299	48337	91336	42999	1.88
Nalgonda	No STBF	40	10	2535	51493	131820	80309	2.55
	STFA in groundnut			2620	50322	136305	85982	2.70
Nalgonda	Tank silt application	10	4	2828	74012	143531	69518	1.93
	No tank silt application			2582	50962	131165	80203	2.57
Ahmednagr	Without bio organic slurry	50	20	14080	456542	972692	516150	2.13
	Use of bio organic slurry			14920	449692	1029792	580100	2.29

4. Crop Production

4.1 Climate Resilient crop cultivars

Flood tolerant varieties

Srikakulam

Paddy crop in some low lying areas of the district is often subject to floods resulting in inundation and submergence of the crop at different growth stages. Farmers are leaving the land fallow without raising any crop in high inundation areas. In order to mitigate the situation, flood tolerant varieties were tested for their suitability since 2012-13.

Table 16: Performance of flood tolerant varieties in NICRA village

Comparison of Treatments	Crop	Variety	Yield (kg/ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	Benefit cost ratio
Improved Practice	Paddy	RGL-2537	5806	77857	40103	2.06
	Paddy	PLA-1100	6095	81734	43984	2.17
	Paddy	MTU-1061	6158	82583	44833	2.19
	Paddy	MTU-1064	6058	81237	43488	2.15
Farmers practice	Paddy	MTU-1001	5297	71032	33282	1.88
	Paddy	MTU-1075	6950	93205	55455	2.47
	Paddy	MTU-7029	6153	82511	44761	2.19

The performance of flood tolerant varieties RGL-2537 (58.06q/ha), PLA-1100 (60.95q/ha), MTU-1061 (61.58q/ha) and MTU-1064 (60.58q/ha) is on par with non-tolerant varieties viz., MTU-1001 (52.97q/ha), MTU-7029 (61.53q/ha) except for MTU-1075 (69.50q/ha), due to non occurrence of floods during the crop season (Table 16).

Table 17: Up scaling of flood tolerant paddy varieties in NICRA village

S.No.	Variety	Area (ha)	No. of farmers
1	RGL-2537	33.2	52
2	PLA-1100	0.4	1
3	MTU-1061	12.6	11
4	MTU-1064	3.2	3
	Total	**49.4**	**67**

Table 18: Up scaling of flood tolerant paddy varieties in surrounding villages

S.No.	Name of the village	Area (ha)	No. of farmers
1	Kondavalasa	5.4	1
2	Gedda kancharam	2	4
3	Singivalasa	0.8	1
4	Chintalapeta	1.2	1
5	Navanambadu	0.8	1
6	Honjaram	0.4	1
7	Batteru	2	1
8	Gedelavanipeta	1.2	3
9	Borrampeta	1.2	3
10	Ragolu	0.2	1
11	Avatarabad	0.8	2
12	Bituwada	0.4	1
13	Ramayyaputtuga	0.2	1
14	Marripadu	0.2	1
15	Gollapeta	0.6	1
	Total	**17.4**	**23**

Table 19: Seed supplied through department of agriculture covering 2877 ha area

S.No.	Name of the variety	Seed in (Q) 2016-17	Extent (ha) of spread 2016-17	Area(ha) before NICRA 2011-12	Increase in area (ha)
1	MTU-1061	971	1294	22	1272
2	RGL-2537	650	866	475	391
3	MTU-1064	538	717	0	717
	Total	**2065**	**2877**	**552**	**2325**

West Godavari

Flood tolerant verities MTU-1061 and MTU-1064 recorded higher yield of 941 and 1316 kg/ha respectively over the farmers variety MTU-7029 with additional net returns of Rs.25550/ha and Rs. 21127/ha respectively (Table 16).

Table 20: Performance of flood tolerant varieties during 2016-17

Treatments	Yield (kg/ha)	Cost of cultivation (Rs/ha)	Gross income (Rs/ha)	Net income (Rs/ha)	B:C ratio
MTU-7029	5247	45357	66857	21500	1.47
MTU-1061	6563	43950	91000	47050	1.93
MTU-1064	6188	41458	84150	42692	1.97

Upscaling of Technology

In 2011 MTU-7029 is the major variety covering 95% of the acreage. However with consistent efforts from NICRA, the area occupied by flood tolerant varieties increased to considerable level replacing MTU-7029 (Swarna). In the entire West Godavari district area under MTU-7029 came down by 24%.

Drought tolerant varieties

Anantapur

Climate resilient varieties of groundnut (Dharani), Foxtail millet (SIA-3085) and paddy (Sheetal) were demonstrated in the NICRA village. Resilient variety Dharani of groundnut recorded 47 kg/ha higher yield compared to traditional K-6 variety. SIA-3085 of foxtail millet gave Rs.1618/ha of net returns over farmers variety Krishnadevaraya. Cold, blast and BPH tolerant variety of paddy, Sheetal recorded additional yield advantage of 778 kg/ha with higher net income of Rs.15502 over farmers variety (MTU-1010) (Table 21).

Kurnool

Climate resilient varieties of pulses LRG-41 (Pigeonpea), NBeG-3 (Chickpea) were demonstrated in 34.8, 12 ha area covering 87, 30 farmers' fields respectively. The varieties LRG-41 and NBeG-3 recorded 101, 192 kg/ha additional yields over the traditional varieties (PRG-176, JG-11) with B:C ratios of 2.37 and 3.05 respectively (Table 21).

NBeG-3 (Chickpea)

West Godavari

Short duration varieties of paddy MTU-1121 and MTU-1156 were demonstrated in 15 ha area covering 18 farmers. MTU-1121 was high yielder (9750 kg/ha) followed by MTU-1156 (9562 kg/ha) compared to the farmers practice i.e., MTU-1010 (8437). Higher net returns were also obtained with MTU-1121 (Rs.75952/ha) (Table 21).

Nalgonda

Improved varieties of pulses, PRG-176 and WGG-42 of pigeonpea and greengram were demonstrated as resilient varieties to drought in the NICRA village. The variety PRG-176 recoded 1501 kg/ha yield with a net income of Rs.48476/ha covering an area of 17.6 ha in 44 farmers fields. WGG-42 recorded 17.85% higher yield over the traditional variety MGG-295.

Ahmednagar

Sorghum varieties, Phule Suchitra and Phule Anuradha were introduced in NICRA village based on soil type. Farmers have been using Maldandi variety in all types of soil. This variety did not give good grain and fodder yield in light soils. Phule suchitra gave 24.74% higher yield than conventional variety Maldandi in medium soil, while in light soil Phule anuradha recorded 320 per cent higher yield than variety Maldandi (Table 21).

Phule suchitra (Sorghum)

Aurangabad

Improved BDN-711 variety of pigeonpea recorded 36% higher yield over farmers practice compared to traditional variety Khadka (1260 kg/ha) with a benefit cost ratio of 4.20. Soybean variety JS-335 yielded 35.75% higher yield and 77.39% net returns over traditional varity MAUS-71. High yielding variety utkarsha of greengram obtained higher net returns of Rs.7759/ha over conventional variety kopargao. JAKI-9218 variety of bengal gram was demonstrated as a drought resilient variety with 18% increase in yield over farmer's practice with a benefit cost ratio of 2.78 (Table 21).

Utkarsha (Green gram)

Jalna

Variety Digvijay of Bengal gram recorded an yield advantage of 30.82% over conventional variety Vijay. Drought tolerant variety BDN-711 of pigeonpea covering 8 ha in 20 farmers fields gave higher yield (792 kg/ha) and net returns (29556/ha) over the conventional variety Khadki (Table 21).

Nandurbar

GM-6 variety of maize was evaluated for drought tolerance over the conventional variety. The drought tolerant variety GM-6 recorded higher yield (262 kg/ha) and net income (2375/ha) with a BC ratio of 2.31. Desi cotton Ambika recorded higher yield and economic advantage of 192 kg/ha and 16256/ha respectively with a benefit cost ratio of 4.66 (Table 21).

Table 21: Performance of crop cultivars for adaptation to climate variability

KVK	Crop	Intervention	No. of demons-trations	Area (ha)	Yield (kg/ha)	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	BC ratio
Anantapur	Groundnut	Farmers practice (K-6)	05	5.0	478	32308	28534	3774	1.15
		Dharani			525	37894	31327	6567	1.26
Anantapur	Foxtail millet	local variety (Krishnadevaraya)	05	5.0	350	11064	9432	1632	1.21
		Improved practice (SIA-3085)			410	14300	11050	3250	1.41
Anantapur	Paddy	MTU-1010	03	0.5	3885	62000	90494	28494	1.46
		Sheetal (cold tolerant variety)			4663	64220	108416	43996	1.68
Chittoor	Groundnut	Kadiri-6	07	3.2	2380	65625	130900	65275	1.99
		Dharani			2650	68825	144375	75550	2.09

KVK	Crop	Intervention	No. of demons-trations	Area (ha)	Yield (kg/ha)	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	BC ratio
Kurnool	Pigeonpea	Farmers variety (LRG-41)	87	35	995	24697	49766	25068	2.02
		Improved variety (PRG-176)			1096	23324	54817	31493	2.37
Kurnool	Chickpea	Conventional variety (JG-11)	30	12	1134	29500	79380	49880	2.69
		Improved Variety (NBeG-3)			1326	30750	92828	62078	3.05
Srikakulam	Greengram	Conventional variety (ML-267)	10	4	777	72140	40970	31170	4.18
		Improved Variety (LGG-460)			549	51828	30564	21264	3.29
West Godavari	Paddy	MTU 1010	15	18	8437	46286	103528	57242	2.24
		MTU 1156 (short duration)			9562	44650	115419	70769	2.58
		MTU 1121 (short duration)			9750	43680	119632	75952	2.74
Khammam	Paddy	Farmers variety (BPT-5204)	30	12	5692	57660	82534	24874	1.43
		WGL-44 (Siddi)			6476	53620	93902	40282	1.75
Nalgonda	Pigeonpea	LRG-41	44	17.6	12	25721	59612	33891	2.31
		PRG-176			15.01	24635	73112	48476	2.96
Nalgonda	Greengram	MGG-295	50	20	700	13750	30100	16350	2.20
		WGG-42			825	12500	35475	22975	2.80
Ahmednagar	Rabi sorghum	Maldandi	15	6	1212	23160	54345	31185	2.35
		Suchitra			1512	23230	60737	37507	3.00
Ahmednagar	Rabi sorghum	Maldandi	15	6	125	18398	12155	-6243	0.66
		Phule Anuradha			575	19350	23225	3875	1.19
Amravati	Wheat	Lok-1	05	2	1750	16875	29750	12875	1.76
		PDKV-Washim			2250	16875	38250	21375	2.27
Aurangabad	Pigeonpea	Conventional variety Khadka	20	8	1260	23140	63630	40490	2.75
		Improved variety (BDN-711)			1983	23855	100142	76287	4.2
Aurangabad	Soybean	Conventional variety JS -335	30	12	1950	28165	48555	20390	1.72
		Improved variety MAUS- 71			2647	29740	65910	36170	2.27

