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वार्षिक प्रतिवेदन
Annual Report
2015-16




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भाकृअनुप - भारतीय जल प्रबंधन संस्थान
ICAR-Indian Institute of Water Management
Bhubaneswar, Odisha, India

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भारतीय जल प्रबंधन संस्थान
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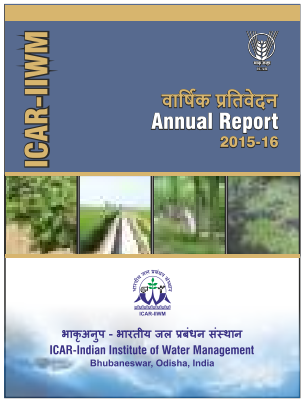

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PREFACE

Water is the most important natural resource for agricultural production systems; but its availability for irrigation is being seriously affected due to increase in population, rapid industrialization, urbanization and declining groundwater table. Per capita availability of water per year is steadily declining over years. Though there has been a significant achievement in water resources development in the country, a wide gap still exists between irrigation potential created and its utilization. With this background and challenges, our Institute is working towards research on on-farm water management in the country, capacity building of associated personnel and farmers, and dissemination of technologies. I feel extremely happy to bring out the detailed presentation of Institute's progress contained in the Annual Report of the Institute for the year 2015-16.

Significant research achievements for the year 2015-16 have been included in this annual report under five approved programmes of the Institute i.e., rainwater management, canal water management, groundwater management, waterlogged area management and on-farm research and technology dissemination. Our scientists have assessed groundwater storage potential using NASA's GRACE satellites, developed water resource management plan for coastal areas, drainage plan for Mahanadi delta, methods of computing virtual water, delineated waterlogged areas; developed runoff recycling and land modification technique for enhancing productivity, water and nutrient self-reliant farming system for rainfed areas, optimized stocking density of pacific white shrimp culture, climate resilient agriculture, groundwater management for enhancing adaptive capacity to climate change, options for enhancing irrigation efficiency and integrated farming systems in canal command, SRI and constraints in its adoption, drip irrigation for rice-based cropping, drum-based drip irrigation system, N-application strategy for waterlogged area; while addressing wastewater use, our Scientists have developed filter for wastewater treatment and remediation of polluted water; developed software for conjunctive use of water, livelihood improvement options for tribal farmers, social and sustainability implications of water management interventions and developed agriculture water management portal.

Under the *Pradhan Mantri Krishi Sinchayee Yojana* (PMKSY) of the Government of India, our Scientists have played a major role in capacity development to all India service officers (IAS and IFS) of eastern Indian states, district agricultural officers and soil conservation officers etc., prepared district irrigation plan (DIP) for five districts of Odisha, a quick study report on cropping pattern for optimal utilization of water resources. Our institute coordinates AICRP on Irrigation Water Management and has initiated Agri-Consortia Research Platform on Water. Under MoA & FW funded project, our institute has initiated activities of on-farm water management at farmer's field of Rasulpur Jattan of Muzzaffarnagr

district of UP. Also, under *Mera Gaon Mera Gaurav* (MGMG) programme, our scientists have participated in transfer of technology to thirty villages across seven blocks in Odisha. All scientists and staffs are actively involved in cleanliness drive throughout the year under *Swachh Bharat Abhiyan*. We have organized one National Symposia at the Institute, conducted seven training programs for Government officials and students; fifteen training programs for farmers on various aspects of water management, and participated in nine exhibitions to showcase Institute developed technologies.

Scientists of the Institute have published 36 research papers, 18 books/ bulletins/ training manuals and 4 leaflets/ folders/ brochures during 2015-16. As recognition for significant achievements, our scientists have received the J.J. Chinoy gold medal award by Indian Society for Plant Physiology, Ekamara Shree award and Fellow award by Indian Society of Coastal Agricultural Research, along with many other honours and recognitions.

I acknowledge sincerely the valuable guidance, suggestion and support of Dr. S. Ayyappan former Secretary, DARE and Director General, ICAR; Dr. T. Mohapatra, Secretary, DARE and Director General, ICAR; Dr. A.K. Sikka, former Deputy Director General (NRM), ICAR; Dr. S.K. Chaudhari, Assistant Director General (S&WM), NRM, ICAR, New Delhi and other concerned officials of the Council. I express my sincere thanks to the esteemed Chairman and members of RAC and IMC for their valuable guidance, inputs and involved support. I thank all members of IRC, Chairman and members of different institute committee, administration and finance section of the Institute for help, cooperation and smooth functioning of the Institute. The efforts rendered by programme leaders and publication committee for compilation and editing the Annual Report are highly appreciated. I thank all staffs of the institute for their support in carrying out institute's activities. I hope that our Annual Report will be immensely useful for stake holders i.e., policy makers, researchers, development functionaries and farmers.

30 June 2015
Bhubaneswar

S.K. Ambast
Director, ICAR-IIWM

कार्यकारी सारांश

वर्षा आधारित क्षेत्रों के लिए पानी एवं पोषक तत्व आत्मनिर्भर खेती की पद्धति पर अध्ययन: धान की फसल में सिसबेनिया हरी खाद 14.8 टन/हेक्टेयर एवं वर्मीकम्पोस्ट 3 टन/हेक्टेयर के प्रयोग से अनाज की उपज में 7% की कमी हुई, लेकिन रसायनिक उर्वरकों के प्रयोग की तुलना में ऊर्जा दक्षता (20.5) एवं विशिष्ट ऊर्जा अधिक प्राप्त हुई।

उत्पादकता बढ़ाने के लिए वर्षा अपवाह रीसाइक्लिंग मॉडल का विकास एवं भूमि संशोधन: भूमि संशोधन वर्षा के मौसम में अधिक वर्षा अपवाह का संचय बढ़ाने के लिए किया गया और इस संचित पानी को रबी मौसम की फसलों की सिंचाई के लिए उपयोग में लिया गया। इसमें खेत में नियमित अंतराल पर मिट्टी के माउन्ड बनाए गये, जिससे जलग्रहण क्षेत्र में 390 वर्ग मीटर/हेक्टेयर का अतिरिक्त सतही क्षेत्र उपलब्ध हुआ। तालाब में मछली-पालन एवं तटबंध पर पपीता की खेती सफल रही। जलग्रहण क्षेत्र में धान, लोबिया, ब्रोकोली, सरसों, उड़द तथा मूंग की फसलों को उगाने से वार्षिक शुद्ध आय में 1,80,000 रुपये तक की वृद्धि हुई।

पेसिफिक सफेद झींगा के भंडारण घनत्व का अनुकूलन: लीटोपीनियस वान्नामी के लिए वांछित भंडारण घनत्व 50 लार्वा/वर्ग मीटर पाया गया जिससे अधिक उपज (10.3 टन/हेक्टेयर), कम उपभोगीत जल उपयोग (1.93 घन मीटर/ किग्रा जैविक उत्पादन), अधिक आर्थिक आय (1.99) एवं शुद्ध उपभोगीत जल उत्पादकता (रुपए 73.3/ घन मीटर) प्राप्त होती है।

नहरी कमांड में सिंचाई दक्षता बढ़ाने के लिये व्यवहार्यता का मूल्यांकन: इनलेट संरचना के प्रवाह हाइड्रोलिक्स एवं आउटलेट संरचना में प्रवाह विनिमय पैटर्न से पता चला कि नॉन स्कोरिंग वेग के साथ सर्विस जलाशय द्वारा फ्लो रेजिम उप संवेदनशील था। निर्माण किए गये कुंए का ड्रॉडाउन, प्रारंभिक रिकूपिरेसन दर 8.3 सेमी/घंटा के साथ 0.9 पाया गया। इन कुंओं के कमांड क्षेत्र में फव्वारा सिंचाई पद्धति के प्रदर्शन का भी अच्छी तरह से अध्ययन किया जा रहा है।

जलवायु अनुरूप कृषि पर अध्ययन: मक्का की फसल के लिये सकल एवं शुद्ध प्राथमिक उत्पादकता (NPP एवं GPP) तथा ऊर्जा संतुलन का एडी सहप्रसरण तकनीक का उपयोग कर मूल्यांकन किया गया। मक्का में शुद्ध प्राथमिक उत्पादकता -247 ग्राम/ वर्ग मीटर प्राप्त हुई। पॉलिथीन पलवार के प्रयोग से जल उत्पादकता बिना पलवार की तुलना में मूंगफली में 180% एवं सूरजमुखी में 148% से बढ़ी। तमिलनाडू राज्य की अमरावती बेसिन में भूजल पुन:भरण क्षेत्रों का मैप तैयार किया गया।

नहरी कमांड के तहत एकीकृत खेती पद्धति का विकास: ओडिशा राज्य के नयागढ़ जिले के अंदर दसपाला ब्लॉक में कुआंरिया नहर कमांड क्षेत्र के विभिन्न स्थानों जैसे हेड, मध्यम एवं टेल छोर के तहत एकीकृत खेती पद्धति को विकसित किया गया। तटबंध पर बागवानी, तालाब में मछली पालन एवं पूरक सिंचाई द्वारा जल के बहुआयामी उपयोग से जल उत्पादकता में 20.5 से 53.5 रुपए/ वर्ग मीटर तक वृद्धि हुई।

धान सघनता पद्धति (एसआरआई) के तहत अनाज की गुणवत्ता एवं इसके अपनाने में आने वाली बाधाओं का विश्लेषण: एसआरआई विधि ने धान के दानों में सूक्ष्म पोषक तत्वों की सांद्रता (40% आइरन, 214% जिंक, 32% मेंगनीज एवं 99% कॉपर) को बढ़ाया। साबूत चावल की प्राप्ति पारंपरिक रोपित धान (49.2%) की तुलना में एसआरआई (55.8%) में अधिक हुई। धान के मुख्य टिलर की दाना भरने की दर भी एसआरआई में रोपित धान की बजाय 45.7% अधिक थी।

धान आधारित फसल अनुक्रम के लिए ड्रिप सिंचाई विधि का मूल्यांकन: धान-शिमला मिर्च-बेबी कॉर्न फसल अनुक्रम में 1.0 मीटर लेटरल द्वारा ड्रिप सिंचाई करने से डेफ़िसीट जल आपूर्ति के तहत बिना उपज को प्रभावित किए 55% तक जल बचत हुई। ड्रिप विधि के तहत डेफ़िसीट सिंचाई करने पर पूर्ण सिंचाई की तुलना में 65% तक जल उत्पादकता में वृद्धि होती है तथा साथ ही 3.1 लाभ:लागत अनुपात से शुद्ध आय रुपए 2.8 लाख/हेक्टेयर प्राप्त होती है।