KVK	Crop	Intervention	No. of demons-trations	Area (ha)	Yield (kg/ha)	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	BC ratio
Aurangabad	Greengram	Traditional variety (Kopargao)	20	8	566	16926	29120.7	12194.7	1.72
		Improved variety (Utkarsha)			725	17348	37301.25	19953.25	2.15
Aurangabad	Bengalgram	Traditional variety vijay	20	8	1164	25976	64020	38044	2.46
		Improved Variety (JAKI-9218)			1395	27624	76725	49101	2.78
Aurangabad	Rabi sorghum	Traditional Variety Dagdi	30	12	219	13813	35382	21569	2.56
		Parbhani moti			370	15250	61540	46290	4.04
Aurangabad	Wheat	Traditional Variety Lok-1	20	8	1766	28170	30022	1852	1.07
		NIAW-1415 (Wheat)			2112	29860	35904	6044	1.2
Jalna	Bengalgram	Conventional variety Vijay	10	4	1090	18760	47250	28490	2.51
		Improved variety Digvijay			1426	21840	69075	47235	3.16
Jalna	Wheat	Conventional variety Lok-1	15	5	2062	24500	33000	8500	1.34
		Improved variety Netravati			2625	23700	42000	18300	1.77
Jalna	Pigeonpea	Khadki	20	8	1050	29135	45150	16025	1.55
		BDN-711			1842	33625	79206	45581	2.35
Jalna	Soybean	JS-335	10	4	1375	26925	39937	13012	1.48
		MAUS-71			1585	27755	45502.5	17750.5	1.63
Nandurbar	Greengram	Non descriptive variety	10	4	430	12850	20640	7790	1.6
		IPM-02-03			545	13500	26705	13205	1.97
Nandurbar	Maize	Non descriptive variety	10	4	1588	12500	27375	14875	2.19
		GM-6			1850	13200	30450	17250	2.31
Nandurbar	Cotton	Non descriptive variety	10	4	988	16100	57304	41204	3.56
		Ambika (Desi variety)			1180	15700	73160	57460	4.66

Table 22: Performance of climate resilient cropping systems

KVK	Intervention	No. of demon-strations	Area (ha)	Yield (kg/ha)	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	BC ratio
Chittoor	Sole Ground nut	05	02	725	29300	32625	3325	1.13
	Ground nut + Field Bean			655+1288	44538	63595	19058	1.43
Kurnool	Sole foxtail millet	69	25	93	14070	19860	5790	1.40
	Foxtail millet+pigeonpea			919+394	15228	38080	22852	2.50
Srikakulam	Cotton	10	04	1667	46500	73326	26826	1.58
	Cotton+ pigeonpea			1228+120	41000	69671	28671	1.66
Khammam	Sole cotton	5	10	1995	61842	95760	33918	1.54
	Cotton+pigeonpea			1956+286	64993	113469	48476	1.66
Nalgonda	Sole cotton	22	8.8	27.26	52373	139963	87590	2.67
	Cotton + pigeonpea			26.60+5.70	56345	164355	108010	2.9
	Sole Pigeon pea	7	2.8	10.07	18145	50375	32230	2.77
	Pigeon pea + Setaria			8.52+7.75	19630	69327	49697	3.53
Aurangabad	Sole cotton	30	12	2000	36400	110000	73600	3
	Cotton+ greengram			1749+6.25	37430	126195	88765	3.37
	Cotton + blackgram			1684+4.90	37430	128880	91450	3.44
Aurangabad	Sole crop soybean	10	04	2647	29740	65910	36170	2.27
	Soybean + pigeon pea			1875+780	30615	86078	55463	2.81
Aurangabad	Sole rabi sorghum	10	04	316	15250	50328	35078	3.3
	Rabi sorghum + safflower			224+418	15614	63134	47520	4.04
Aurangabad	Sole pigeonpea	10	04	1458	12790	21433	8643	1.68
	Pigeonpea + pearl millet			2375	14628	34913	20285	2.39

4.2 Climate Resilient intercropping systems

Chittoor

Groundnut is taken up as sole crop under rainfed conditions in NICRA village. Due to erratic rainfall farmers are getting low yields resulting in poor net returns. To overcome this problem KVK introduced field bean as intercrop in groundnut. For every 10 rows of groundnut one row of field bean was grown as intercrop. Main objective of introducing field bean is to provide additional returns to farmers in case groundnut crop fails due to vagaries of monsoon. Sole groundnut crop recoded an average yield of 725 kg per ha with net returns of Rs.3325/- per ha. In case of inter cropping, groundnut recorded an average yield of 655 kg per ha and yield of filed bean was 1288 kg/ ha. Additional net returns achieved by the farmers due to intercropping system was Rs.15733/ha. Hence it is suggested to go for intercropping system under rain fed situation instead of sole groundnut (Table 22).

Groundnut+field bean

Kurnool

Adverse weather conditions like delayed onset of rains and prolonged dry spells during the crop period are very common in rainfed situation of this district. Such situation results in economic losses to the farmers due to partial or total failure of the sole crops. In order to utilize the bi-model distribution of rainfall and also to insure against crop failure due to drought, millet based inter cropping systems were demonstrated.

Pigeonpea+ foxtail millet (1:5)

Pigeonpea+foxtail millet (1:5) inter cropping system was demonstrated in comparision with sole crop of Redgram and foxtail millet in order to increase the cropping intensity and net returns of the farmers. Results of intercropping of pigeonpea+foxtail millet in the demonstration plots indicated that net income was higher (Rs.22852/ha) than sole foxtail millet. The results on cropping system oriented demonstrations for drought mitigation clearly indicate that inter cropping system is economically advantageous than sole crops under rainfed situations. In the long run the fertility and microbial activity of the soil also increase with addition of biomass of pigeonpea (Table 22).

Srikakulam

Cotton is cultivated under ID situations and is frequently prone to drought or heavy rains during the crop season leading to heavy crop loss. Therefore, an intercrop suited for the situation (red gram) is introduced so that an alternative crop is available to the farmer without loss. By raising redgram as intercrop, a net income of Rs.28670/ha was recorded instead of raising cotton as sole crop (Rs.26826/ha) (Table 22).

Khammam

The NICRA village received heavy rainfall during the months of September and October when the cotton crop was at flowering and boll bursting stage and as a result cotton crop was damaged heavily. Cotton and pigeonpea intercropping system in 6:1 ratio was taken up in NICRA village of khammam for obtaining additional benefit compared to sole cotton. An enhanced net income of Rs.14558/ha was obtained in intercropping system compared to sole crop (Table 22).

Nalgonda

To minimize the risk of low productivity and income from crops due to erratic rainfall, cotton + redgram intercropping was taken up in 12.4 ha area covering 22 Farmers in NICRA village of Nalgonda district. Supplemental irrigation through farm pond resulted in additional net income of Rs.20420/ha (Table 22).

Aurangabad

Cotton + blackgram and cotton + greengram intercropping systems were demonstrated in the NICRA village against sole cotton. Higher net incomes of Rs.15165/ha and Rs. 17850/ha were obtained through the intercropping systems than sole cotton with benefit cost ratios of 3.37 and 3.44 respectively. Similarly soybean+pigeonpea (4:2) inter cropping system also recorded an additional advantage of Rs.19293/ha. Rabi sorghum+safflower intercropping system (3:3) increased the yield by 39% over farmers practice with a benefit cost ratio of 2.39. Rabi sorghum + safflower inter cropping system (6:3) was advantageous over the farmers practice with a BC ratio of 4.04 (Table 22).

Soybean+pigeonpea (4:2)

4.3 Farm mechanization for resource conservation

Anatapur

Sowing groundnut with seed cum fertilizer drill in 24 ha area covering 59 farmers resulted in additional yield of 72 kg/ha. Mechanized intercultivation in groundnut realized additional yield of 55 kg/ha compared to bullock drawn guntaka (Table 23).

Sowing groundnut with seed cum fertilizer drill

Chittoor

Demonstrations on weeding using power weeder in tomato were conducted in 10 farmers fields covering 4 ha area. An additional yield of 5400 kg/ha was obtained with higher net income of Rs. 35870/ha in this demonstration (Table 23).

Power weeder in tomato

Seed drill in jowar

Kurnool

Farm mechanization reduces the cost of sowing of agricultural crops and increases the precision and covers more area in unit time. Traditional method of seeding with bullocks involves higher cost, less coverage and less precision. Sowing with improved seed drill in Jowar and bengalgram covering 50 acres of land resulted in higher net income of Rs.10230/ ha and reduced cost of cultivation by Rs. 686/ha in chickpea. Similarly sowing with seed drill in sorghum resulted in additional net income of Rs.8805/ha (Table 23).

West Godavari

Mechanical transplanting of paddy resulted in higher yield advantage of 1374 kg/ha over manual transplanting. The cost of cultivation was reduced by Rs 1650/ha with higher net income of Rs. 26321/ha.

Mat nursery

Mechanical transplanting of paddy

4.4 Resource/Water Saving Technologies

Srikakulam

Zero tillage in maize was followed to utilize residual soil moisture available in rice fallow. Due to low yield and susceptibility to YMV and low temperatures combined with fog during crop growth period zero tillage maize was taken up in place of blackgram which resulted in additional yield advantage of 355 kg/ha compared to farmers practice and additional net income of Rs.9478/ha.

Zero tillage maize

West Godavari

System of rice Intensification (SRI) was adopted to reduce the cost of cultivation and to improve the water use efficiency. SRI in paddy resulted in 10.5% increase in yield and 64.7% increase in net income compared to traditional method of cultivation. Direct sowing with drum seeder reduced the cost of cultivation to Rs.17216/ha in paddy with additional yield advantage of 825 kg/ha (Table 24).

Chittoor

Direct seeding in paddy using drum seeder conserves seed, water, labour and allows the crop to produce more tillers. It resulted in higher yield advantage (10.5%) over conventional method of paddy production with higher net returns of Rs.19072/ha. Crop duration was also reduced by 10 days in direct seeding method (Table 24).

Direct seeding with drum seeder

Nalgonda

Direct sowing with drum seeder was practised for resource conservation in paddy. High cost of labour and labour shortage for transplanting are main constraints in paddy production which leads to late planting and reduction in yield. Direct sowing requires less seed rate, labour and is having less crop duration than manually transplanted paddy. 475 kg/ha additional yield was obtained and Rs.5240/ha was saved through drum seeding (Table 24).

4.5 Crop diversification

Diversification with climate resilient crop options has been demonstrated in various NICRA centers as an adaptive strategy to mitigate the adverse effects of climate vulnerability.

Anantapur

Groundnut cultivation realized very low net returns due to delayed sowing because of delayed on set of monsoon. Crop diversification with the introduction of drought tolerant and short duration variety of foxtail millet SIA-3085 resulted in higher net returns (Rs.4352/ha) and BC ratio (1.55) compared to groundnut.

Chittoor

Tomato is the major vegetable crop grown in NICRA village of Chittoor district. There is a high incidence of pest and diseases in tomato during rabi season resulting in lower yield. Market glut and very low prices are also affecting the income of farmers. Crop diversification with high valued flower crop chrysanthemum using high yielding varieties 'Paper Yellow' and 'Paper white' was demonstrated. Both the varieties performed better with an average yield of 9850 kg/ha. Cost of cultivation is higher in case of chrysanthemum (Rs.145907/ ha) but it was compensated by additional net returns (Rs.75291/ha) obtained due to more demand and high market price of chrysanthemum.

Kurnool

Cotton is the traditional crop grown in NICRA village of Kurnool district. Crop diversification with foxtail millet and castor was practiced to maximize the yield and to combat harsh weather conditions (Drought). Castor realized additional net returns of Rs.9186/ha over cultivation of cotton.

Srikakulam

Farmers are growing blackgram and greengram in rice fallows during rabi season and getting low yields due to low temperatures prevailing during the cropping season. Introduction of non traditional crops like chickpea and mustard in rabi was found remunerative over pulses. The performance of chickpea was observed to be better both in terms of yield (1900 kg/ha) and net returns (Rs.51304/ha) over black gram with net returns of Rs.20280/ha.

Jalna

Cultivation of cotton was traditional practice in NICRA village of Jalna but farmers are getting lower yields due to drought conditions. Sericulture was taken up instead of growing cotton which resulted in higher net income of Rs.310000 per season with a benefit cost ratio of 4.10.

Nandurbar

Frequent drought, heat stress and limited availability of water are the major constraints in production of wheat at NICRA village of Nandurbar district. The soils are shallow, prone to moderate to severe soil erosion. Crop diversification with potato and peas can be a suitable option over cultivation of wheat. Cultivation of peas and potato was found remunerative over wheat with net returns of Rs.142700/ha and Rs.44500/ha respectively.

Table 23: Influence of farm implements on yield and economics of crops in NICRA villages

KVK	Intervention	No. of demon-strations	Area (ha)	Yield (kg/ha)	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	BC ratio
Anantapur	Farmers practice	59	23.6	391	24760	22562	-2198	0.91
	Sowing of groundnut with seed cum fertilizer drill			463	24760	25974	1214	1.04
Anantapur	Bullock drawn danthi guntaka	8	3.6	348	24760	22908	-1852	0.92
	Mechanized Intercultivation			403	24760	25798	1038	1.04
Chittoor	Manual weeding	10	4	74100	149000	197600	48600	1.33
	Weeding using power weeder			79500	127000	211470	84470	1.66
Kurnool	Bullock drawn seed drill in bengalgram	50	50	1261	36600	88270	51693	2.40
	Improved seed drill			1125	37286	78750	41463	2.10
Kurnool	Farmers method of seeding in jowar	50	50	1876	17560	37520	19960	2.13
	Improved seed drill			2265	16535	45300	28765	2.73
West Godavari	Farmers practice	3	2.4	8938	56250	125132	68882	2.22
	Mechanical trans planting in Paddy			10312	54600	144368	95203	2.60

Table 24: Effect of water saving technologies on productivity and profitability of different crops

KVK	Intervention	No. of demon-strations	Area (ha)	Yield (kg/ ha)	Cost of cultivation (Rs./ha)	Gross returns (Rs./ ha)	Net returns (Rs./ha)	BC ratio
Anatapur	Manual transplanting	6	2.5	5508	64220	137896	75405	2.14
	SRI cultivation of Paddy			8760	62491	202356	139865	3.24
Chittoor	Direct seeding with drum seeder	5	1	6469	46350	94875	48525	1.52
	Manual Transplanting in paddy			5855	56413	85866	29453	1.96
West Godavari	Farmers practice	30	24	8625	52333	120750	68417	2.30
	Direct sowing with Drum Seeder			9450	46667	132300	85633	2.80
	Farmers practice	5	6	8438	56775	118132	61357	2.08
	SRI method of paddy cultivation			10500	44500	141400	97900	3.17
Nalgonda	Manual Transplanting	5	2	6550	37785	92222	54437	2.44
	Direct sowing with drum Seeder			7025	32545	98899	66354	3.03
Ahmednagar	Flood irrigation	10	4	315	75375	236063	160688	3.27
	Irrigation based on soil moisture condition			317	75150	237563	162413	3.90
Srikakulam	Farmers practice	15	6	6995	136084	87437	48647	2.26
	Zero tillage maize			7350	153000	91875	58125	2.72

Table 25: Crop diversification for sustainability in different NICRA centers

KVK	Intervention	No. of demon-strations	Area (ha)	Yield (kg/ ha)	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	BC ratio
Anantapur	Groundnut (K-6)	22	15.0	433	24760	26323	1563	1.06
	Diversification with foxtail millet			472	7800	12152	4352	1.55
Chittoor	Tomato	10	4.0	55100	65125	201000	135875	1.99
	Diversification with Chrysanthemum			9850	145907	357073	211166	2.44
Kurnool	Cotton	48	19.2	693	22936	31185	8249	1.36
	Foxtail millet			1078	14071	18334	4263	1.30
	Castor			1124	21919	39354	17435	1.80
Srikakulam	Mustard	05	1.5	5	12500	29280	16780	2.34
	Blackgram			5	7000	27280	20280	3.90
	Chick pea			19	15000	66304	51304	4.42
Jalna	Cotton	18	7.2	2010	50000	100500	50500	2.01
	Diversification with sericulture			820	100000	410000	310000	4.10
Nandurbar	Wheat	10	4.0	2301	29200	42016	12816	1.43
	Diversification with Potato			14680	77500	220200	142700	2.84
Nandurbar	Wheat	15	0.5	2301	29200	42016	12816	1.43
	Diversification with Pea			3200	35500	80000	44500	2.25

4.5 Nutrient Management

Srikakulam

Foliar nutrition during water scarce situation in blackgram recorded an increase of 25.16% in yield over farmers practice without nutrient treatment.

West Godavari

Indiscriminate use of chemical fertilizers is leading to high cost of cultivation and lower yield in paddy. Use of Bio Fertilizers (500 ml Azospirillum + 500 ml PSB) + 75% RDF (40 kg Urea + 40 Kg DAP + 40 Kg MOP) enhanced the paddy yield by 300 kg/ha over farmers practice (Table 26).

Nalgonda

Foliar nutrient application in Bt cotton covering 14 farmers in 5.6 ha area recorded additional yield of 88 kg/ha and net income of Rs.4879/ha over farmers practice (Table 26).

Ahmednagar

Foliar nutrient application in crops of soybean, cotton and chickpea recorded higher yield advantage of 15.2, 19.4 and 14.4% respectively over farmers practice with higher net returns of Rs.6737, 7242 and 9953/ha respectively (Table 26).

4.6 Crop Protection

Chittoor

Leaf miner is a serious pest of tomato. Farmers are using pesticides indiscriminately to control the pest leading to higher cost of cultivation. To economize the cost of plant protection in tomato adoption of IPM practices was taken up resulting in average yield increase of 24.5% in the demonstration over farmers practice (Table 27).

Kurnool

Management of sucking pests in Bt cotton by following IPM practices was demonstrated in NICRA village. The crop was infested with sucking pests viz., aphids, jassids and whiteflies due to continuous dry spells that prevailed after sowing. Stem application with imidacloprid and monocrotophos at 20, 40 and 60 DAS and installation of yellow sticky traps @ 25/ha and spraying of acetamiprid @ 0.5g/l with neem oil @ 0.03% (5 ml/l) checked the incidence of whiteflies effectively in the demonstrations resulting in healthy plants compared to farmers practice (Table 27) .

Stem application in Bt cotton

Srikakulam

Biotic stress management in flood prone area for management of paddy sheath blight, blast and brown plant hopper was demonstrated to reduce the yield loss because of disease incidence during floods. The improved practice involves seed treatment, formation of alleyways, need based chemical spray for blast, sheath blight and brown plant hopper which resulted in additional yield advantage of paddy over no plant protection measures with very low incidence of pests and diseases (Table 27).

Ahmednagar

Fog and dew are favourable factors for the spread of purple blotch at faster rate in onion during rabi season. Application of azoxystrobin @ 0.5 ml/l of water along with soil application of *Trichoderma* @ 5 l/ha resulted in reduced disease incidence along with additional yield of 3500 kg/ha (Table 27).

IPM in onion crop

Table 26: Effect of nutrient management practices on productivity and profitability of different crops

KVK	Crop	Intervention	No.of demon-strations	Area (ha)	Yield (kg/ha)	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	BC ratio
Srikakulam	Blackgram	Farmers practice	5	2.0	771	32011	57022	25011	4.57
		Nutrient spray in blackgram			616	40082	71664	31582	4.72
West Godavari	Paddy (Kharif)	Use of bio fertilizers in paddy	5	2.0	5450	45167	69820	24653	1.54
		Without use of biofertilizers			5580	42167	70560	28393	1.67
	Paddy (Rabi)	Use of bio fertilizers in paddy	5	2.0	8962	52200	125468	73268	2.40
		Without use of biofertilizers			9262	49500	129668	80168	2.61
Nalgonda	Bt cotton	Without nutrient application	14	5.6	2642	51257	136949	85692	2.67
		Foliar nutrient application			2730	50912	141483	90571	2.77
Ahmednagar	Soybean	Without nutrient application	50	20.0	1445	25422	37570	11131	1.48
		Foliar nutrient application			1665	26439	43290	17868	1.64
	Cotton	Without nutrient application	30	12.0	1023	37233	48018	10785	1.29
		Foliar nutrient application			1220	39273	57300	18027	1.46
	Chickpea	Without nutrient application	35	14.0	1247	29683	57418	27735	1.94
		Foliar nutrient application			1427	27944	65633	37688	2.35

Table 27: Effect of Crop protection measures on productivity and profitability of different crops

KVK	Intervention	No. of demon-strations	Area (ha)	Yield (kg/ha)	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	BC ratio
Chittoor	Indiscriminate use of pesticides	7	3	6000	153300	158667.0	48600.0	1.04
	Integrated pest management practices in tomato			7400	149000	197600.0	55670.0	1.33
Kurnool	Indiscriminate use of pesticides	45	18	1278	42905	69873.0	26969.0	1.62
	Integrated pest management practices in cotton			1334	39765	73346.0	33580.0	1.84
Srikakulam	Manual weeding	10	4	5340	39500	71664.4	32164.4	1.80
	Weedicide application in paddy			5630	37750	75534.5	37784.5	2.00
Srikakulam	Farmers practice	10	4	6010	36500	80532.4	44032.4	2.21
	Integrated disease management in paddy			6280	37750	84268.4	46518.4	2.23
Srikakulam	Farmers practice	10	4	5660	36500	75857.7	39357.7	2.14
	Management of BPH in flood prone paddy			6080	37750	81591.8	43841.8	2.16
Srikakulam	Spraying of chemical	10	4	1670	40000	68068.0	28068.0	1.70
	Stem application in cotton			2200	46500	94512.0	48012.0	2.03
Ahmednagar	Chemical control	85	34	14470	462458	1151812	689354	2.49
	Integrated disease management			16810	462980	1338076	875096	2.89
Ahmednagar	Chemical control	20	8	28000	86515	209155	122643	2.42
	Integrated disease management in onion			31500	85123	236625	151503	2.78

KVK	Intervention	No. of demon-strations	Area (ha)	Yield (kg/ha)	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	BC ratio
Srikakulam	Chemical control	10	4	1935	134945	89010	45935	2.07
	Integrated crop management in groundnut			2275	167425	104650	62775	2.50
Srikakulam	Farmers Practice	10	4	575	42500	28750	13750	1.92
	Integrated crop management in sesamum			725	57500	36250	21250	2.42
Ahmednagar	Improper use of fungicides and insecticides for bacterial blight of pomegranate	20	8	28000	86515	209155	122643	2.42
	Use of bio-pesticides + chemical pesticide + timely management practices			31500	85123	236625	151503	2.78
Amravati	Chemical control	10	4	1650	39500	75650	36150	1.91
	Integrated pest management			2800	58400	134400	76000	2.30

5. Livestock and Fisheries

5.1 Performance of improved fodder varieties

Nalgonda

Improved fodder variety APBN-1 was demonstrated in 4 farmers fields against farmers variety MP chari. APBN-1 gave a higher yield of 195 t/ha with a benefit cost ration of 7.52 over the farmers practice (Table 28).

Ahmednagar

Cultivation of fodder sorghum variety Phule Govardhan in 19 farmers fields covering an area of 7.6 ha recorded higher yield of 15.3 t/ha and higher net income of Rs. 21859/ha over the farmers practice. High yielding fodder sorghum sugargraze recorded higher yield of 46.8 t/ha over the conventional fodder sorghum (30.8) with a benefit cost ration of 4.74 (Table 28).