जल उत्पादकता को बढ़ाने के लिए धान उत्पादन पद्धतियाँ: धान के दाने की उपज पूरक सिंचाई (3.76 टन/हेक्टेयर) के कारण वर्षा आधारित धान (3.34 टन/हेक्टेयर) से मामूली अधिक थी। मानसून मौसम के दौरान बिना किसी लंबे सूखे अंतरालों के बावजूद यह अंतर दर्ज किया गया। सामान्य धान (किस्म-पुजा) की उपज (3.25-3.68 टन/हेक्टेयर) भूरे धान (2.93-3.14 टन/हेक्टेयर) की तुलना में अधिक थी। इसके अलावा, वहाँ सामान्य एवं भूरे धान की क़िस्मों की उपज रोपाई विधि (3.68 टन/हेक्टेयर) के तहत सीधी बुआई विधि (3.38 टन/हेक्टेयर) की तुलना से अधिक थी।

आभासी पानी आकलन के लिये मानकीकृत तरीके: भारतीय परिस्थितियों में विभिन्न जल प्रबंधन विधियों के तहत फसलों एवं फसल आधारित उत्पादों के लिये आभासी पानी की आकलन विधि को तैयार किया गया। पूर्वी भारत के लिए भविष्य के जलवायु परिदृश्यों के तहत आभासी पानी की मात्रा का विश्लेषण भी किया गया।

भारत में चरम वर्षों में भूजल भंडारण का मूल्यांकन: नासा के ग्रेविटी रिकवरी एवं जलवायु प्रयोग उपग्रहों से प्राप्त स्थलीय जल भंडारण एवं भूजल भंडारण के रूप में 129 महीने के गुरुत्वाकर्षण समाधानों द्वारा चरम वर्षों में जल भंडारण की स्थिति का मूल्यांकन किया गया तथा साथ ही इन सीटू भूजल स्तर के साथ सत्यापित भी किया गया। देश की गंगा बेसिन जो भूजल दोहन द्वारा मुख्य रूप से धान-गेहूं फसल पद्धति को बचाए रखी है वहाँ सूखे के वर्षों 2004, 2009, एवं 2012 में पानी के भंडारण का अधिकतम नुकसान क्रमश: 41, 44 एवं 42 घन किलोमीटर के रूप में हो चुका है।

जल संसाधन प्रबंधन योजना का विकास: तटीय ओडिशा के केन्द्रापाड़ा जिले में महाकालपाड़ा ब्लॉक के सुनीति गांव में एक व्यापक जल संसाधन प्रबंधन योजना 3900 हेक्टेयर क्षेत्र के लिए विकसित की गयी। अधिकतम उत्पादन के लिए फसल की योजना (भूमि आवंटन) 3 मौजूदा प्रमुख फसलों के यानि धान (497 हेक्टेयर), दालों (289 हेक्टेयर) तथा सब्जियों (238 हेक्टेयर लिए अनुकूलित की गयी; मौजूदा जल संचयन संरचनाओं को 2.5 से 2.8 मीटर गहराई की बाधा के साथ 7000 घन मीटर की औसत क्षमता के लिए मानकीकृत किया गया; क्रीक के माध्यम से खारे पानी के प्रवेश तथा अतिरिक्त पानी की निकासी को रोकने के लिए सुनीति क्रीक के मुंहाने पर एक स्लूइस गेट का निर्माण किया गया। क्रीक से 25 घन मीटर/सेकंड का डिसचार्ज छोडने के लिए हाइड्रोलिक डिजाइन प्रस्तावित किया गया।

जल उत्पादकता बढ़ाने के लिए डीएसएस (DSS) का विकास: कृषि जलवायु क्षेत्र VI के तहत पंजाब एवं हरियाणा में धान-गेहूं फसल पद्धति के लिए सत्रह सजातीय भूमि पार्सल इकाइयों (HLPU) को विकसित किया गया। भूजल स्तर गहराई जमीन की सतह के नीचे 10-20 मीटर के भीतर मौजूद थी, जो स्तर में गिरावट दर्शाती है। लुधियाना के लिए लंबे समय तक वर्षा आंकड़ों के विश्लेषण से पता चला कि कम अवधि वाली खरीफ धान की बुवाई 28 मानक मौसम सप्ताह के भीतर करने का सुझाव दिया जाना चाहिए, ताकि अधिक से अधिक वर्षा को उपयोग में लिया जा सके, जिससे भूजल संसाधनों से पूरक सिंचाई के उपयोग को कम किया जा सके।

अपशिष्ट जल उपयोग के लिए एक फिल्टर का डिजाइन: सिंचाई के लिए अपशिष्ट जल के सुरक्षित उपयोग के लिए एक फिल्टर बनाया गया जिसका ड्रिप सिंचाई पद्धति का उपयोग कर किसानों के खेत में मूल्यांकन किया गया। ड्रिप्पर्स की औसत निर्वहन क्षमता 1.38-1.43 लीटर/घंटे थी, जबकि एकरूपता गुणांक 98.1% था। इस फिल्टर से तलछट प्रवाह (टरबीडिटी के रूप में), माइक्रोबियल लोड (बीओडी के संदर्भ में) तथा भारी धातु सामग्री (केडमियम एवं क्रोमियम) आदि की मात्रा क्रमशः 36-44, 46-52 एवं 50% तक कम हो गई।

जलकुंभी द्वारा प्रदूषित पानी से क्रोमियम तत्व का सुधार: ओडिशा राज्य के सुखिन्दा क्रोमाइट खदान क्षेत्रों से एकत्रित पानी के नमूनों की गुणवत्ता के मूल्यांकन द्वारा पता चला कि 11% नमूने क्रोमियम की मात्रा अधिक होने के कारण सिंचाई के लिए उपयुक्त नहीं हैं। क्रोमियम प्रदूषित पानी के साथ जलकुंभी उगाकर एक प्रयोग किया गया जिससे क्रोमियम की मात्रा में 52 से 85% तक कमी हुई। क्रोमियम का संचय शाखाओं की तुलना से जड़ों में 1 से 44 गुना ज्यादा पाया गया।

जल के संयोजी उपयोग के लिए सॉफ्टवेयर का विकास: संयोजी जल उपयोग मॉडल को संभव चर एवं बाधाओं के साथ तैयार किया गया। प्रयोगकर्ता के अनुकूल निर्णय हेतु समर्थन पद्धति सॉफ्टवेयर कृषि क्षेत्र में पानी के संयोजी उपयोग की योजना के लिए विजुअल बेसिक आधार पर विकसित किया गया। रैखिक प्रोग्रामिंग का उपयोग करके औब्जैकटिव फंक्सन एवं बाधाओं को एमएस एक्सेल में तैयार किया गया। डीएसएस के लिए इनपुट पैरामीटर एवं एक्सेल फाइल एक सास इनपुट फ़ाइल है जो वांछित परिणाम के लिए SAS पर्यावरण पर काम करेगी एवं क्रियान्वित की जाएगी।

ड्रम आधारित ड्रिप सिंचाई पद्धति का विकास एवं मूल्यांकन: ड्रम आधारित ड्रिप सिंचाई पद्धति के प्रदर्शन का अध्ययन हवा रिलीज व्यवस्था के साथ फूलगोभी एवं बैंगन की फसलों में किया गया। माइक्रो ट्यूब्स एवं लाइन ड्रिप्पर्स के साथ इस पद्धति के हाइड्रोलिक्स ने संकेत दिया कि एमिटर प्रवाह भिन्नता, विविधता गुणांक तथा वितरण एकरूपता गुणांक काफी सटीक थे।

गन्ने की फसल में जलवायु परिवर्तन हेतु अनुकूल क्षमता को बढ़ाने के लिए भूजल प्रबंधन: उत्तर प्रदेश राज्य में मुज्जफरनगर जिले के रसूलपुर जाट्टन गाँव में एक पायलट परियोजना की शुरुआत की गयी जहां गन्ने की फसल हेतु सिंचाई के लिए अत्यधिक दोहन के कारण भूजल स्तर कम होता जा रहा है। इस जिले के लंबे समय के जलवायु आंकड़ों का विश्लेषण किया गया। जल के नुकसान को रोकने के लिए 15 किसानों के खेत में भूमिगत पाइप लाइनों को उपलब्ध करवाया गया। एक किसान के खेत में रेनगन पद्धति को भी स्थापित किया गया है। इसके अलावा, भाकृअनुप- भारतीय मृदा एवं जल सरंक्षण संस्थान ने चैक डैम के एक जोड़े का वर्षा अपवाह को संचित करने के लिए निर्माण किया गया है। आत्मनिर्भर खेती पद्धति विकसित करने हेतु दो वर्मीकम्पोस्ट इकाइयाँ भाकृअनुप- केन्द्रीय गोवंश अनुसंधान संस्थान द्वारा स्थापित की गयी हैं।

असम एवं बिहार के जलाक्रांत क्षेत्रों का चित्रिकरण तथा उपयुक्त फसल योजना: असम एवं बिहार में इसरो के रैखिक इमेजिंग सेल्फ स्कैनिंग सेंसर (लिस) -III) डेटा (1: 50,000 पैमाने पर) का उपयोग कर उपयुक्त फसल योजना बनाने तथा मछलीपालन के लिए जलाक्रांत क्षेत्रों को चित्रित किया गया। गहरे पानी धान की मिश्रित खेती जिसको स्थानीय स्तर पर 'अहु' एवं 'बाओ' कहा जाता है असम में एक उपयुक्त बाढ़ सहनशील उपाय है। बिहार में भागलपुर एवं कटिहार जिलों के लिए सर्वेक्षण तथा भूमि निश्चितिकरण को भी पूरा किया गया। मानसून पूर्व एवं मानसून बाद की अवधि के लिए भू-संदर्भित उपग्रह पी6-LISS-III इमेजरी (पाथ 106 एवं पंक्ति 54) को जलाक्रांत क्षेत्रों के वर्गीकरण के लिए प्रसंस्कृत किया गया।

नीम लेपित यूरिया के माध्यम से जलाक्रांत स्थिति के तहत धान में नाइट्रोजन उपयोग दक्षता बढ़ाना: जलाक्रांत पारिस्थितिकी तंत्र में धान के खेत में यदि जब नाइट्रोजन को 60 किलोग्राम/हेक्टेयर की दर से यूरिया एवं डाइसाइनेमाइड तथा नीम एवं पोंगेमिआ पिन्नाटा के पत्ती निष्कर्षों के साथ यूरिया को लेपित करके प्रयोग करने पर एपेरेंट नाइट्रोजन प्राप्ति क्रमश: 61.5 एवं से 58.2% हुई। केवल यूरिया प्रयोग से प्राप्ति 46.3% हुई। हालांकि, धान की फसल में उच्चतम फिजियोलोजिकल दक्षता (41.7 किलो अनाज /किलो नाइट्रोजन ग्रहण) केवल यूरिया प्रयोग से ही प्राप्त हुई।

महानदी डेल्टा में भार्गवी-दया नदीयों के दोआब के लिए जल निकासी की योजना: महानदी डेल्टा के भार्गवी-दया नदीयों के दोआब में भूमि उपयोग कवर सांख्यिकी से पता चला कि 7.46% क्षेत्र खरीफ में एक फसली, 24.4% क्षेत्र द्विफसली, 18.06% क्षेत्र दोनों मौसम में तथा 12.46% क्षेत्र कृषि पार्टी भूमि के रूप में है। गीली भूमि एवं नदियां/धाराएँ क्रमश: 9.81% एवं 2.22% क्षेत्र को कवर करती है। अध्ययन क्षेत्र के लिए डिजिटल ऊँचाई मॉडल विकसित किया गया।