Amravati

Fodder varieties MP chari, Yeshwant grass and African tall (fodder maize) were demonstrated at NICRA village of Amravati district in Maharashtra in 4 ha area covering 10 farmers fields. African Tall variety of maize recorded highest fodder yield of 29 t/ha whereas Yeshwant grass and MP chari recorded yields of 23, 19 t/ha respectively. African tall recorded higher net income of Rs. 5500 and Rs.10150/ha compared to Yeshwant grass and MP chari fodders respectively (Table 28).

Jalna

African tall variety of maize was found to be superior yielder over conventional fodder in NICRA village of Jalna with benefit cost ratio of 2.44 (Table 28).

Phule Govardhan (Fodder sorghum)

African Tall (Fodder Maize)

Table 28: Performance of improved fodder varieties at different NICRA centers

KVK	Intervention	No. of demon-strations	Area (ha)	Yield (t/ha)	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	BC ratio
Nalgonda	Local variety fodder (MP Chari)	4	1.6	62.0	42241	187000	144759	4.42
	Improved variety (APBN-1)			195.0	77200	585000	507800	7.52
Ahmednagar	Conventional fodder sorghum	19	7.6	32.9	13634	49493	35707	3.64
	fodder sorghum-Phule govardhan			48.2	14710	72275	57566	4.94
Ahmednagar	Conventional fodder sorghum	20	8.0	30.8	12748	46420	33470	3.68
	New HYV fodder sorghum sugargraze			46.8	14940	70125	55185	4.74
Amravati	MP Chari farmers variety	10	4.0	19.0	5600	16700	11100	2.98
	Yeshwant			23.0	6750	22500	15750	3.33
	Maize (African Tall)			29.0	7500	28750	21250	3.83
Jalna	Local variety fodder	20	2.0	33.0	4210	8250	4040	1.95
	Improved variety Afican Tall			42.0	4300	10500	6200	2.44

5.2 Green Fodder Preservation through silage making

Ahmednagar

Green fodder scarcity has been observed every year mainly during summer and farmers are purchasing green fodder at higher cost leading to increased cost of milk production. Silage making is a process of preserving green fodder by making it into small pieces with the help of chaff cutter and storing in air tight condition in plastic bags for easy transportation and handling. Fodder sorghum, maize, hybrid napier grasses, sugarcane tops are used for silage making. Silage can be stored well for 8 to 10 month and can be used during scarcity period. Silage making saves cost of labour required for fodder cutting and transporting. Farmers of NICRA village prepared silage whenever green fodder is available to them (Table 29).

Table 29: Effect of silage making in NICRA village of Ahmednagar (Maharashtra)

Treatments	Green fodder cost (Rs./kg)	Milk production (l/day/animal)	Fat %	Gross Cost in Rs./2 months	Gross Return in Rs./2 months	Net Returns Rs./2 months	BCR
Purchasing green fodder	3.73	12.20	3.50	9858	15950	6091	1.63
Silage making	2.85	12.46	3.62	9607	16191	6584	1.70

5.3 Introduction of superior breeds of small ruminants

Khammam

Superior breeding lambs were introduced to reduce the mortality and morbidity loses due to biotic stress and to produce healthy lambs for additional income generation (Table 30 & 31).

Table 30: Production of genetically superior breeding lambs

Type of animal introduced	No of animals introduced	Additional returns/year	Gross returns (Rs./ha)	Net returns (Rs./ha)	BC Ratio
Local breed	-	12800	44000	31200	3.43
Superior breeding ram	02	14530	64000	49470	4.40

Table 31: Performance of lambs produced due to release of elite breeding rams.

Year	No. of lambs produced/ year	No. of sheep sold /year	Income generated from selling of sheep (Rs.)
2013-14	22	19	47450
2014-15	31	28	53450
2015-16	35	30	58500
Total	**88**	**77**	**159400**

Srikakulam

Local breeds were raised by the shepherds, there by realizing less remuneration out of their hard ship. In order to make their efforts more profitable, replacement of local rams with genetically superior breeding rams was done so that the breed fits to the existing climatic conditions. Each shepherd was supplemented with one breeding ram. An increase of 18.7, 4.4 and 28.4 per cent in height, length and weight, respectively, over local lambs at 30 days after birth and 19.6, 5.4, 30.4 per cent at 60 days after birth was observed, there by realizing better price by the farmers (Table 32).

Table 32: Performance of lambs produced by superior breeding rams

Age of the lamb	Local lambs			Lambs produced from breeding rams		
	Height (cm)	Length (cm)	Weight (kg)	Height (cm)	Length (cm)	Weight (kg)
30 days	36.4	40.6	8.8	43.2	42.4	11.3
60 days	42.8	51.8	11.2	51.2	54.6	14.6
% increase at 30 days over local lambs				18.7	4.4	28.4
% increase at 60 days over local lambs				19.6	5.4	30.4

5.4 Feed enrichment techniques

Supplementation of mineral mixture/ mineral blocks to milch animals

Kurnool

Protein and energy are the major factors influencing milk yield in milch animals. Supplementation of protein and energy along with minerals through urea molasses mineral blocks is very effective and economical practice in low and medium production animals. The demonstration was conducted selecting 10 milch buffaloes. Farmers practice of feeding included feeding of dry fodder and rice bran whereas improved practice involved feeding of mineral mixture (150 g/animal/day) along with farmers method of feeding. The animals were allowed to lick the block twice daily for 30 minutes at the time of milking. Feed supplementation with mineral mixture resulted in additional net income of Rs.2650/6 months per animal (Table 33).

Table 33: Influence of urea molasses/mineral mixture on productivity of live stock at KVK Kurnool

Treatments	Average milk yield/animal (l/day)	Total milk yield per animal (l/60days)	Cost of feeding (Rs./animal)	Gross Returns (Rs./animal)	Net returns (Rs./animal)/ 60 days
Farmers practice	3.47	208.2	1395	6770	5375
FPF+ urea molasses	4.01	240.6	1965	9990	8025

Khammam

Feeding livestock with mineral mixture along with farmers practice of feeding resulted in higher milk production (540 l/60 days) with higher net income of Rs.10220 compared to the farmers practice in NICRA village of Khammam (Table 34).

Table 34: Influence of mineral mixture on productivity of live stock at Khammam

Treatments	Average milk yield/animal (l/day)	Total milk yield /animal (l/60days)	Cost of feeding (Rs./animal)	Gross Returns (Rs./animal)	Net Returns (Rs./animal)
Farmers practice	06	360	2300	21600	19300
FPF+Mineral mixture	08	540	2880	32400	29520

Ahmednagar

In NICRA village of Ahmednagar, farmers are using green, dry fodders and concentrate feed to the animals which does not contain minerals. Feeding of mineral mixture @ 50 gm/day/ cow resulted in increased milk production (Table 34).

Table 34: Influence of Urea molasses/mineral mixture on productivity of live stock at Ahmednagar

Treatments	Milk production (l/day/cow)	Fat %	Gross return (Rs./animal/60 days)	Net return (Rs./animal/60 days)	B:C
Without mineral mixture	13.72	3.57	18527	6410	1.53
Use of mineral mixture @ 50 g/cow/day	14.53	3.68	19826	7259	1.58

Jalna

Feed enrichment with mineral mixture was demonstrated in NICRA village of Jalna, Maharashtra. Supplementation of minerals through mineral mixture resulted in higher growth rate and low mortality rate in lambs resulting in higher net income of Rs.3850/animal (Table 35).

Table 35: Influence of mineral mixture on growth of small ruminants (lambs) at KVK Jalna

Treatments	Total Average milk feeding (l/60days)	Mortality (%)	Cost of Feeding (Rs./animal)	Gross Returns (Rs./animal)	Net Returns (Rs./animal)
Farmers practice	12	5%	60	2500	2440
FPF+ Mineral Bricks	15	3%	120	3000	2880
FPF+Mineral mixture	18	2%	150	4000	3850

• FPF-Farmers Practice of Feeding

Forty Mineral bricks were used for 10 goats and 10 cows as supplemental feed. The farmers method of feeding involved feeding with milk, green fodder and weaning. Improved practice involved feeding with mineral blocks along with farmers practice resulting in improved growth, skin coat and exhibited heat earlier with additional net returns of Rs.380/animal (Table 36).

Table 36: Influence of mineral mixture on growth of live stock

Particulars	Farmers practice	Mineral mixture
Initial body weight (kg)	2.25	2.55
Final body weight (kg)	8	10
Gross returns (Rs.)	1100	1200
Cost of feeding (Rs.)	--	120
Net returns (Rs.)	800	1180

Ratnagiri

Feed enrichment with azolla and mineral mixture in Pandharpuri buffalo was demonstrated in NICRA village of Ratnagiri district. Farmers method of feeding involved feeding of dry fodder along with concentrates. Improved practice of feeding involved feeding with azolla (300 gm/animal/day) and mineral mixture (30 gm/animal/day) along with farmers practice (Table 37).

Table 37: Impact of azolla and mineral mixture on productivity of livestock at Ratnagiri

Treatments	Milk yield/ animal (l/day)	Milk yield/ animal (l/60days)	Cost of feeding (Rs./60days/ animal)	Gross Returns (Rs./60days/ animal)	Net returns (Rs. /60days/ animal)
Farmers practice	6.1	366	550	18300	17750
FPF+ Azolla + mineral mixture	7.2	432	670	21600	20930

• FPF-Farmers Practice of Feeding

Azolla Production

Demonstration of azolla production as alternative feed to milch animals was conducted at NICRA village of Chittoor district covering 10 farmers with 10 units of azolla for providing balanced nutrition and enhancing the milk productivity in milch animals (Table 38).

Table 38: Impact of azolla feeding on productivity of livestock at Chittoor

Treatments	Azolla Yield (kg/m²)	Fat percentage of milk before feeding azolla	Fat percentage of milk after feeding azolla	Net income (Rs/ m²)	B:C ratio
Azolla production	5	6.5	8.5	960	3.0

Farmers are feeding dairy animals with fodder sorghum variety sugargraze. Feeding of azolla along with fodder sorghum was demonstrated covering 8 farmers in the NICRA village which resulted in improvement of fat percentage (2%) in milk.

5.5 Backyard Poultry for nutritional needs and income generation

Chittoor

Agriculture alone cannot meet the livelihood security of small and marginal farmers in rain fed regions. There is a need to supplement the income of the farmers though income generating activities like backyard poultry (Table 39).

Table 39: Performance of poultry birds in augmenting farm income at Chittoor

Particulars	Initial weight (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.)
Local Breed	40	2.25	186	960	744	450	1196
Improved breed (Rajasri)	50	2.75	274	1200	1096	550	1646

Khammam

Local poultry breeds have less growth rate, egg laying capacity and high .susceptibility to diseases. So demonstrations on improved breed Rajasree were conducted in NICRA village of Khammam district. Rajasri breed performed better than local breed with higher net returns of Rs. 520/bird (Table 40).

Table 40: Performance of poultry birds in augmenting farm income at Khammam

Treatment	Gross returns (Rs./ha)	Net Returns /year (Rs./bird)	Benefit Cost Ratio
Local breed	450	215/bird	1.00
Improved breed Rajasri	1479	520/bird	1.54

Nalgonda

Demonstrations on improved poultry breed Rajasri were conducted covering 40 farmers to supplement income of small and marginal farmers. Rajasri breed was found superior to local breed with higher growth rate and additional net income of Rs. 750/year/bird (Table 41).

Table 41: Performance of poultry birds in augmenting farm income at Nalgonda

Particulars	Initial weight (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.)
Local breed	300	2.2	54	590	270	440	710
Vanaraja	450	3.8	140	900	700	760	1460

Ahmednagar

Improved poultry breeds Srinidhi and Giriraja at NICRA village of Ahmednagar, showed superior performance in terms of weight and egg laying capacity. These improved varieties produced more number of eggs per year (170-175) compared to local breeds (60-70 eggs/ year) and higher weight (2-2.2 kg) over local breeds (1.25-1.50 kg).

Aurangabad

Improved poultry breed Grampriya was demonstrated as resilient poultry breed in NICRA village of Aurangabad district. Grampriya birds produced more body weight (3.8 kg/bird) and more number of eggs (180/bird/year) than the local breed with higher net income of Rs. 3800/bird/year (Table 42).

Table 42: Performance of poultry birds in augmenting farm income at Aurangabad

Breeds	Initial weight (g/bird)	Weight of bird after one year (kg/bird)	No. of eggs/bird/ year	Expenditure (Rs/10 birds)	Income from eggs (Rs.)	Income from meat (Rs.)	Total income (Rs.)
Local breed	23	2.85	90	1300	4800	4800	9600
Grampriya	34	3.80	180	1300	9600	3800	13400

Nandurbar

Poultry breed Satpuda performed better over the local breed with higher egg laying capacity (119 eggs/bird/year) with additional net income of Rs. 847/bird (Table 43).

Table 43: Performance of improved poultry breed Satpuda at Nandurbar

Particulars	Initial wt.(g)	Weight of bird after one year (kg/bird)	No. of eggs / year	Total expenditure (Rs./bird)	Income from eggs (Rs./bird)	Income from meat (Rs./bird)	Total income (Rs./bird)
Local Breed	30.04	1.32	34	360	340	397	737
Satpuda	40.36	2.04	119	400	1187	611	1799

Pune

In NICRA village, improved poultry breed Kaveri was introduced. Farmer got assured income by selling eggs as well as meat in village and local market. It ultimately improved livelihood of farmers by providing additional income of Rs.1003/bird (Table 44).

Table 44: Performance of poultry birds in augmenting farm income at Pune

Particulars	Initial wt.(g)	Weight of bird (kg/bird)	No. of eggs/ year	Total expenditure (Rs.)	Income from eggs (Rs.)	Income from meat (Rs.)	Total income (Rs)
Local breed	245	1.40	52	219	416	350	766
Kaveri breed	250	1.70	168	292	1344	425	1769

Rajasri breed at Chitoor

Eggs of rajashri breed

Grampriya birds at Aurangabad

5.6 Conservation of cattle

Calf Registration and healthy calf programme at Kurnool

Calf registration programme was initiated under NICRA project in Yagantipalle village of Kurnool district of Andhra Pradesh during 2011 with an objective to reduce the calf mortality and to improve growth rate in calves. During 2016-17, 50 buffalo calves were registered under the programme in NICRA village. The registered calves were administered monthly de-worming and supplemented with vitamin A and B-complex and feeding with calf starter for 5 months @ 500g/day. Health camps were organized every month along with medication (Table 45).

Table 45: Performance of calves registered under calf registration programme

Particulars	Farmers practice	Demonstration	Remarks
Initial body weight (kg)	28.4	26.9	The calves exhibited heat because of increased growth rate.
Final body weight (kg)	76.7	84.3	
Body weight gain (kg)	48.3	57.4	
% increase in body weight (%)	18.84		
Mortality percentage	12%	4%	

5.7 Shelter Management for stress tolerance at Jalna

Two low cost sheds of 500 birds capacity each were erected by 10 farmers in two groups. (5 farmers/group). Kadaknath breed was grown in one shed and desi birds in another one. An annual income of Rs.14920/farmer was obtained. This intervention had a marked impact on backyard poultry production especially by small and marginal farmers and has a potential for upscaling in the future (Table 46).

Shelter management for Kadaknadh breed

Table 46: Performance of various poultry breeds in low cost shed

Particulars	Kadaknath	Desi birds	Total
No. of birds produced	1000	220	1220
No. of birds sold in the market	200	20	220
No. of eggs sold in the market	-	350	350
No. of eggs used for hatching	-	230	230
Chicks hatched	-	190	190
Net Income (Rs.)	118000	31200	149200
Net Income per member (Rs.)	**23600**	**6240**	**29860**

5.8 Promotion of Fisheries

Srikakulam

Captive rearing of fish seed

Availability of water is essential for release of fish seed in main tank. Due to non assurance of water availability in main tank and requirement of higher seed rates with bigger size fish fingerlings during later period and to reduce the investment on seed cost and to increase the rate of survival, farmers are suggested to rear the fish fry up to fingerling size in captivity.

Through rearing of fish fry up to fingerling size in captivity, it was observed that the cost invested on fingerlings was reduced by Rs.0.96 on each fingerling i.e., upon release of 8830 fingerlings through captive rearing an amount of Rs 8477 was saved. When the fingerlings are purchased from the market and released into the tank, natural mortality will occur due to variation in the water temperature unlike in captive rearing where there will not be any change, as they were reared in the same situation over a period of 20-30 days. Hence, it is always advantageous to rear the fries till fingerlings in captivity (Table 47 & 48).

Table 47: Captive rearing of fish at NICRA village of Srikakulam

Treatments	Cost of rearing (Rs.)	No. of fingerlings released	Cost of each fingerlings (Rs.)	Cost incurred towards purchase of fingerlings (Rs.)	Difference in cost of investment (Rs.)
Improved practice	9220	8830	Rs. 1.04/ fingerling	9220	8444
Farmer Practice	---	8830	Rs. 2.0/ fingerling	17660	

Table 48: Economics of captive rearing of fish

Input	Captive rearing (20days)		Farmer practice	
Fry stage fish **15000 no's** released in hapa (3x7 mt) for rearing up to fingerlings	No.of fingerlings available	8830	No.of fingerlings	8830
	Cost of cultivation		**Market price of fingerlings**	
	Cost of fish fry	Rs. 4020	@ Rs. 2.00 per fingerling i.e., 8830×2.00 →	Rs. 17660.00
	Feed cost for 20 days	Rs. 700		
	Hapa charges	Rs. 3000		
	Labour charges	Rs. 1500		
	Total cost of cultivation	**Rs. 9220**		
	Price of fingerling obtained through captive rearing	9220/8830 =Rs. 1.04	Price of fingerling if purchased directly from market	17660/8830 =Rs. 2.00
	Difference in cost of investment	(cost incurred towards purchase of fingerlings – cost of fish fingerlings in captive rearing) i.e., 17660 – 9220 =Rs. 8444 **Hence, net saving through captive rearing in 20 days period = Rs. 8440**		

Optimization of stocking density of IMC Culture

Farmers generally stock the tanks with more of Catla, Rohu and CC/Mrigala and less of Grass Carp (3:4:1:2) which is leading to more weed growth in the tank reflecting lesser growth of major carps. By releasing the fish at a ratio of 3:3:1:3, the weed growth in the tank would be reduced due to higher proportion of grass carp imparting better growth of the same, further giving better scope for the growth of other IMCs viz., Catla, Rohu and CC/ Mrigala. An increase of 11.71% in yield was recorded over farmers practice with increased net income of Rs.22140.00 (Table 49).

Table 49: Optimization of stocking density of IMC Culture

Comparison of Treatments	Stock density	Seed yield (kg/ha)	Net returns (Rs./ha)	Benefit cost ratio
Improved Practice: Stocking of grass carp @300-400/acre in community tanks	**(3:3:1:3)** Catla: Rohu: CC/Mrigala: Grass carp	2346	91140	1.75
Farmers practice: Stocking of less number of Grass carps along with Indian major carp	**(3:4:1:2)** Catla: Rohu: CC/Mrigala: Grass carp	2100	69000	1.50

Water quality management in fish ponds

West Godavari

Water quality management in fish ponds was taken up to avoid sudden mortality due to changes in water quality parameters. Monitoring of water quality viz., Dissolved oxygen (DO), ammonia content and pH in fish ponds and adoption of correction measures on need basis resulted in 5.9% increase in yield and gave an additional income of Rs. 33520/ ha (Table 50).

Table 50: Water quality management in fish ponds at West Godavari

Treatments	Yield (kg/ha)	Cost of cultivation (Rs/ha)	Gross income (Rs/ha)	Net income (Rs/ha)	B:C ratio
Water quality managed pond	6460	336880	516800	179920	1.57
Without water quality management	6100	341600	488000	146400	1.42

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 animals 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 make farm machinery available within the reach of farmers with small/marginal holdings, collective ownership or Custom Hiring Centers (CHC) need to be promoted in a big way.

CHC is 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 commonly in all crops. Therefore, an ideal model envisaged in this project comprises of farm machinery that are commonly used for tillage operations for all crops, multi crop equipment and a minimum of crop specific machinery.

Objectives:

- To make available various farm machinery/equipment 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 and interventions proposed in various NICRA villages in 100 vulnerable districts, 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 centers 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 manages the custom hiring centre in each project village. The rates for hiring the machines/implements are 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 Village Climate Risk Management Committee (VCRMC) decides the price of hiring of each farm implement on consensus basis and it is displayed at the CHC. 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 CHCs in NICRA centers

Andhra Pradesh

Anantapur

Groundnut is an important oilseed crop grown in NICRA village of Anantapur district. Timeliness and precision in sowing and other operations are essential to raise the productivity of this crop. 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 services in 25 ha area of groundnut and realized income of Rs.4200. In 2013, the custom hiring centre provided hiring services to 44.8 ha area of groundnut and earned net income of Rs.14500. During rabi, it helped to provide services on hire basis to chilies and tomato in 10.5 ha area. The total net income realized by providing services in NICRA village is Rs.21500. In 2014, center provided hiring services to 25 ha of groundnut and realized service charges to an extent of Rs.3900. Thus the center generated Rs.23000 by providing services to105 ha from 2011 to 2014. During 2015-16 the centre realized a net income of Rs.24100 covering crops over 120.4 ha in 48 farmers fields using the implements viz., duck foot five row cultivator, sub-soiler for moisture conservation and seed drill for ground nut, green gram, foxtail millet. During 2016-17, 59 ha area was provided with custom hiring services benefitting 24 farmers and realized a net income of Rs.22920.

Chittoor

Custom hiring centre was established during 2015-16. 30 farmers utilized the hiring services covering an area of 10.4 ha. The list of equipment procured by the centre during 2015-16 is as follows:

S.No.	Item	No of units
1	Sub soiler	2
2	Taiwan sprayers	3
3	Portable sprayers	3
4	Power weeders	2
5	Knapsack sprayers	10
6	Disc plough	1
7	Tarpaulins	20
8	Brush cutter	1
9	Pole pruner	2
10	Tractor mounted sprayer	2
11	Star weeders	10
12	Mango harvesters	14
13	Sprinkler system	2
14	GPS	1
15	Weather instruments	1 (Rain gauge, Cup anemometer, Wind vane, Stevenson screen)
16	Rice mill machine	1
17	Paddy row seeders	5
18	Chain saw	1

The custom hiring center got an income of Rs.41500 and the same was utilized for maintenance of the machinery and the center during 2016-17.

Kurnool

Custom hiring center was established in 2011 with an investment of Rs.6.25 lakh as a group activity. The centre has 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 like pigeonpea, castor, chickpea and sorghum. The area covered under different crops was 79.4 ha. The centre realized an income

of Rs.12000 in 2011-12. About Rs.1575 was incurred towards the maintenance of tools in the centre. The net amount realized by the centre was Rs.10425/year.