सब्जियों के तहत क्रोमियम संचय का मूल्यांकन: मिट्टी में क्रोमियम के प्रयोग (० से १५० मिलीग्राम/किलोग्राम मिट्टी) से छ: सब्जियों की फसलों जैसे टमाटर, चोलाई, भिंडी, तोरई, मूली एवं फ्रेंच बीन्स को उगाया गया। इससे पता चला कि क्रोमियम के लिए जैव-ट्रांसफर फैक्टर (TF) इसकी मिट्टी में बढ़ती सांद्रता के साथ घटता है और फसल बायोमास को कम करता है। क्रोमियम के लिए ट्रांसफर फैक्टर इस क्रम में था: फल < शाखाएँ <जड़ें। चुना प्रयोग से मिट्टी में क्रोमियम की उपलब्धता में वृद्धि हुई एवं जिसने भिंडी के बीज अंकुरण को कम किया।

संभावित उपज एवं पानी सीमित बाजरा की उपज का अनुमान: राजस्थान एवं महाराष्ट्र राज्यों के जलवायु बफर क्षेत्रों में WOFOST मॉडल का उपयोग करके वर्षा आधारित ज्वार फसल की सिमुलटेड संभावित उपज 4.8 से 7.8 टन/हेक्टेयर के बीच दर्ज हुई। इसी तरह, भारत के विभिन्न जलवायु बफर क्षेत्रों में ज्वार की पानी सीमित उपज 1.8 से 5.4 टन/हेक्टेयर के बीच थी। इसी प्रकार, भारत के विभिन्न जलवायु बफर क्षेत्रों में संभावित उपज व बाजरा की पानी सीमित उपज क्रमश: 4.5-6.0 टन/हेक्टेयर एवं 1.0-5.0 टन/हेक्टेयर के बीच थी।

कृषि जल प्रबंधन पोर्टल (AWMP) (http://www.iiwm.res.in/awmp) का विकास: वेब आधारित सूचना प्रणाली अर्थात कृषि जल प्रबंधन पोर्टल (AWMP) को कृषि के क्षेत्र में आईसीटी प्रयोग का उपयोग कर विभिन्न हितधारकों के बीच ज्ञान बांटने वाले एक मंच के रूप में सेवा प्रदान करने के लिए विकसित किया गया; देश में अखिल भारतीय समन्वित अनुसंधान परियोजना केन्द्रों के प्रमुख वैज्ञानिकों के लिए पासवर्ड सुरक्षित डेटा प्रबंधन मॉड्यूल की जानकारी अपलोड की गयी। पीसी इकाई पर नोडल अधिकारी के लिए भी मॉड्यूल अलग-अलग केन्द्रों द्वारा प्रस्तुत जानकारी की निगरानी के लिए विकसित किया गया।

ओडिशा में सामाजिक-आर्थिक अध्ययन: ओडिशा के विभिन्न गरीबी युक्त कृषि परिस्थितियों में सामाजिक-आर्थिक अध्ययन ने बताया कि लगभगआधी आबादी गैर-कृषि गतिविधियों में लगी हुई थी। कुल जनसंख्या में से क्रमशः 64.19% एवं 41.86% भूमिहीन तथा छोटे किसानों थे जो गैर-कृषि कार्यों से अपनी आजीविका कमाते हैं। अध्ययन क्षेत्र में गरीबी रेखा से नीचे के परिवार 17-62% के बीच थे।

जल प्रबंधन तकनीकियों की स्थिरता: विभिन्न कृषि पारिस्थितिक तंत्र में भाकृअनुप-भारतीय जल प्रबंधन संस्थान द्वारा विकसित तकनीकों के प्रभाव की स्थिरता का अध्ययन करने के लिए विभिन्न परियोजना स्थलों एक अध्ययन पर शुरू किया गया। विभिन्न स्थलों पर लाभार्थी किसानों की प्रतिक्रिया सिंचाई के लिए अपने वर्तमान में प्रारंभिक संरचनाओं के उपयोग के संबंध के साथ बदलती हुई प्राप्त हुई।

बेहतर जल प्रबंधन उपायों के माध्यम से आदिवासी किसानों की आजीविका में सुधार: ओडिशा के सुंदरगढ़ जिले में जल निकासी लाइन के तहत एक कुंआ एवं फव्वारा सिंचाई पद्धति को इस परियोजना के तहत कमांड क्षेत्र में अच्छी तरह से स्थापित किया गया। कृषि आदान जैसे पौध एवं उर्वरक किसानों के बीच वितरित किए गए। ऊंची क्यारियों पर उगाये गए टमाटर की पैदावार 25.4 टन/हेक्टेयर प्राप्त हुई। परियोजना के तहत तालाब से उत्पादित मछली फिंगरलिंग की उपज 2.72 टन/हेक्टेयर थी।

सिंचाई जल प्रबंधन पर अखिल भारतीय समन्वित अनुसंधान परियोजना: भाकृअनुप-भारतीय जल प्रबंधन संस्थान देश में कुल 26 एआईसीआरपी- सिंचाई जल प्रबंधन केन्द्रों के प्रमुख समन्वित केंद्र के रूप में करता है। इस संस्थान के निर्देशन में इन समन्वित केन्द्रों पर मिट्टी, पानी, पौधा संबंध एवं इनकी प्रतिक्रिया पर बुनियादी अध्ययन तथा पानी की उपलब्धता का आकलन, उच्च वर्षा वाले क्षेत्रों में वर्षा जल प्रबंधन, जल के बहुआयामी उपयोग द्वारा जल उत्पादकता में वृद्धि, क्षेत्रीय स्तर पर भूजल उपयोग, भूजल आकलन एवं पुन:भरण, दबाव सिंचाई प्रणाली का मूल्यांकन, बागवानी एवं अधिक मूल्य वाली फसलों में जल प्रबंधन,नहरी जल एवं भूजल का संयोजी उपयोग तथा जल उत्पादकता बढ़ाने के लिए जल निकास अध्ययन आदि विषयों पर प्रचार-प्रसार का अनुसंधान किया जाता है।

जल पर कृषि-भागीदारी अनुसंधान मंच के तहत शुरू की गयी परियोजनायें: भाकृअनुप-भारतीय जल प्रबंधन संस्थान, जल पर कृषि-भागीदारी अनुसंधान मंच के लिए एक समन्वयक केंद्र के रूप में कार्य कर रहा है। इस अनुसंधान मंच के तहत मुख्य रूप से पाँच परियोजनाओं की शुरुआत की गयी है वे इस प्रकार हैं: भारत के विभिन्न कृषि पारिस्थितिकी क्षेत्रों में एकीकृत जल संसाधन विकास एवं प्रबंधन; स्वत: सिंचाई एवं ड्रिप सिंचित केला की फसल में फर्टिगेशन; कृषि एवं मछली पालन क्षेत्रों में अपशिष्ट जल उपयोग के लिए उपाय; विभिन्न मछलीपालन उत्पादित पद्धतियों में जल के बहुआयामी उपयोग द्वारा जल बजट एवं जल उत्पादकता बढ़ाना; तथा नहरी कमांड क्षेत्र में सिंचाई पद्धति एवं उच्च जल उत्पादकता के लिए सुधार के उपायों का मूल्यांकन।

प्रकाशन, पुरस्कार एवं सम्मान: भाकृअनुप-भारतीय जल प्रबंधन संस्थान के वैज्ञानिकों ने वर्ष 2015-16 के दौरान कुल 37 शोध पेपर, 18 पुस्तके/बुलेटिनों/प्रशिक्षण मैनुअल, एवं 4 पुस्तिकाएं/ फ़ोल्डर/ ब्रोचर आदि प्रकाशित किए। प्रधान वैज्ञानिक डॉ. ए. के. ठाकुर ने भारतीय प्लांट फिजियोलॉजी सोसाइटी द्वारा जे. जे. चिनॉय स्वर्ण पदक पुरस्कार प्राप्त किया। प्रधान वैज्ञानिक डॉ. जी. कर ने एकामरा श्री पुरस्कार प्राप्त किया एवं प्रधान वैज्ञानिक डॉ. सोमनाथ रॉय चौधुरी को भारतीय तटीय कृषि अनुसंधान सोसाइटी द्वारा फैलो पुरस्कार-2016 प्राप्त हुआ। इस प्रकार अन्य वैज्ञानिकों को भी कई अन्य सम्मान मिले एवं पहचान प्राप्त की।

अनुसंधान परियोजनायेँ: भाकृअनुप-भारतीय जल प्रबंधन संस्थान के वैज्ञानिक एक परामर्श परियोजना के अलावा 23 संस्थान परियोजनाएं एवं 13 बाह्य वित्त पोषित अनुसंधान परियोजनाओं पर अनुसंधान कार्य कर रहे हैं।

प्रशिक्षण एवं क्षमता निर्माण: भाकृअनुप-भारतीय जल प्रबंधन संस्थान ने सरकारी अधिकारियों एवं छात्रों के लिए सात प्रशिक्षण कार्यक्रम तथा कृषि जल प्रबंधन के विभिन्न विषयों पर 1455 किसानों के लिए पंद्रह प्रशिक्षण कार्यक्रम आयोजित किए। साथ ही साथ नौ प्रदर्शनियों के माध्यम से कृषि जल प्रबंधन की तकनीकों का विभिन्न स्थानों पर प्रदर्शित किया गया। भाकृअनुप-भारतीय जल प्रबंधन संस्थान ने एक राष्ट्रीय संगोष्ठी का भी आयोजन किया।

मेरा गांव मेरा गौरव: भाकृअनुप-भारतीय जल प्रबंधन संस्थान वैज्ञानिकों के छह समूहों ने 'मेरा गांव मेरा गौरव' कार्यक्रम के तहत ओडिशा के पांच जिलों से सात ब्लॉकों में तीस गांवों को अपनाया। इस कार्यक्रम में कुल 1170 किसानों को कृषि के विभिन्न क्षेत्रों पर जागरूकता के बारे में जानकारी प्रदान करवाई गयी तथा अपनाये गये गांवों के 858 किसानों को हमारे वैज्ञानिकों द्वारा प्रशिक्षण/बातचीत/ आयोजित बैठकों के साथ लाभान्वित किया गया।

स्वच्छ भारत अभियान: भाकृअनुप-भारतीय जल प्रबंधन संस्थान ने स्वच्छ भारत- स्वस्थ भारत अभियान में भी उत्सुकता से भाग लिया। संस्थान परिसर एवं आवासीय कॉलोनी, ओडिशा के केंद्रपाड़ा एवं सुंदरगढ़ जिलों में अनुसंधान स्थलों पर सक्रिय रूप से कुल 15 साफ-सफाई ड्राइव/अभियानों को वर्ष 2015-16 के दौरान आयोजित किया गया।

EXECUTIVE SUMMARY

Studies on water and nutrient self-reliant farming system for rainfed area: Green manuring with *Sesbania* @ 14.8 t ha^{-1} and vermicompost @ 3 t ha^{-1} resulted in 7% decrease in rice grain yield, but with high energy efficiency (20.5) and specific energy as compared to chemically fertilized rice crop.

Development of runoff recycling and land modification for productivity enhancement: Land modification, including construction of a farm-pond to facilitate harvesting of excess runoff during rainy season and recycling it for *rabi* season crops and soil heap construction at regular intervals- an additional surface area of 390 m^2 ha^{-1} in the catchment was made available. Fish culture in the pond and on-dyke papaya cultivation was successful. Rice, cowpea, broccoli, mustard, black gram and green gram were grown in the catchment area and annual net monetary return increased to Rs 1,80,000.

Optimization of stocking density of pacific white shrimp: Desirable stocking density of *Litopenaeus vannamei* was found 50 post-larvae m^{-2} that gives significantly higher yield (10.3 t ha^{-1}), lower consumptive water use (1.93 m^3 kg^{-1} biomass production), higher economic benefit i.e., output value to the cost of cultivation (1.99) and net consumptive water productivity (Rs.73.3 m^{-3}).

Evaluation of feasibility of enhancing irrigation efficiency in canal command: The flow hydraulics of the inlet structure and the flow regulating pattern in the outlet structure revealed that the flow regime through the service reservoir was subcritical with non-scouring velocity. The drawdown of constructed dug well was found 0.9 with initial recuperation rate of 8.3 cm h^{-1}. The performance of the sprinkler irrigation system is being studied in the dug well command.

Studies on climate resilient agriculture: Gross and net primary productivity (GPP & NPP), and energy balance for maize were assessed using eddy covariance technique; NPP was found to be -247 g C m^{-2}. Polythene mulching enhanced water productivity by 180% in groundnut and by 148% in sunflower as compared to no mulch. Groundwater recharge zones map of Amaravathy basin, Tamil Nadu was prepared.

Developed integrated farming systems under canal command: Integrated farming systems were developed under different head-, mid- and tail end sites of Kuanria Irrigation Command area, Daspalla, Nayagarh, Odisha. Multiple use of water through on-dyke horticulture, fish culture and life-saving irrigation enhanced water productivity, varied between 20.5 and 53.5 Rs. m^{-3}.

Grain quality under SRI and constraints analysis in its adoption: SRI method enhanced the concentration of micronutrients (by 40% Fe, 214% Zn, 32% Mn and 99% Cu) in rice grains than the crop grown under conventional transplanted method (TP). Significantly higher head rice recovery was found in SRI (55.8%) than TP (49.2%). Grain-filling rate of main tiller was 45.7% higher under than TP.

Evaluated drip system for rice based cropping sequence: Drip irrigation (DI) with 1.0 m lateral spacing saved 55% irrigation water without affecting yield of crops under deficit water supply in rice-capsicum-baby corn crop sequence. Deficit irrigation under DI improved water productivity by 65% over full irrigation and generated net profit of Rs. 2.8 lakh ha^{-1} with benefit-cost ratio of 3.1.

Rice production systems to enhance water productivity: Grain yield of rice was marginally higher with supplemental irrigation (3.76 t ha^{-1}) than rainfed conditions (3.34 t ha^{-1}); this non-significant difference was observed as there was no long dry spells during the monsoon season. Yield (3.25-3.68 t ha^{-1}) of normal rice (var. 'Pooja') was higher than brown rice (2.93-3.14 t ha^{-1}). Also, there was higher yield under transplanting method (3.68 t ha^{-1}) compared to direct seeding (3.38 t ha^{-1}) in both normal rice and brown rice varieties.

Standardized methods of computing virtual water: Methodology of computing virtual water of crops and crop-based products has been standardized under different water management practices in Indian context; virtual water content was analyzed for eastern India under future climate scenarios.

Evaluation of groundwater storage in extreme years in India: Using 129 months of gravity solutions from NASA's Gravity Recovery and Climate Experiment satellites in the form of terrestrial water storage and groundwater storage, status of the water storage in extreme years has been evaluated and validated with the *in-situ* groundwater levels. The Ganges basin of the country, which sustains the rice-wheat cropping system mainly by groundwater withdrawals, has experienced the maximum loss of water storage was 41, 44 and 42 km^3 in drought years viz. 2004, 2009 and 2012, respectively.

Development of water resource management plan: A comprehensive water resource management plan was developed for 3900 ha area in Sunity village of Mahakalapada block in Kendrapara district of coastal Odisha. Crop planning i.e., land allocation was optimized to 3 existing major crops i.e. rice (497 ha), pulses (289 ha) and vegetables (238 ha) for maximum production; existing water harvesting structures were standardized for average capacity of 7000 m^3 with depth constraint within 2.5 to 2.8 m; ingress of saline water through creeks and drainage of excess water was checked through construction of a sluice gate in the mouth of Sunity creek. The hydraulic design of creeks was proposed to carry the discharge of 25 $m^3 s^{-1}$.

Development of DSS for enhancing water productivity: Seventeen numbers of homogeneous land parcel units (HLPU) were developed for rice-wheat cropping system in Punjab and Haryana under Agro-Climatic Region-VI. Groundwater table depth lies within 10-20 m below ground surface and is in declining trend. Long-term rainfall analysis for Ludhiana showed that sowing of short duration *kharif* paddy should be suggested within 28th standard meteorological week so that maximum rainfall would be captured to minimize the use of supplemental irrigation from groundwater resources.

Design of a filter for wastewater use: A filter designed for safe use of waste water for irrigation was evaluated in farmers' field using drip irrigation system. The average discharge of drippers was 1.38–1.43 lph, whereas the uniformity coefficient was 98.1%. The sediment flow (in terms of turbidity), microbial load (in terms of BOD) and heavy metal content (Cd and Cr) were reduced by 36-44, 46-52 and 50%, respectively.

Remediation of chromium from polluted water through water hyacinth: An appraisal of water quality of chromites-mine areas at Sukhinda, Odisha reveal that 11% of collected samples are not suitable for irrigation owing to excess Cr (VI) content. A water culture experiment on growing of water hyacinth (*Eichhornia crassipes*) with Cr (VI) polluted water has shown to reduce Cr by 52 to 85%. Accumulation of Cr was found 1 to 44 times higher in roots than shoots.

Developing software for conjunctive use of water: An open-ended conjunctive use model has been conceptualized considering the possible variables and constraints. User-friendly decision support system software was developed on Visual Basic for planning the conjunctive use of water in agriculture. Using linear programming, the objective functions and constraints were formulated in MS Excel. Input parameters and Excel file for the DSS will be executed to create a SAS input-file that will work on SAS environment for desired output.

Developed and evaluated drum-based drip irrigation system: The performance of drum based drip irrigation system with air release arrangement was studied in cauliflower and brinjal. The hydraulics of the system with microtubes and in-line drippers indicated that the emitter flow variation, coefficient of variation and distribution uniformity were reasonably accurate.

Groundwater management for enhancing adaptive capacity to climate change in sugarcane: A pilot project is undertaken in Rasulpur Jattan village of Muzzaffarnagar district of UP where falling groundwater table has been observed due to its over-exploitation for irrigation to sugarcane crop. The long-term climatic data of the district is analyzed. Underground pipe lines have been put in 15 farmer's field to check conveyance losses. Raingun system has also been installed in one of the farmer's field. Also, a couple of check dam has been constructed by ICAR-IISWC for harvesting of runoff water. In order to develop self-reliant farming system, two vermicompost units have been installed by ICAR-CIRC.

Delineated waterlogged areas in Assam and Bihar for suitable crop planning: The delineation of waterlogged areas in Assam and Bihar was made using linear imaging self-scanning sensor (LISS)-III data (1:50,000 scale) of ISRO for identifying suitable cropping and aquaculture in the areas. Mixed cultivation of deepwater rice, locally called as '*Ahu*' and '*Bao*' is a suitable flood resilient measure in Assam. The survey and ground truthing were completed for Bhagalpur and Katihar districts in Bihar. The georeferenced satellite P6-LISS-III imagery (path 106 and row 54) for pre- and post-monsoon period was processed for classification of waterlogged area.

Enhancing NUE in rice under waterlogged situation through neem-coated urea: Apparent N-recovery fraction was 61.5 and 58.2% from a rice field in an waterlogged ecosystem when N was applied @ 60 kg ha^{-1} through urea in combination with dicyandiamide (DCD) and urea coated with leaf extracts of *Azadirachta indica* and *Pongamia pinnata*, respectively; recovery fraction enhanced compared to only urea application (46.3%). However, the highest physiological efficiency (41.7 kg grain/ kg N uptake) of rice crop was obtained in sole urea application.

Drainage planning for Bhargabi-Daya doab in Mahanadi delta: The land use land cover statistics of Bhargabi-Daya doab in Mahanadi delta revealed 7.46% area under *kharif* monocrop, 25.4% area under *rabi* monocrop, 18.06% area cropped for two seasons, and 12.46% area under agricultural current fallow. Wetland and rivers/stream covers 9.81% and 2.22% area, respectively. The digital elevation model was developed for the study area.

Evaluated Cr uptake under vegetables: Graded levels of chromium (Cr) application (0 to 150 mg kg^{-1}) to soil, grown with six vegetable crops viz. tomato, amaranthus, okra, ridge gourd, radish and french bean, showed that bio-transfer factor (TF) for Cr decreased with increasing Cr concentration in soil and decreasing crop biomass. The TF for Cr was in the order: fruits<shoots<roots. Liming increased Cr availability in soil and decreased seed germination of okra.

Estimated potential yield and water limited yield of pearl millet: Using WOFOST model, simulated potential yield of rainfed sorghum ranged between 4.8 and 7.8 t ha^{-1} in climatic buffer zones of Rajasthan and Maharashtra, respectively. Similarly, water limited yield of sorghum ranged between 1.8 and 5.4 t ha^{-1} in different climatic buffer zones of India. The potential yield and the water limited yield of pearl millet ranged from 4.5 to 6.0 t ha^{-1} and 1.0 to 5.0 t ha^{-1}, respectively in different climatic buffer zones of India.

Developed Agriculture Water Management Portal (AWMP) (http://www.iiwm.res.in/awmp): A web-based information system viz. Agriculture Water Management Portal(AWMP) (http://www.iiwm.res.in/awmp) has been developed using ICT application in agriculture to serve as a knowledge sharing platform among different stakeholders; password protected data management module for Chief Scientists of AICRP-IWM centres in the country has been created for uploading information. The module for Nodal Officer at PC unit has been developed for accessing and monitoring information submitted by individual centres.

Socio-economic studies in Odisha: The socio-economic studies in different poverty-laden agro-ecologies of Odisha indicated that half of working population was engaged in non-farm activities. Out of the total population, 64.19% and 41.86% are landless and small farmers, respectively, which earn their livelihood from non-farm works. The family below poverty line in the study area was 17-62%.

Sustainability of water management technologies: To study the extent of sustainability and impact of created water management technologies of ICAR-IIWM in different agro-ecosystems, a study has been initiated at different project sites. The response of beneficiary farmers vary for different intervention sites with respect to initial physical structures and their present day utilization for irrigation.