During 2013-14, the centre provided services to various farmers' fields covering 85.4ha and realized an income of Rs.12772. About Rs.2500 was incurred towards the maintenance of tools. The net amount realized due to providing need based services was Rs.12272/year. The progress of the centre was monitored by the VCRMC of the village. During 2014-15, center provided 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. During 2015-16, the centre provided services to various farmers' fields by providing rotavator, drum seeders, taiwan sprayer, and sprinklers with pumpset covering 104 ha and realized an income of Rs.8400. During 2016-17 custom hiring center earned an amount of Rs.12310 through seed drills, rotavator, drum seeders, taiwan sprayer, sprinklers and pumpset benefitting 36 farmers covering 90 ha area.

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 an 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 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 a net amount of Rs.12180 during 2013. The center provided hiring services to the crops of paddy (7.0 ha), Cotton (2.0 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 net amount of Rs 8300 during 2013. The VCRMC suggested for proper utilization of the equipments, prompt collection of service charges and timely repairs of the equipments.

During 2014-15, the center provided need based hiring services to the crops of paddy, pulses, groundnut and vegetables and collected rental charges of Rs.7405. Among the equipment power sprayer was used in 150 ha and winnowing fan in 25 ha and sprinkler unit was used in 85 ha. During 2015-16 the centre realized a net income of Rs. 1500 in 50 farmers fields. 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. During 2016-17, custom hiring center realized an income of Rs.2000 covering 4 ha area in 10 farmers fields.

West Godavari

The custom hiring centre was established in NICRA village of Undi in West Godavari district on 25.10.11 with an investment of Rs.482077. The centre provided hiring services in various agricultural crops like paddy and vegetable to the extent of 31 ha in 2012. The centre realized net income of Rs.3100 for the year 20012-13. The centre provided hiring services for paddy covering 31 ha and earned a 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 every month to monitor the progress of the work and performance of the centre. During 2014-15, the center provided hired services to paddy (29 ha) and realized net income of Rs3140. During 2015-16 the centre got an income of Rs.3600 covering 15.5 ha area. 18 ha area was provided with custom hiring services in 20 farmers fields realizing a net income of Rs.241200 during 2016-17.

Telangana

Khammam

The centre was established in Nacharam village (NICRA village) of Khammam district during 2010-11 with an investment of Rs.55047 for providing hiring services for different agricultural operations to the farmers. About 9 persons were 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 Taiwan 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, chillies and maize covering 18.2 ha and realized an amount of Rs.3400. In 2014-15, the center provided the equipment on rent basis in 26.0 ha area covering the crop of paddy. During 2015-16, 25.4 ha area was provided with hiring services covering 16 farmers fields and realized an income of Rs.6070. During 2016-17 net income of Rs.3400 was earned through custom hiring of farm implements in 3.5 ha area covering 12 farmers.

Nalgonda

The centre was established in Nandyalagudem 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 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 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 service charges. The net amount realized from this centre for the current year was Rs.31000. During 2015-16 Rs.7300 was realized from custom hiring of farm implements in 23 farmers fields covering an area of 15.6 ha. Custom hiring centre earned a net income of Rs.7260 benefitting 68 farmers covering an area of 55 ha during 2016-17.

Maharashtra

Ahmednagar

The custom hiring center was established in NICRA village of Ahmednagar to provide hiring services for agricultural operations during 2011-12. A Financial support of Rs.6.25 lakhs was received from the project to establish the centre. The center initiated the activities of hiring services and covered an area of 29.4 ha in 2011-12 and earned 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 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 a net amount of Rs 64140 by covering 145.6 ha. During 2014-15, the center extended 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 a net income of Rs 31740/year. The centre generated an income of Rs.17310 in 29 farmer's fields covering an area of 37.1 ha during 2015-16. Custom hiring centre realized a net income of Rs.15500 covering 64.7 ha area during 2016-17.

Amravati

As a part of institutional innovations, the center established community based custom hiring center with an 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 a total area of 633.7 ha and realized net amount of Rs.60728. The center helped farmers in performing timely operations for the crops of soybean, cotton and chickpea and earned net profit of Rs. 33100 by covering 480.5 ha in 2013. In 2014-15, the custom hiring center helped the farmers in raising cotton (256 ha), soya bean (290 ha), chickpea (220 ha) during the year. The centre realized the amount of Rs.40750/year and incurred an expenditure of Rs17249/year. Among various equipments, the center has more demand for seed drills, Rotavator, BBF planter and sprinkler sets. The center earned a net amount of Rs.17429/year. 401 ha area is covered under hiring of farm implements realizing an income of Rs. 24430. 184 ha area was covered under custom hiring of farm implements in 168 farmers fields realizing a net income of Rs. 35000 in NICRA village during 2016-17.

Aurangabad

The center was established to provide custom hiring services to the farmers of NICRA village during 2012 with an investment of Rs.328845 with 7 implements. The centre has realized an income of Rs.95000 covering an area of 52 ha in crops of cotton, soybean and chickpea during 2014-15. During 2015-16 a net profit of Rs.58000 was obtained covering 60 ha area. Maximum number of farmers utilized sprinkler irrigation sets which not only saved water but increased profit. During 2016-17, 73 ha of area was provided with hiring services realizing a net income of Rs.7800 in crops of soybean, maize, cotton, chickpea, wheat and rabi sorghum. 46 quintals of dal (pigeon pea, chickpea, green gram and black gram) was prepared through mini dal mill unit benefiting 125 farmers from NICRA village.

Jalna

The custom hiring centre was established during 2015-16 with the following implements.

1. Tractor operated BBF planter
2. Tractor operated shredder
3. Rotavator
4. Sprinkler sets /Rain gun
5. Bullock drawn seed cum fertilizer drill (02 Nos)
6. Battery operated power sprays (02 Nos)
7. Power operated chaff cutter
8. Village level small weather station
9. GPS

The centre realized a net income of Rs. 11425 covering 30 ha area in 71 farmers fields during the year. Custom hiring center realized a net income of Rs. 12150 by providing hiring services to 126 farmers fields covering 70 ha area.

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 a net income of Rs.7000 by covering the cropped area of 110 ha. An amount of Rs.1200 was incurred towards maintenance of tools. In 2013, the center realized an amount of Rs. 2315 as hiring charges by covering the total cropped area of 99 ha. An amount of Rs.1630 was incurred as repairing and maintenance charges of tools. The important crops covered during 2013 were maize, sorghum, soybean, chickpea, wheat, garlic, groundnut, mango and vegetables. The activities of the center were monitored by VCRMC of the village. The recommendation of the committee for improved functioning of the centre was to place the implements at 4-5 places for easy accessibility since villages are scattered in hilly areas. About 12 farmers purchased their own allen cultivator for their use. Small hand tools are also purchased by the farmers. The key issues realized for the sustainability of this center are: 1. The implements which are light in weight, have been preferred by the farmers due to easy transportability. 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 like 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 a total area of 16 ha and earned net profit of Rs.1070 besides earning total gross income of Rs.5480/year. During 2015-16, 33 ha of area is covered in 93 farmers field with an income of Rs.980. Custom hiring center in NICRA village benefitted 165 farmers realizing a net income of Rs.2900.

Pune

Custom hiring center was established in NICRA village with an investment of Rs.6 lakhs during 2011. 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 hiring charges of Rs.10090. An amount of Rs.10900 was incurred towards repair and maintenance charges of tools. The centre helped the farmers in providing hiring services on 36.1 ha area and realized the amount of Rs. 6960. The CHC provided hiring services in 33.4 ha covering the crops of pearlmillet, onion, rabi sorghum, chickpea and maize realizing an amount of Rs.5130 during 2014-15. An amount of Rs.2700/year was incurred as expenditure

to maintain the center. During 2015-16, 59.5 ha area is covered under custom hiring of farm implements in 114 farmers fields with a net income of Rs.7750. Net income of Rs.2900 was earned by providing hiring services to 165 farmers.

Ratnagiri

The Custom hiring center was established as a group based activity to provide hiring services of agricultural operations in NICRA village in 2011with the project support of Rs. 6.25lakhs. About 13 VCRMC members are engaged in running the center. The center helped in providing hiring services for paddy over 170 ha and realized a net amount of Rs.2200 after incurring maintenance charges of Rs. 3500 in 2012. In 2013, the center earned a 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 on 19 ha area and realized a income of Rs.14560. The important crops covered with hiring services were paddy (14.0 ha), cowpea (1 ha) and cashew (5 ha).The center realized an amount of Rs.12080/year due to custom hiring services. During 2015-16 custom hiring of implements realized an income of Rs.10550 covering 10.1 ha area. 38.5 ha of area was provided with custom hiring services during 2016-17 realizing a net income of Rs.9020.

Table 51: Performance of custom hiring center at different NICRA centers during 2016-17.

KVK	Farmers covered	Area covered (ha)	Revenue generated through CHCs (Rs.)
Anantapur	24	58.8	22920
Chittoor	150	144.0	41500
Kurnool	36	9.0	12310
Srikakulam	10	4.0	2000
West Godavari	20	18.0	241200
Khammam	12	3.5	3400
Nalgonda	68	55.0	7260
Ahmednagar	54	64.7	15500
Amravati	168	184.2	35000
Aurangabad	31	73.0	7800
Jalna	126	70.2	12150
Nandurbar	165	99.0	2900
Pune	9	24.4	3210
Ratnagiri	13	38.5	9020
Total	**886**	**927.3**	**416170**

6.2 Seed bank

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 requirement of small farmers at affordable prices and at the right time which would enhance crop productivity and household food security. The baseline studies in the project areas identified key problems related to seed supply system. Lack of timely availability of good quality seed of high-yielding varieties is one of the major constraints contributing to stagnant yields of crops in the project area.

The project devised alternative 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 villages. 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 ensured higher incomes to farmers through local seed enterprises.

Andhra Pradesh

Seed production of groundnut var K-6(120 kg), groundnut var Dharani(180 kg), foxtail millet (20 kg), Paddy var NLR-34449, Fodder jowar (300 kg), Co-FS-29 (200 kg) was taken up for seed bank in NICRA village of Anantapur district covering 40 farmers in 18.5 ha area. During this kharif 2016 seed production in Paddy (BPT-5204), redgram (Asha-87119 & PRG-176) and foxtail millet (SIA-3088) and bengalgram (NBeG-3) was taken up to establish seed bank in the NICRA village of Kurnool district. Timely availability of seed of flood tolerant varieties of paddy is the major problem in NICRA village of Srikakulam district. Seed of flood tolerant varieties RGL-2537(30 kg), PLA-1100 (30 kg), MTU-1061 (30 kg) and MTU-1064 (30 kg) was produced during 2016-17 for maintenance of seed bank.

Telangana

Seed of salinity tolerant variety of paddy Siddi (WGL-44) and sun hemp crops were produced from 2014-15 to 2016-17 to maintain the seed bank in NICRA village. 31 q of paddy seed and 27 q of sun hemp seed was produced benefiting 69 and 48 farmers respectively over three years.

Maharashtra

276 kg of soyabean seed (MAUS-158) was produced in NICRA village of Amravati district involving 19 farmers. Seed of drought tolerant varieties of rabi sorghum Phule Anuradha (5 q) and Phule Vasudha (10 q) was produced to overcome the shortage of seed availability in NICRA village of Pune.

6.3 Fodder bank

Fodder cultivars Tanzania, Co-3 and Co-4 were cultivated in 8, 14 and 20 ha of area respectively in NICRA village of Khammam district. 900 tones of fodder was produced during 2016-17. 400 q of fodder was sold to the farmers during deficit period earning a net income of Rs. 7300. 82 q of fodder was produced in NICRA village of Amravati district covering an area of 28 ha. KVK Jalna has ensured availability of green fodder through effective demonstrations of fodder crops like fodder maize, hybrid napier, lucern, berseem, etc. Sufficient quantity of hybrid napier and dry kadbi is now available in NICRA village.