Livelihood improvement of tribal farmers through better water management practices: A dug-well was constructed in the drainage line and a sprinkler irrigation system was installed in the well command under the project in Sundargarh district, Odisha. Farm inputs like seedlings and fertilizers were distributed among the farmers. The yield of tomato grown on raised beds was 25.4 t ha^{-1}. The fish fingerlings produced from the pond under the project was 2.72 t ha^{-1}.

Coordinating AICRP on Irrigation Water Management: ICAR-IIWM acts as a coordinating center of twenty six centers of AICRP-IWM to carry out basic studies on soil, water, plant relationship & their interaction and extension work in the field of assessment of water availability, rainwater management in high rainfall areas, enhancing productivity by multiple use of water, groundwater use at regional level, groundwater assessment and recharge, evaluation of pressurized irrigation system, water management in horticultural and high value crops, conjunctive use of canal and groundwater, and drainage studies for enhancing water productivity.

Projects initiated under Agri-CRP on Water: ICAR-IIWM acts as a coordinating center of Agri-CRP on Water and five new research projects were started namely, Development and management of integrated water resources in different agro-ecological regions of India; Automatic irrigation and fertigation in drip-irrigated banana; Strategies for wastewater use in crops and aquaculture sectors; Water budgeting and enhancing water productivity by multiple use of water in different aquaculture production systems; and Evaluation of irrigation system and improvement strategy for higher water productivity in canal commands.

Publication, awards and recognitions: During 2015-16, scientists of ICAR-IIWM published 37 peer reviewed research papers, 18 books / bulletins / training manuals and 4 Leaflets / folders / brochures. Dr. A.K. Thakur received J.J. Chinoy Gold Medal Award instituted by the Indian Society for Plant Physiology; Dr. G. Kar received Ekamara Shree Award; and Dr. S. Roy Chowdhury received Fellow of Indian Society of Coastal Agricultural Research, 2016 along with many other honors and recognitions.

Research projects: Scientists of ICAR-IIWM working on 23 in-house and 13 externally-funded research projects along with one consultancy project.

Training & capacity building: ICAR-IIWM conducted seven training programs for government officials and students; fifteen training programs for farmers covering 1455 farmers on various topic of agricultural water management; nine exhibitions to showcase ICAR-IIWM technologies. Also organised one National Symposium on Innovations in Coastal Agriculture - Current Status and Potential under Changing Environment.

Mera Gaon Mera Gaurav: Six groups of scientists of ICAR-IIWM adopted thirty villages across seven blocks spreading over five districts of Odisha under the '*Mera Gaon Mera Gaurav'* program. 1170 farmers were provided information on awareness on various areas in agriculture and 858 farmers of adopted villages were benefited with trainings/ interaction meetings organized by our scientists.

Swachh Bharat Abhiyan: ICAR-IIWM actively participated in *Swachh Bharat Abhiyan* and 15 campaigns / cleanliness drives were organized during 2015-16

CONTENT

INTRODUCTION

The ICAR-Indian Institute of Water Management (erstwhile Directorate of Water Management or Water Technology Centre for Eastern Region) was established on 12th May, 1988 with the aim to cater the research and development need of agricultural water management at national level. The institute is located at Chandrasekharpur, Bhubaneswar on a 5.71 ha of land along with its main office-cum-laboratory building, guest house and residential complex. It is situated about 8 km north of Bhubaneswar railway station and at about 15 km away from Biju Patnaik International Airport, Bhubaneswar. The location of the Institute is at 20°15' N and 85° 52' E at 23 m mean sea level. The research farm of the Institute (63.71 ha of farm land) is located at Deras, Mendhasal (20°30' N and 87°48' E) and is 30 km away from main institute complex.

Mandate

- **Strategies for efficient management of on-farm water resources for sustainable agricultural productivity.**
- **Coordinate research for generating location-specific technologies for efficient use of water resources.**
- **Centre for training in agricultural water management.**

Research Achievements

Core research activities of the institute are carried out under five programs, viz., rainwater management, canal water management, groundwater management, waterlogged area management and on-farm research & technology dissemination to solve the agricultural water management related problems. The institute has experienced multi-disciplinary team of scientists.

Significant research achievements for the year 2015-16 include assessment of groundwater storage potential using NASA's GRACE satellites, development of water resource management plans for coastal areas in Odisha and delineation of waterlogged areas in Assam and Bihar using land use land cover (LULC) data of ISRO. Projects have been initiated for development of drainage plan for Mahanadi delta and development of standards and methods of computing virtual water and water trade potential. There has been a considerable research work conducted towards development of runoff water recycling and land modification technique for enhancing productivity, water and nutrient self-reliant farming system for rainfed areas; climate resilient agriculture, groundwater management for enhancing adaptive capacity to climate change, options for enhancing irrigation efficiency and development of integrated farming systems in canal commands, SRI method of rice cultivation for enhancing water productivity and analyzed constraints in its adoption by farmers in a canal command. With the aim of water budgeting and enhancing water productivity in

aquaculture systems, stocking density of pacific white shrimp culture has been optimized. Significant research work has been carried out on drip irrigation systems for rice-based cropping, drum-based drip irrigation for citrus orchard etc. For management of waterlogged areas, nitrogen application strategy has been developed for enhancing nitrogen- use efficiency. As an attempt to explore wastewater use in agriculture, a filter has been designed and developed for wastewater treatment. A considerable work has been done for livelihood improvement of tribal farmers through water management intervention. Our institute has developed one web-based agricultural water management portal. Studies are being carried out for bioremediation of polluted water, social and sustainability implications of water management interventions.

Under the *Pradhan Mantri Krishi Sinchayee Yojana* (PMKSY) of the Government of India, Institute has played a major role in capacity development to all India service officers (IAS and IFS) of eastern Indian states, district agricultural officers and soil conservation officers, prepared district irrigation plan (DIP) for five districts of Odisha, a quick study report on cropping pattern for optimal utilization of water resources. In addition to research and development efforts at the Institute level various agricultural water management related issues at the national level are being addressed by different centres under the AICRP on Irrigation Water Management. The ICAR-Agri-Consortia Research Platform on Water has been successfully initiated. With the aim of dissemination of technology and working with farmers, Scientists are involved with thirty adopted villages across seven blocks in Odisha under *Mera Gaon Mera Gaurav* programme; conducted training programs for Government officials, farmers and students on various aspects of water management, participated in exhibitions to showcase Institute developed technologies.

Infrastructure facilities and organization

The institute has state-of-the-art infrastructure facilities and has four well-equipped laboratories, viz, soil-water-plant relationship laboratory, irrigation and drainage laboratory, hydraulic laboratory, and plant science laboratory with all the latest equipment for research activities. An engineering workshop also cater to the needs of the institute. Four field laboratories at farm, viz, meteorological laboratory, pressurized irrigation system, solar photovoltaic pumping system, and agricultural drainage system also add to the research related inputs. The institute has a state of-the-art communication facility with an automatic EPABX system and LAN. The institute has its own web server and regularly updated website (www.iiwm.res.in). The entire network administration of the computers, internet and website management is looked after by the ARIS cell. The ARIS cell also accommodates a fully developed GIS laboratory. The air-conditioned library of the Institute has more than 2000 reference books and subscribes to 14 international and 6 national journals. It has a CD-ROM Server with bibliographic, database from AGRIS, AGRICOLA and Water Resources Abstracts. The subscription of electronic journals and its access through LAN to all the scientists is another useful facility of the library. The installed video conferencing and IP Telephony System facility at the Institute as part of the project ICAR net is being utilized for related use from time to time.

The ICAR-IIWM has linkages with various agencies through providing training, consultancy, collaboration or contract research services. It has provided a platform for public and private sector institutions dealing with water management research to address their scientific problems, monitor research

and development activities and their evaluation in a cost effective manner. The institute has developed linkages with different state and central government agencies like Watershed Mission (Government of Odisha), Directorate of Agriculture (Government of Odisha), Central and State Ground Water Board, Command Area Development Agency, Government of Odisha, WALMI, ORSAC to implement farmer friendly water management technologies in the region. In addition to ongoing in-house research projects, the institute is awarded with many sponsored/collaborative projects by various organizations like INCSW (formerly INCID), Ministry of Water Resources, GOI; ICAR-NCAP; University of Nebraska, Lincoln, USA; ICRISAT, Bill and Melinda Gates Foundation and consultancy project by Odisha Watershed Mission for preparing District Irrigation Plan (DIP) under PMKSY. The institute is coordinating center for ICAR-Agri-Consortia Research Platform on Water, ICAR, New Delhi. Also, ICAR-IIWM has conducted ICAR entrance examinations like JRF, SRF at national level.

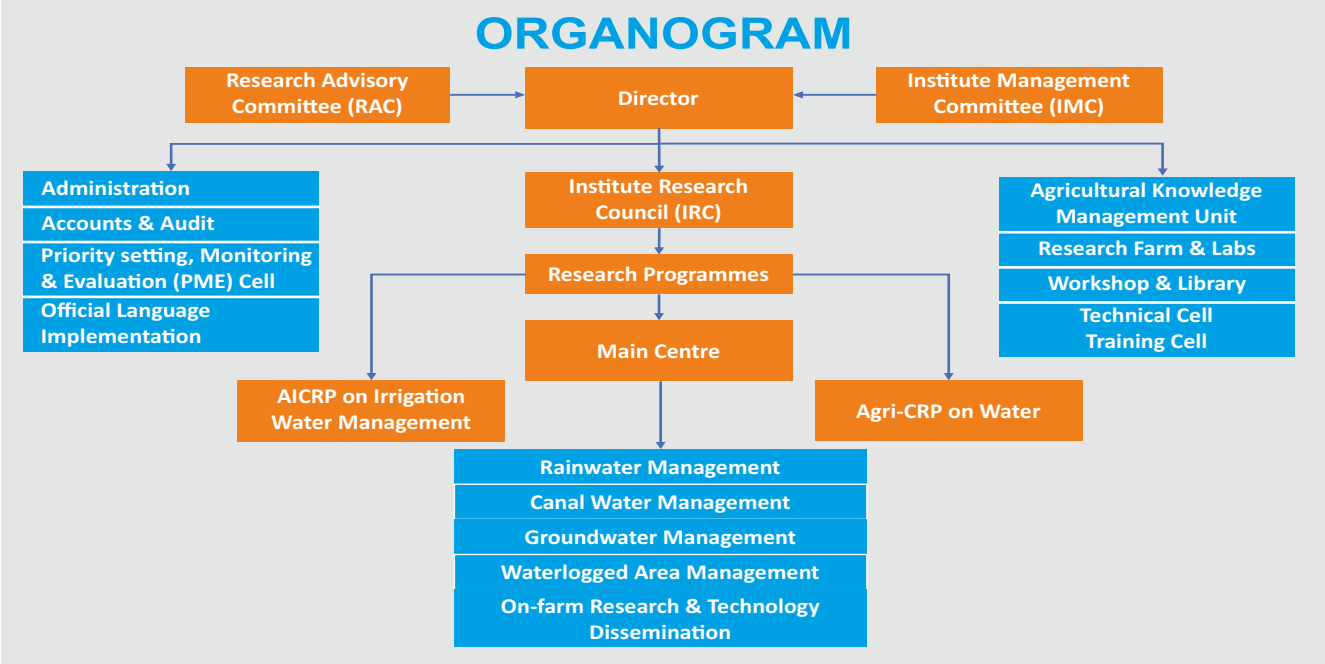
Finances

Summary of fund allocation, and expenditure during the year 2015-16 under plan and non-plan budget of the institute is presented at the end of this report.

Staff

At the end of March 2016, ICAR-IIWM had 80 sanctioned posts (including AICRP-IWM) out of which 57 are in position. The breakup of the posts under different categories is given below

Cadre	Sanctioned	In Position	Vacant
RMP	01	01	nil
Scientific	35	27	08
Administrative	16	10	06
Technical	17	13	04
Supporting	11	06	05
Total	**80**	**57**	**23**



4

RAINWATER MANAGEMENT

Water and Nutrient Self-reliant Farming System for the Rainfed Farmers in High Rainfall Zone

Project Code: IIWM/15/168
Investigators: S.K. Rautaray, S. Mohanty, S. Raychaudhuri, R.K. Mohanty, R. Dubey and R.C. Srivastava

To develop a strategic approach to make farming self-reliant, a model is under developmental stage. Aim of this model is to provide a resilient agro-ecosystem with inbuilt resistance against seasonal adversities for rainfed conditions and using a combination of rice in *kharif*, various *rabi* crops, horticultural crops and pisciculture to diversify the farmers' food sources and nutritional security. To achieve this, a water harvesting pond (66m x 59 m with 3 m depth) was used for composite fish culture; whereas its dyke (278 m x 4.5 m width) was used for banana and papaya cultivation with drip irrigation system.

During k*harif,* rice was grown and nutrients were supplied through *in-situ* sesbania green manure (14.8 t ha^{-1}) and vermi-compost @ 3.04 t ha^{-1}. To compare

Banana and papaya cultivation on dyke

it, adjacent plot was grown with the recommended dose of chemical fertilizers (80 kg N, 40 kg P_2O_5 and 40 kg K_2O ha^{-1}). The grain and straw yields under the organic nutrition were 3.88 t ha^{-1} and 5.52 t ha^{-1}, respectively, as compared to 4.21 t ha^{-1} and 5.65 t ha^{-1} under the chemically fertilized rice crop. Total energy input was 6.2 GJ ha^{-1} and 10.2 GJ ha^{-1} under organic nutrition with sesbania green manure + compost and inorganic nutrition, respectively. Total energy output from grain and straw was insignificantly lower for organic nutrition (126.0 GJ ha^{-1}) as compared with the inorganic nutrition (132.5 GJ ha^{-1}). However, energy efficiency (output energy/ input energy) was higher (20.5) with the organic nutrition. Further, the specific energy was also higher (1.53 t GJ^{-1}) under the organic nutrition. Absolute value of net energy was similar under both organic nutrition and inorganic nutrition. Gross and net returns were lower (Rs. 60,616 ha^{-1} and Rs. 16,922 ha^{-1}, respectively) under organic nutrition as compared to chemical nutrition (Rs. 65,432 ha^{-1} and Rs. 20,817 ha^{-1}, respectively).

Water harvesting pond of the farming system was used for composite pisciculture (30000 fry ha^{-1}) and total estimated biomass of the fishes was 1.42 t ha^{-1}. On the dyke, two rows of banana and one row of papaya was planted and drip irrigation system was installed for irrigating these fruit trees. The studies on hydraulics of the drip system indicated that average emitter discharge was 3.87 lph with emitter flow variation of 10.4%, coefficient of variation of 3.2% and distribution uniformity of 96.1%. The water applied to banana and papaya plants were 62 mm, 84 mm and 112 mm in the month of January, February and March, respectively.

Development of a Runoff Recycling Model for Production and Profit Enhancement through Alternate Land and Crop Management Practices

Project Code: DWM/12/157
Investigators: P.K. Panda, R.K. Mohanty and P. Panigrahi

Land modification techniques in a rice-fallow upland area of about one ha (9700 m^2) in the research farm of ICAR-IIWM, Bhubaneswar facilitated conversion to

Papaya variety 'Red lady' on the embankment

Yield of various crops grown in the experiment

Name of crops	Variety	Yield(t ha^{-1})
Rice	Lalata	4.02
Cowpea	EC-4216 (green fodder)	22.00
Broccoli	CHB-1	8.40
Mustard	NRCBH-101	1.47
	NDRE-7	1.04
	Rajendrasuflam	0.84
Black gram	B-3-8-8	0.98
	OBG-17	0.96
Green gram	OBGG-52	1.04
	OUM 11-5	0.94

double cropping by harvesting excess runoff in a constructed farm-pond (40 m x 30 m x 2.5 m). This model enhanced production and farm profit by ensuring water supply to crops in the events of dry-spells during *kharif* season and lifesaving irrigations to winter season crops. Constructed pond facilitated storage of runoff water, fish culture with Indian major carp (IMC) and on-dyke papaya cultivation. Some portion of excavated soil was heaped in the catchment area in regular intervals at a distance of 7 m with a dimension of parabolic shape with a radius of 2 m and height of 1 m. Additional surface area of 390 m^2 ha^{-1} was created for crop cultivation due to the land modification. Acid lime variety 'Sai Sarbati' was planted on the heaps; *kharif* paddy in the inter-mound spaces, cowpea on the heap, and winter season crops viz. broccoli, mustard, black gram and green gram in other catchment areas were grown.

Runoff of 4186 m^3 was collected in the excavated pond. Crop cultivation in the catchment area including on heaps was successful with good yield of crops. From on-dyke hybrid papaya variety 'red lady', a huge green fruit yield to the tune of 40.4 kg per tree was obtained. Average fish weight was 417.2 g per fingerling. By this technology, net farm income from the whole system increased to Rs 1,80,000, which is 4.5 times higher than the existing rice-pulse paira cropping system.

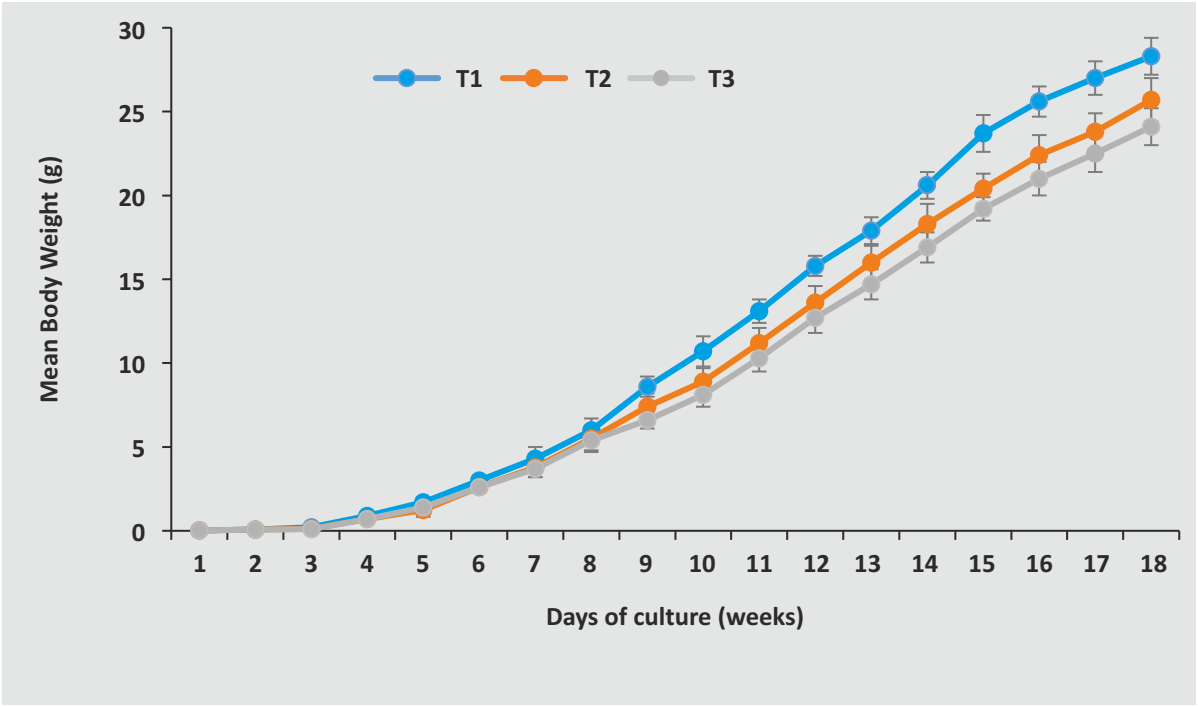
Density-Dependent Water Use in Coastal Aquaculture of *Litopenaeus vannamei*

Project Code: IIWM/15/175
Investigators: Rajeeb K. Mohanty, D. K. Panda, P. Panigrahi and D. U. Patil

An attempt is being made to quantify consumptive water use (CWU), total water use (TWU) or total crop water requirement (TWR) and consumptive water use index (CWUI) of one of the commercially important species viz. Pacific white shrimp (*Litopenaeus vannamei*) at varying levels of intensity in monoculture system to ensure higher water productivity, profitability and to develop protocols for best water management practice (BWMP). During first crop in the year 2015, density-dependent TWR was 3.13, 3.42, 3.9 ha m in T_1 (400000 post-larvae ha^{-1}), T_2 (500000 post- larvae ha^{-1}) and T_3 (600000 post- larvae ha^{-1}), respectively, while CWU was 1.74, 1.99 and 2.50 ha m in T_1, $T_2$and T_3, respectively. As density increased, TWU and CWU increased due to increased necessity of

water replenishment. Evaporation and seepage losses contributed significantly to CWU. On an average, evaporation loss was 0.54-0.66 m^3 water per kg production of *L. vannamei*. The estimated CWUI was 1.90, 1.93 and 2.20 in T_1, T_2 and T_3, respectively. Size at harvest was 28.3, 25.7 and 24.1 g in T_1, T_2 and T_3, respectively and the recorded productivity was 9.15, 10.31 and 11.36 t ha^{-1} in T_1, T_2 and T_3, respectively. The shrimp pond water quality suitability index/ hydrological index that expresses the overall water quality in a given place and time infers that regulated or less water exchange in T_2 improved overall suitability of water quality for shrimp culture.

The estimated net total water productivity (NTWP, Rs m^{-3}) was 43.4, 42.7 and 36.9 in T_1, T_2 and T_3, respectively, while the net consumptive water productivity (NCWP, Rs m^{-3}) was 77.8, 73.3 and 57.6 in T_1, T_2 and T_3, respectively. Output value to the cost of cultivation (OV:CC) was 2.08, 1.99 and 1.8 in T_1, T_2 and T_3, respectively. Density-dependent growth and yield performance takes place at higher intensity levels, probably due to mutual competition for food and space that causes physiological stress, resulting in slow growth, size-heterogeneity and weight distribution of shrimp, which ultimately affects water productivity. Lower the density, higher was the feeding efficiency and lower was the apparent feed conversion ratio. Higher the density, higher was the sedimentation load that ranged from 37.1 to 51.9 m^3 t^{-1} biomass in monoculture of *L. vannamei* under varying intensity levels. Higher intensity level although substantially increase the harvestable biomass, also significantly affects production cost due to increase in the demand for more external inputs (feed, power, mechanical aeration, water, pumping cost, labor etc.). Therefore, the desirable stocking density is suggested as 50 post-larvae per m^{-2} that gives significantly higher yield, economic return and water productivity.