7. Capacity building of farmers and youth on climate resilience in agriculture

There is a need to focus on skill oriented training programmes to farmers of NICRA villages pertaining to on-farm technological demonstrations in participatory mode, so that they can extend their cooperation in recording need based data on technologies in respect of raising crops and livestock, NRM activities and crop production in different districts of Andhra Pradesh, Telangana and Maharashtra. The NICRA centers working in the state of Andhra Pradesh organized 130 skill oriented training programmers with the active participation of 4050 participants, while the NICRA centers in the state of Telanaga, organized 21 need based training programmes on improving the productivity of agricultural and horticultural crops, livestock, and custom hiring centers with active involvement of 557 participants. In Maharashtra, the NICRA centers organized 168 training programmes with the participation of 4255 farmers. Thus the Programme Coordinators in the states of Andhra Pradesh, Telangana, and Maharashtra organized 319 training programmes with the participation of 7175 farmers and 1687 farm women. The list of training programmes organized includes: Natural resource management, resource conservation technologies, soil productivity improvement, climate resilient intercropping systems, contingency crop planning, crop diversification, nutrient management, integrated pest management, soil test based fertilizer application, farm implements, fodder and feed management, livestock management, seed banks, fodder banks and integrated livestock Management etc (Table 52&53).

Table 52: State-wise Summary of capacity building activities

State	No. of courses	Male	Female	Total
Andhra Pradesh	130	3404	646	4050
Telangana	21	494	63	557
Maharashtra	168	3277	978	4255
Grand Total	**319**	**7175**	**1687**	**8862**

Table 53: Capacity building activities

KVK	Title of the training programmes	No. of courses	Male	Female	Total
Anatapur	Crop diversification	1	126	21	147
	Crop management	5	130	22	152
	Exposure Visit to ARS Rekulakunta	1	10	4	14
	Exposure visit to GKVK, Bangalore	1	8	--	8
	Farm implements and machinery	1	130	22	152
	Field day on redgram improved varieties	2	67	15	82
	Field day on redgram zero tillage	1	59	7	66
	Fodder and feed management	1	126	21	147
	Live stock management	1	120	35	155
	Nursery raising	1	97	28	125
	Nutrient management	1	103	20	123
	Pest and disease management	4	69	7	76
	Resource conservation technologies	4	120	35	155
	Veterinary training on animal feeding & Backyard poultry	1	48	6	54
	Veterinary training on milch animals	2	84	12	96
	Weed control	1	102	29	131
	World Soil day	1	97	28	125
	World Water day	1	67	11	78
Chittoor	Azolla production	1	11	8	19
	Fodder and feed management	2	48	28	76
	Importance of critical irrigation stages and life saving irrigation in groundnut	1	20	8	28
	Importance of kitchen gardening for farm women	1	6	18	24
	Importance of medicinal plants in daily life	1	20	7	27
	Improved production technology of tomato	1	8	4	12
	Integrated crop management	1	22	3	25
	Integrated nutrient management	1	35	10	45
	Irrigation water management – Sprinkler and rain gun method of irrigation	1	20	2	22
	Live stock management	1	30	5	35

KVK	Title of the training programmes	No. of courses	Male	Female	Total
	Natural resource management	1	30	5	35
	Pest and disease management	1	25	5	30
	Pest and disease management in Chrysanthemum	3	54	12	66
	Pest and disease management in tomato	1	9	8	17
	Post harvest management in mango	1	17	6	23
	Production technology of chrysanthemum	1	11	7	18
	Resource conservation technologies	1	38	7	45
	Soil fertility management in mango	1	20	4	24
	Training programme on 'Control of Parthenium weed'	1	22	4	26
	Weed management in field and hort. crops	1	22	9	31
Kurnool	Crop diversification	5	92	20	112
	Crop management	6	180	26	206
	Drought management	2	74	10	84
	Farm implements & machinery	1	26	0	26
	Fodder& feed management	1	18	4	22
	Livestock	7	135	40	175
	Resource conservation technology	8	124	13	137
	Nursery raising	1	32	4	36
	Pest & Disease management	3	62	22	84
	Pomegranate cultivation	1	30	4	34
Srikakulam	Captive rearing of fish seed to reduce the mortality and cost of cultivation	1	25	0	25
	Importance of flood tolerant paddy varieties in flood prone area	1	20	0	20
	Management practices of paddy and cotton	1	45	8	53
	Nursery management in shade net	1	28	1	29
	Production technologies in summer pulses and oil seeds	1	31	6	37
	Stem application in Bt cotton against sucking pests	1	20	5	25

KVK	Title of the training programmes	No. of courses	Male	Female	Total
West Godavari	Backyard poultry	2	22		22
	Bio fertilizers application in paddy	2	22	--	22
	Black headed caterpillar in coconut	2	27	--	27
	BPH and disease management in paddy	2	26	--	26
	Custom hiring center-Farm implements and machinary	2	20		20
	Direct sowing with drum seeder in Paddy	2	26		26
	Disease diagnosis in prawn ponds	2	20	--	20
	Machine transplanting in paddy	2	19		19
	Nursery management in mechanical trans planting	2	30		30
	Paddy nursery management	2	26	-	26
	Pest and disease management in paddy	2	36	--	36
	Resource conservation technologies	2	20		20
	Training on pest and disease management in rabi paddy	2	23		23
	Training programme on direct sowing & machine transplanting in rabi paddy	2	20		20
	Training programme on mechanical transplanted paddy	2	22		22
	Vermicompost making	2	26		26
	Water quality management in fish ponds	2	26	--	26
	Weed control in direct sowing	2	20		20
Khammam	Integrated farming system(IFS)	2	46	3	49
	Farm mechanization and utilization of custom hiring center	2	41	6	47
	Fish rearing and disease management in ponds	2	45	5	50
	Soil and water conservation techniques	2	47	4	51
	Pest and disease management in kharif and rabi crops.	2	48	4	52

KVK	Title of the training programmes	No. of courses	Male	Female	Total
Nalgonda	Crop diversification	1	21	6	27
	Drought mitigation practices	1	28	5	33
	Farm implements	1	26	2	28
	Livestock management	2	59	4	63
	Nutrient management	1	26	5	31
	Pest and disease management	1	14	4	18
	Resource conservation technology	3	75	8	83
	Vermicompost	1	18	7	25
Ahmednagar	Climate resilient crop management practices in kharif crops	1	32	0	32
	Fodder management in livestock	2	78	0	78
	Integrated bacterial blight management in pomegranate	1	42	0	42
	Silage making	1	45	0	45
	Use of evaporation retardant in farm ponds	1	48	0	48
Amravati	Crop Management	5	154	41	195
	Employment generation	2	32	15	47
	Farm implements and machineries	5	78	23	101
	Fodder and Feed management	3	142	15	157
	Live stock management	4	98	15	113
	Natural resource management	3	56	17	73
	Women awareness	1	0	69	69
	Nutritional gardening	0	0	0	0
	Organic farming	0	0	0	0
	Pest and Disease management	2	45	18	63
Aurangabad	Advance water management practices for rabi crop for increasing water use efficiency	2	43	30	73
	Back yard poultry management	1	26	14	40
	Bahar management in sweet orange	2	40	20	60
	BBF technology for good crop yield	1	25	14	39
	Commercial cultivation of dry land horticultural crops	3	23	13	36
	Cultivation of green folder	2	18	12	30
	Cultivation of turmeric and ginger	1	29	6	35

KVK	Title of the training programmes	No. of courses	Male	Female	Total
	Different crops grown under drought conditions and contingency measures to overcome drought.	1	44	27	71
	Different methods of preparation of compost and their importance.	1	48	35	83
	Efficient utilization of wheat straw by enriching with urea treatment	1	36	10	46
	Feed management in goat rearing	4	62	27	89
	Foliar spraying of 13:0:45 and 19:19:19 on field and horticultural crops	1	21	0	21
	Importance of micronutrients	1	24	0	24
	Importance of vaccination in livestock	2	20	14	34
	Improved technology for higher production of maize & bajra	4	12	15	27
	Insect and pest management in pomegranate crop	2	28	13	41
	Integrated pest and disease management in kharif crops	3	24	18	42
	Land preparation for better soil and water conservation.	1	50	34	84
	Mini dal mill maintenance and management	3	49	36	85
	Modern cultivation practices in gram and wheat	2	23	16	39
	Nursery management in fruit crops	1	41	8	49
	Package & practices of soybean	3	27	10	37
	Post-harvest management practices in rabi crops	1	26	12	38
	Production of vermicompost by different method	3	46	13	59
	Production technology in onion	2	23	10	33
	Protected cultivation of vegetables & flower crops	1	23	16	39
	Integrated pest and disease management in rabi crops	2	42	11	53
	Seed production technology in wheat & bengal gram	4	24	9	33
	Soil test based INM in cotton	1	38	12	50

KVK	Title of the training programmes	No. of courses	Male	Female	Total
	Sustainable livelihood through Integrated farming	4	19	31	50
	Training and pruning in pomegranate	1	30	0	30
	Weed management of Kharif crops	1	45	20	65
	Weed management of rabi crops	1	30	7	37
Jalna	Management of Onion seed production	1	16		16
	Backyard poultry farming	1	25	-	25
	Bahar management in Sweet orange	1	16	-	16
	Care & maintenance of farm implements	1	8	-	8
	Commercial fodder production	1	20	-	20
	Community approach for white grub management	1	18	-	18
	Development of nutritional garden for family health	1	-	12	12
	Different methods of rain water harvesting and its management	1	27	-	27
	Floriculture for small farmers	1	14	-	14
	Foliar nutrition in major Kharif crops during dry spell	1	52	-	52
	ICM in major rabi crops (Safflower, Sorghum, Chick pea & Wheat)	1	22	-	22
	Identification of common diseases in animals and first aid	1	18	-	18
	Importance of soil health & nutrient management	1	45	-	45
	Importance of Vaccination in animals & Vaccination schedule	1	21	-	21
	Integrated crop management in major kharif crops (Cotton, Soybean, Maize &Bajra)	1	21	-	21
	Integrated nutrient management in red gram, cotton & sweet orange	1	26	-	26
	Integrated Pest Management in cotton	1	18	-	18
	Integrated Pest management in pigeon pea	1	24	-	24
	IPM in Bengal gram	1	18	-	18
	Methods of in-situ soil moisture conservation for major Kharif crops	1	28	-	28

KVK	Title of the training programmes	No. of courses	Male	Female	Total
	Production technology of rabi & summer vegetable	1	18	-	18
	Safflower Production Technology	1	21	-	21
	Silk worm rearing	1	22	-	22
	Soybean processing	1	-	35	35
	Techniques of community water budgeting in the village	1	17	3	20
	Urea treatment on wheat straw	1	22	-	22
	Value addition of red gram	1	23	-	23
	Vermicompost production	1	22	-	22
	Water management in rabi crops	1	36	-	36
Nandurbar	Backyard poultry management	1	11	5	16
	Cultivation technology of green gram	1	25	0	25
	Cultivation technology of okra	1	13	0	13
	Disease and pest management in ground nut	1	18	0	18
	Drought mitigation techniques	1	10	7	17
	Drudgery reducing tools	2	0	15	15
	Fodder production	1	22	10	32
	Importance of mineral mixture	1	9	5	14
	Improved cultivation practices in groundnut	1	15	0	15
	Improved farm implements	1	16	0	16
	In-situ moisture conservation	2	32	0	32
	Kharif crop management	1	18	0	18
	Production technology of onion seed production	1	11	5	16
	Production technology of potato and pea	1	10	5	15
	Temporary check dam	1	10	6	16

KVK	Title of the training programmes	No. of courses	Male	Female	Total
Pune	Awareness programme of management of Kharif season crops	1	32	0	32
	Awareness programme on cultivation of fodder maize for silage making	1	30	0	30
	Awareness programme on ICM in onion	1	28	0	28
	Cultivation of green gram by BBF Method	1	16	2	18
	Cultivation of rabi sorghum	1	17	0	17
	Cultivation of sunflower as contingency crop	1	21	0	21
	Ecto and endo parasitism control in sheep and goat	1	0	25	25
	Fodder production and silage making	1	0	14	14
	Goat farming	1	13	8	21
	Intercropping of sunflower and bajra	1	25	0	25
	Management of goats under stall fed condition	1	0	25	25
	Management of kharif season crops	1	17	0	17
	Poultry management	1	17	0	17
	Protected cultivation	1	35	0	35
	Seed production and processing	1	18	0	18
	Training on silage making	1	34	0	34
	Transplanting of red gram seedlings	1	18	2	20
	VCMRC meeting and discussion on interventions to be carried out in the year 2016-2017	1	42	0	42
Ratnagiri	Rice crop cultivation	1	29	7	36
	Poultry bird rearing and Azolla production	1	12	20	32
	Fertilizer management in rice	1	12	5	17
	Training on pest and disease management in rice	1	21	4	25
	Training on Azolla production	1	11	7	18
	Groundnut cultivation	1	23	4	27
	Vermicompost making	1	19	6	25
	Crop diversification	1	22	4	26
	Poultry bird rearing	1	18	11	29

Training programme (Anantapur)

VCRMC Meeting (Kurnool)

Training programme (Khammam)

Training programme (Ahmednagar)

Training programme (Aurangabad)

Training programme (Kurnool)

8. Extension activities for popularization of climate smart agricultural practices

Transfer of climate resilient agricultural technologies was done with the involvement of KVK staff located in respective districts of NICRA villages of Andhra Pradesh, Telangana and Maharashtra states through various extension activities. The extension activities organized by different KVKs in NICRA centers during 2016-17 include awareness programmes on climate resilient agriculture, field days, kisan melas, method demonstrations, health camps, diagnostic visits, agro-advisory services, exposure visits etc., During 2016-17, 626 extension activities were taken up with the participation of 23152 farmers. Among these, 221 activities were organized with 4985 farm men and1342 farm women in the state of Andhra Pradesh: while in Telangana state, 109 extension activities were organized with the participation of 2390 farm men and women. About 14435 farm women and men participated in 296 extension activities in the state of Maharashtra during 2016-17. The details are presented below: (Table 54 & 55).

Table 54: State wise Summary of extension activities

State	No. of programmes	Male	Female	Total
Andhra Pradesh	221	4985	1342	6327
Telangana	109	1687	703	2390
Maharashtra	296	11669	2766	14435
Grand Total	**626**	**18341**	**4811**	**23152**

Table 55: Extension activities

KVK	Title of the activity	No. of activities	Male	Female	Total
Chittoor	Agro advisory services	14	69	3	72
	Awareness on post harvest technology in mango	1	19	8	27
	Awareness on Producer Organization (Participated by NICRA farmers at Chittoor conducted by Dept of Horticulture)	1	4	-	4
	Demonstration of foggers and mineral mixture blocks	3	30	5	35
	Demonstration of rain gun and sprinkler system	1	22	-	22
	Diagnostic visit	14	72	23	95

KVK	Title of the activity	No. of activities	Male	Female	Total
	Exposure visit	2	60	10	70
	Farmer interaction meeting with DDG, Dr. A.K. Singh	1	98	67	165
	Farmers interaction meeting with Dr. K. Raja Reddy, DE, ANGRAU and Dr.A.R.Reddy, PS, ATARI	1	8	3	11
	Field day in Chysanthemum	1	25	5	30
	Field day in groundnut	1	21	6	27
	Field day in tomato (Polythene mulch technology)	1	18	5	23
	Field day on green manuring in mango	1	26	5	31
	Financial literacy awareness programme	1	27	22	49
	Method demonstration of enrichment of Farm Yard manure with Trichoderma and Neem cake for soil application in tomato and Chrysanthemum	1	19	5	24
	Method demonstration of plastic mulching in tomato	1	8	4	12
	Method demonstration of power weeder in tomato	1	15	2	17
	Parthenium control awareness week	7	77	28	105
Kurnool	Awareness on kharif preparedness	4	83	20	103
	Group Discussions	7	112	25	137
	Agro advisories	96	3312	984	4296
	Method Demonstration	2	39	7	46
	Diagnostic visit	3	56	6	62
Srikakulam	Training programmes	4	110	13	123
	Method demonstrations	3	45	11	56
	Agro advisory services	20	140	15	155
	Awareness programmes	3	87	39	126
	Group discussion	1	19	6	25
	Diagnostic visit	13	112	15	127
West Godavari	Bacterial leaf blight in paddy	1	29		29
	Bio-fertilizers application in paddy	1	22	--	22
	Direct sowing with drum seeder	1	20	--	20
	Disease diagnosis in prawn ponds	1	20	--	20

KVK	Title of the activity	No. of activities	Male	Female	Total
	Mechanical Transplantation	1	26	--	26
	Seed treatment in paddy	1	15	--	15
	Stem rot in paddy	1	22	--	22
	Stem rot and BPH management in paddy	1	26	--	26
	Testing of dissolved oxygen in ponds	1	18	--	
	Tray nursery	1	30	--	30
	Water quality of fish ponds	2	42	--	42
Khammam	Method demonstrations	8	95	23	118
	Agro advisory services	9	600	440	1040
	Awareness programmes	12	168	72	240
	Group discussions	24	360	76	436
	Diagnostic visit	24	240	48	288
Nalgonda	Agro advisory services on crop production technologies	7	49	6	55
	Awareness programme	2	32	6	38
	Group discussion	4	33	11	44
	Method demonstrations	2	30	8	38
	Diagnostic field visit	15	42	13	55
	Exposure visit to KVK	2	38	-	38
Ahmednagar	Field days on soybean	1	39	0	39
	Field day on bengal gram	1	45	0	45
	Field day on onion	1	35	0	35
	Mobile alert system		530	121	651
	Seminar on pomegranate cultivation	1	108	-	108
	Group meeting - cotton crop management	1	17	-	17
	Exposure visit	1	26	0	26
Amaravathi	Method demonstration	2	95	45	140
	Exposure Visit	1	25	0	25
	Field day	2	156	25	181
	Kisan Melas	1	35	14	49
	Technology Week	1	161	42	203

KVK	Title of the activity	No. of activities	Male	Female	Total
Aurangabad	Field Day	6	138	52	190
	Method Demonstrations	17	368	64	432
	Exposer Visit	2	82	41	123
	Krishi Din	1	67	21	88
	Trainings	34	1059	513	1572
	Agro advisory services	76	424	84	508
	Awareness	23	341	86	427
	Group discussion	20	363	62	425
	Diagnostic visit	11	258	71	329
Jalna	Distribution of 157 soil health card in Kadegaon village	1	157	-	157
	Field survey to FLDs of soybean, Maize, Pigeon pea and Cotton crops	1	18	-	18
	CIAE Bhopal and VNMKV Parbhani scientist visited kadegaon for bullock based agri. Equipment	1	26	-	26
	Participation in National Food security in pulse production program & distribution of green gram on 40 ha	1	100	-	100
	Training on Improved Agri Equipment's and demonstration of Bullock based Agri. Inputs at Department of Agri. Engineering VNMKV Parbhani	1	22	-	22
	Special campaign for Non-loany farmers at Kadegaon under PMFBY to bring awareness on crop insurance	1	22	-	22
	Group discussion on construction of low cost poultry sheds for women SHGs model for poultry- Mr. H. M. Aage SMS Veterinary Science &Shrim. S.R. Gaikwad SMS Home science	1	12		12
	Vaccination camp for cow, buffaloes & goat in Kadegaon (76 Animal benefited)	1	25		25
	Exposure visit: Participation in Kharif Farmers Rally and visit to university	1	20	-	20
	Exposure visit: Visit to Kadwanchi watershed, water budgeting model, successful High Density orchard of Mango & Guava at Bhatepuri	1	40	5	45

KVK	Title of the activity	No. of activities	Male	Female	Total
	Organised Soybean field day by KVK Jalna under NFSM of oilseed at Kadegaon	1	34		34
	Organised Maize field day by KVK Jalna & South Asia Bio-technology centre, New Delhi at Kadegaon	1	126		126
	Exposure visit: High Tech Custard Apple Production of Innovative Farmer at Palaskheda, Avaghadraosavangi & Honey Rearing Centre at Dhad	1	25	-	25
	Awareness programme: KVK scientist with Kadegaon village farmers took oath of 'Gram Swachhata' & celebrated 'Swachhata Pakhawada' as per guidelines of ICAR	1	38	-	38
	Feeding management & disease control programme in livestock & Animal health camp-by Dr. H.M. Aage	1	55	3	58
	Exposure visit for *Climate Resilient Technology*	1	25	-	25
	Celebration of 'Jay Kissan Jay Vigyan' awareness programme	1	32	2	34
	Exposure visit of farmers to College of Agri. VNMKV Parbhani	1	7	-	7
	Rabi crops field day	1	119	-	119
	Field day of Shredder	1	36	1	37
Nandurbar	Awareness prog. on organic farming	1	35	10	45
	Animal health camp and dewormimg	1	30	21	51
	Awareness prog. on crop insurance	1	43	0	43
	Awareness prog. on eradication of Parthenium grass	1	24	0	24
	Awareness prog. on NICRA interventions	1	34	10	44
	Awareness prog. on improved shelter	1	18	5	23
	Awareness prog. on PMFBY	1	22	0	22
	Awareness prog. on tree plantation	1			
	Cleanliness drive	3	70	0	70
	Deworming camp	1	25	7	32

KVK	Title of the activity	No. of activities	Male	Female	Total
	Exhibition on improved farm implements	4	5134	1251	6385
	Exposure visit	2	36	0	36
	Field day of deshi cotton	2	64	0	64
	Group discussion	3	50	0	50
	Method demonstration of hand ridger	1	15	0	15
	Method demonstration of sowing of onion	1	12	4	16
	Method demonstration of drudgery reducing tools	1	35	10	45
	Method demonstration of ridger	1	17	0	17
	Method demonstration of tubular maize sheller	1	18	0	18
	Pre kharif planning meet	1	40	5	45
	Prog. on digital payment	1	36	7	43
	Rabi planning meet	1	14	0	14
	Soil health card programme	1	24	0	24
	VCRMC meeting	3	27	4	31
	Visit of Agri. Officers	1	13	0	13
	Visit of Cini Officers to NICRA village	1	3	2	5
Pune	Celebration of Maharshtra Krushi Din- 1st July	1	41	2	43
	Exposure Visit Jogvadi for see different breeds of goat	1	13	8	21
	Parthenium awareness week at NICRA village	1	48	4	52
	Field day on transplanting of redgram seedlings	1	33	0	33
Ratnagiri	Awareness programme	5	97	34	131
	Farmers rally	1	48	52	100
	Exposure visit	1	18	6	24
	Method demonstrations	1	20	5	25
	Group discussion	15	128	40	168
	Diagnostic visit	9	73	27	100

Method demonstration

Exposure visit to Agricultural Science Congress

Field day (Chittoor)

Field visit (Khammam)

Awareness programme

Field visit (Aurangabad)

Exposure visit

Awareness Programme

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