Production performance of *Litopenaeus vannamei* under varying intensity levels

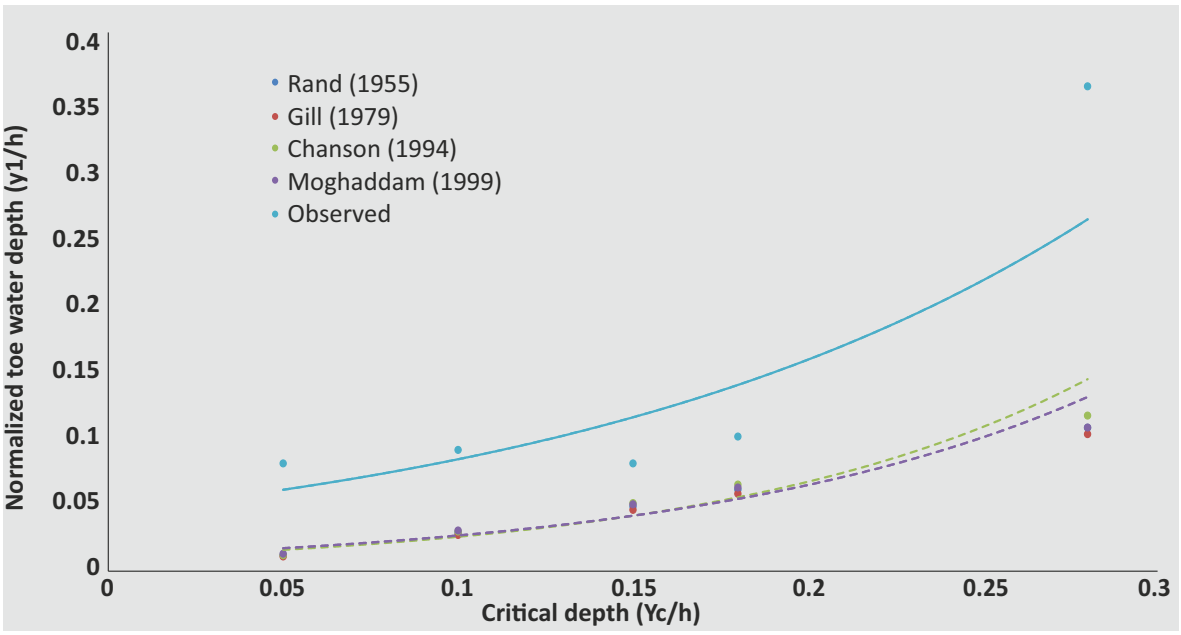
8

CANAL WATER MANAGEMENT

Evaluation of Feasibility of Enhancing Irrigation Efficiency in Canal Command through Improved Surface and Pressurized Irrigation Methods with Adjunct Service Reservoir and Open Dug Well

Project Code: IIWM/15/172
Investigators: R.K. Panda, R.R. Sethi, S.K. Rautaray, R.K. Mohanty and P. Panigrahi

Three hydraulic structures - inlet, outlet and single drop surplus escape were designed and constructed in one of the canal linkage service reservoir namely, Birjaberna Gadhuamunda linkage tank located in Ghurlijore Minor Irrigation Project (MIP), Sundargarh district of Odisha for guiding flow of excess rainwater to the downstream and storage purpose. The flow hydraulics of the inlet device and the flow regulating pattern in the outlet and surplus escape device were recorded during monsoon seasons. In both inlet and outlet structures, occurrence of subcritical flow was observed; implying non-scouring deep slow flow regime, as the Froude number computed within 1.0. The design parameters like toe water depth, pool water depth and residual energy in the single drop surplus escape structure were determined using the observed data and the empirical equations. Normalized toe water depth (y_1/h), normalized pool water



Normalized toe water depth (y_1/h) versus the critical depth (y_c/h)

depth (y_p/h) and normalized residual energy (E_1/H_{max}) as a function of the critical depth (y_c/h) were found to be close agreement among all four empirical equations with an absolute mean deviation of 0.09, 0.72 and 0.18, respectively when compared with the observed data. It was found that the clinging nappe or aeration condition does not exist near the toe of the surplus escape structure as y_p/h was found to be 1 (if $y_p/h < 1$, it is aerated) facilitating a non-scouring flow.

One open dug well (6.0 m diameter and 9.0 m depth) was constructed in the drainage line in Birjaberna village. Pumping tests were conducted during post-monsoon season to study the well hydraulics. The average static water table depth was 2.5 m below ground surface. Pumping test in post-monsoon season showed the drawdown of 0.9 m in 2 hours of pumping, whereas recuperation rate was 8.3 cm h^{-1} during initial period and slowed down afterwards.

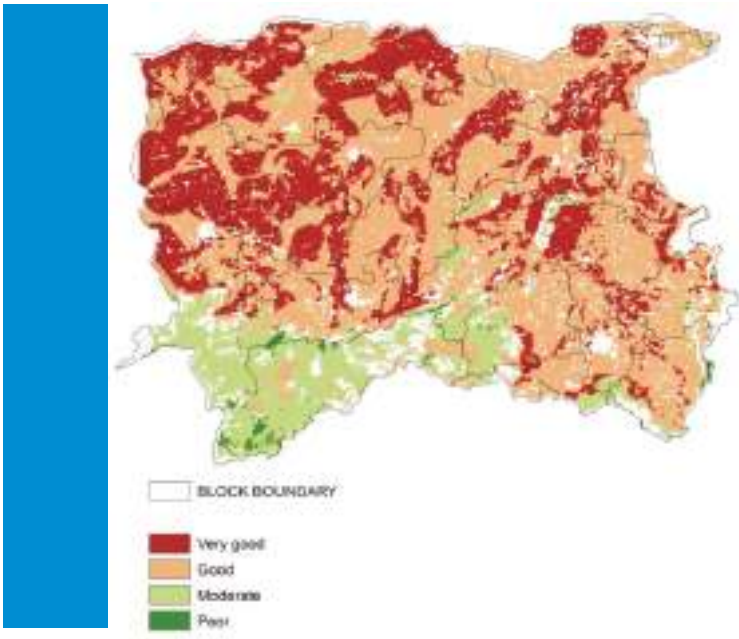
National Innovations for Climate Resilient Agriculture (NICRA)

Externally funded project: NICRA, ICAR, New Delhi
Investigators: G. Kar, P.S.B. Anand, D.K. Panda, A. Raviraj, R.D. Rank and P.K. Singh

Attempts were made to delineate groundwater recharge zones under Amaravathy basin in Tamil Nadu using remote sensing and GIS; evaluation of groundwater recharge structures in Shishvi and Karget village of Udaipur; to study the CO_2 influx/efflux potential of maize and impact of mulches on water productivity (WP) of groundnut and sunflower.

Delineation of groundwater recharge zones under Amaravathy Basin in Tamil Nadu

Basic thematic maps like geomorphology, geology, LULC, soil, slope, drainage density, lineament density of Amaravathy Basin, Tamil Nadu were prepared using remote sensing and GIS, and using multi-criteria technique suitable groundwater recharge zones were identified and categorized as 'very good', 'good', 'moderate' and 'poor'.



Groundwater recharge zones of Amaravathy Basin, Tamil Nadu

Groundwater recharging for climate change adaptation

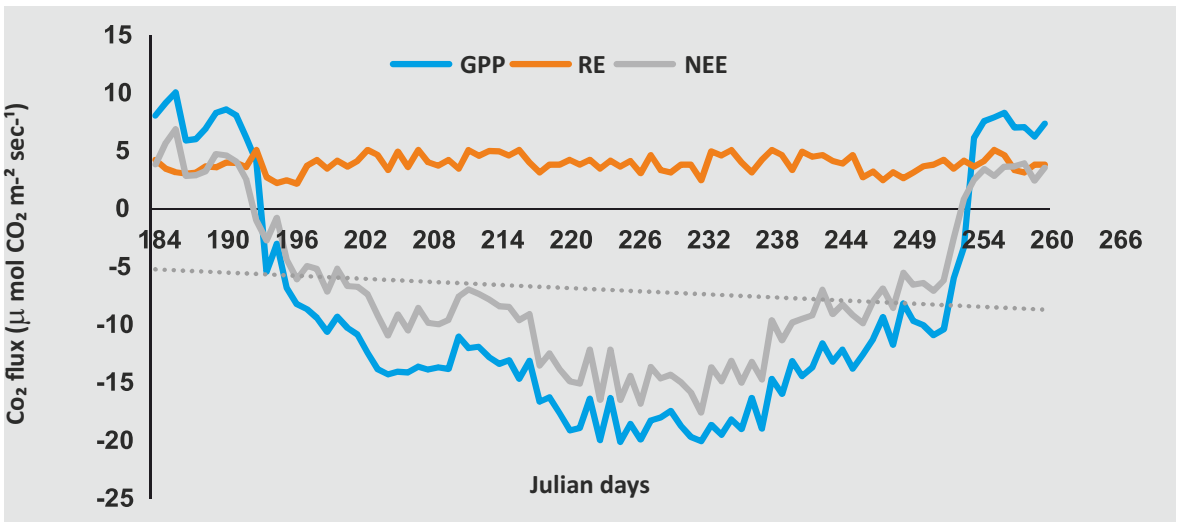
The evaluation of groundwater recharge structures in Shishvi and Karget village of Udaipur clearly show that the recharge rate was decreasing continuously during subsequent years due to siltation of the pond whereas recharge volume was found highest during the year 2013 followed by 2012, 2014 and 2015. The highest recharge volume of 24528 m^3 was recorded in the year 2013 because of occurrence of pre-monsoon in June, 2013 as well as delayed monsoon in September-October, 2013.

Comparison of recharge rate and volume at Shishvi and Karget village of Udaipur

Year	Rainfall (mm)	Recharge rate (cm d^{-1})		Recharge volume (m^3)	
		Shishvi	Karget	Shishvi	Karget
2012	705	7.92	8.32	14607	14669
2013	685	7.10	6.80	24528	24833
2014	532	6.29	4.82	18821	13034
2015	455	3.95	4.14	7903	7811

Co_2 efflux/influx through maize crop, gross primary productivity (GPP) and net ecosystem exchange (NEE)

Maize crop acted as net CO_2 emitter during early vegetative and maturity stage, while it behaved as net CO_2 sink during vegetative stage to milk stage. Seasonal NEE for maize was recorded as -247 g C m^{-2}; its maxima reached at 1130 hour and were highly influenced by leaf area index (LAI); peak NEE was obtained at maximum LAI with the midday CO_2 uptake of –17.87 µmol CO_2 m^{-2} s^{-1} and night-time release of +5.07 µmol CO_2 m^{-2} s^{-1}.



Seasonal variation of gross primary productivity (GPP), net ecosystem exchange (NEE) and respiration

The seasonal variation of aerodynamic and surface resistance were computed, which were used to determine daily latent heat flux using Penman-Monteith (PM) equation. The equation performed reasonably well during mid and peak crop growth stages but underestimated initial stages (when LAI <1.5) compared to eddy covariance technique; at leaf senescence stage again the PM method over-estimated ETc.

Impact of mulches on WP of groundnut and sunflower

Polythene and straw mulch were effective in suppressing weed infestation, preventing evaporation and enhancing WP of groundnut and sunflower. WP of groundnut was 2.91, 3.86 and 5.24 kg $ha^{-1}mm^{-1}$ with no mulch, straw mulch and polythene mulching, respectively; WP of sunflower was 2.12, 2.92 and 3.14 kg $ha^{-1}mm^{-1}$ in corresponding treatments.

Performance of groundnut under polythene mulch (left) and no mulch (right)

Improving Water Productivity under Canal irrigation Command through Conservation and Recycling of Runoff, Seepage, Rainwater and Ground Water using Tanks and Wells

External funded Project: INCSW (formerly INCID), MoWR, Govt. of India
Investigators: K.G. Mandal, R.K. Mohanty and M. Raychaudhuri

Attempts were made to study the integrated farming systems in a canal command, augmented with water harvesting tanks and open wells, in head-, mid- and tail ends under a medium canal command i.e., Kuanria Irrigation project (KIP) in Daspalla block of Nayagarh district in Odisha. Integrated farming systems were developed in different sub-minors with fish culture in ponds, and crop cultivation in commands for improving water productivity. The impact assessment was made on water availability in ponds, groundwater fluctuation, fish & crop production and water productivity in different sites.

Pond-based integrated farming systems and improving water productivity

Fish production was successful in the constructed ponds. The production and performance index, and fish water productivity were studied for water storage tanks. Indian major carps i.e., IMCs (*Catla catla, Labeo rohita and C. mrigala*) were stocked @ 5,000/ha with a stocking composition of 30:30:40 in each pond. After 210 days of rearing, harvesting was carried out and fish production ranged between 1.32-5.20 t ha^{-1} 210 d^{-1}. Species-wise production-size index ranged between 540.7-609.6, 241.1-279.2, and 338.6-382.4 for *Catla catla, Labeo rohita* and *C. mrigala,* respectively.

Conjunctive use of canal and pond/well water facilitated development of integrated farming systems viz. rice + (fish in pond)-maize, rice + (fish in pond)-vegetables (bhindi/ tomato/ cauliflower/ onion/ pointed gourd/ brinjal/

Fish and crop water productivity due to interventions in different canal commands under head, mid- and tail ends indicated with different jurisdictions of water users association (WUA)

Name of sub-minor canal	WUA No.	Canal reach	Gross return (Rs. ha^{-1})	Fish water productivity (Rs. m^{-3})	Crop water productivity (Rs. m^{-3})
Odasar S/M	6	Head reach	2,23,270	17.40	39.91
Mangalpur S/M	2	Mid- reach	1,74,330	8.74	39.32
Khamarasahi S/M	8	Mid- reach	1,63,675	21.48	34.74
Khairapankalsahi S/M	4	Tail- end	77,940	5.29	53.46
Madhyakhand S/M	5	Tail- end	2,00,600	9.70	20.50
Madhyakhand S/M-2	9	Tail- end	1,84,800	9.36	42.71
Lunisara S/M	10	Tail- end	34,663	6.84	25.00
Soroda S/M-II	10	Tail- end	1,12,515	8.05	48.77

pumpkin etc.), rice + (fish in pond) + on-dyke vegetables/ papaya/ banana/ arhar - green gram/ black gram/ ragi etc., rice + (fish in pond)-green gram, rice + (fish in pond)-black gram, rice + (fish in pond)-arhar, rice + (fish in pond)-sesame and rice + (fish in pond)-ragi. The excess canal water and rain water stored in tanks and dug wells provided irrigation to post-monsoon crops, and thereby enhanced productivity of dry season crops and improved livelihood of farmers. Gross economic return ranged from 34,663 to 2, 23,270 Rs. ha^{-1}, fish water productivity ranged from 5.29 to 21.48 Rs. m^{-3} and crop water productivity varied between 20.50 and 53.46 Rs. m^{-3}. There has been positive economic impact of the beneficiary farmers. This pond-based integrated farming technology has potential to improve land and water productivity in the canal command through augmented water resources and involving multi-enterprise components.

Water storage tank under Soroda sub-minor (II)

Open well made under Mangalpur sub-minor

System of Rice Intensification (SRI): Studies on Water Management, Micronutrient Uptake and Crop Rotation

Project Code: DWM/12/156
Investigators: A.K. Thakur, K.G. Mandal, S. Raychaudhuri and A. Kumar

A study was conducted to understand the effect of SRI method on micronutrient uptake, grain-filling efficiency and grain quality. The systems of rice cultivation

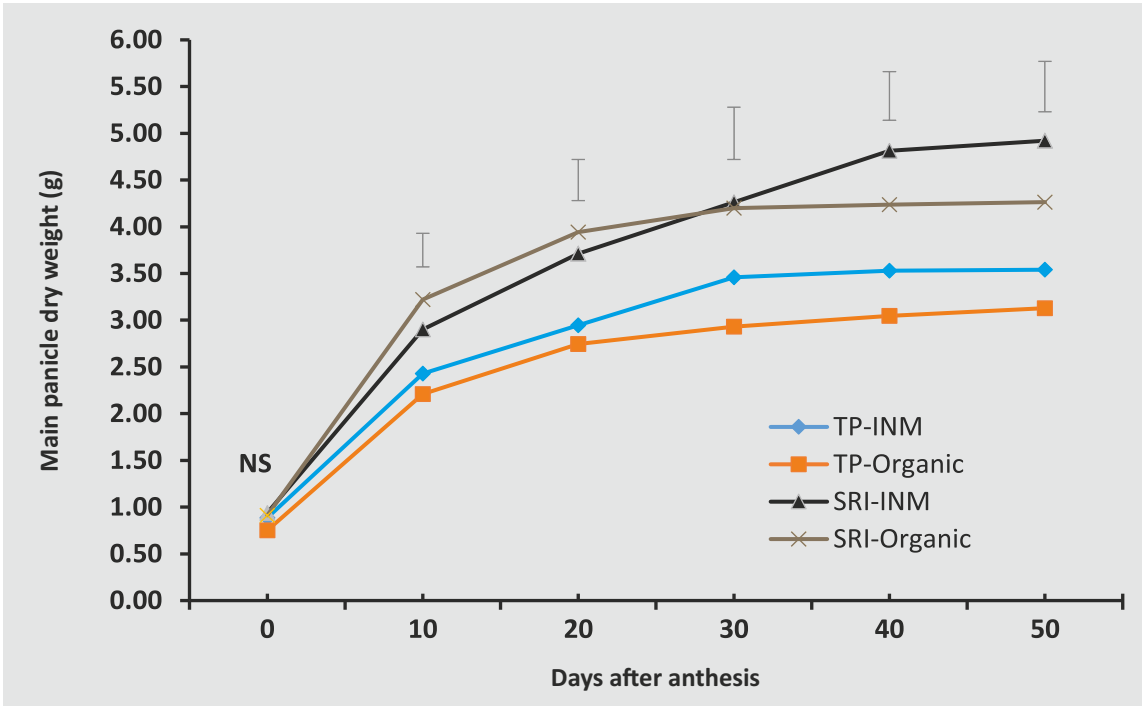
comprise SRI method and conventional transplanting method (TP) with two different nutrient management systems viz. organic and integrated nutrient management (INM).

Effect on micronutrient uptake and grain quality

SRI was found to be superior in enhancing micronutrients concentration in rice grains and had 40, 214, 32 and 99% more of Fe, Zn, Mn and Cu concentration, respectively than TP method. Rice plants get better access to nutrients due to significant improvement in root growth and microbial activities in rhizosphere in SRI. Also, organically grown crop had greater micronutrients content in all plant parts than chemically fertilized one. Hence, current bio-fortification strategies may be adopted through SRI method of rice cultivation which can help in combating problems of malnutrition globally. Grain quality parameters like breaking %, chalkiness, grain shape (L/B ratio) and gelatinization temperature (GT) were measured of milled rice. There was no significant difference in L/B ratio after milling; mean L/B ratio was 2.5 and shape was medium. Also, there was no difference found in gelatinization temperature amongst various treatments. However, a significant difference in head rice recovery as well as chalkiness was found and head rice recovery was greater in SRI (55.8%) than TP (49.2%).

Effect on grain-filling

Highest dry weight of panicle was found under SRI-INM (4.92 g), followed by SRI-organic (4.26 g). Similarly, TP-INM had heavier panicle than TP-organic under conventional transplanted method. Overall, there was 37.7% greater panicle weight under SRI. Highest grain-filling rate (GFR) of main tiller was recorded in SRI-INM (79.7 mg panicle^{-1} d^{-1}) followed by SRI-organic (67.0 mg panicle^{-1} d^{-1}); it was 53.1 and 47.6 mg panicle^{-1} d^{-1} in TP-INM and TP-organic, respectively. Overall, GFR under SRI was 45.7% more than TP; 50% more in SRI-INM than TP-INM and 41% more in SRI-organic than TP-organic.



Changes in main stem panicle dry weight during grain filling in rice under different cultivation practices. Vertical bar represents LSD at p=0.05, NS: non-significant

Analyzing constraints in adoption of SRI method of rice cultivation

Despite yield advantages (20-66%) and greater income through practicing SRI method of rice cultivation, there is a limited adoption by farmers. A study under a canal irrigated command in Nayagarh district, Odisha reveals that yield advantage is not the sole criterion which would have favoured adoption; but there are some other factors as perceived by farmers, which cause limited adoption on a larger scale. In head-reach of the command, farmers were not adopting SRI during *kharif* season due to water logging, while in the tail-ends, only those farmers having alternate source of irrigation adopted SRI. Mid-reach of command was found best suited for SRI water management practices. Constraints are: increased labour demand for square/line planting, unwillingness of agricultural labourers to change practices, difficulties in availability of organic manure and need to replace cheaper women's labour for hand weeding with more costly men's labour for mechanical weeding etc. All such factors have not favoured large scale adoption of SRI method. Risks associated with water-saving irrigation, such as uncertainty about the timing and amount of canal water release, affect adoption as well; there is lack of appropriate management of water; no incentive for farmers to adopt water-saving irrigation. Therefore, farmers tend to flood their rice fields when the canal water is released as water supply for the next irrigation is not guaranteed.

Currently, some farmers continue SRI method on a small part of their operational holdings (5.7-12%) rather than on a large-scale unless appropriate policies governing water management are framed as well as incentives and proper trainings are provided. Moreover, felt needs by farmers are for mechanization of transplanting and weeding due to shortage of labour especially during peak season, village level agreements on irrigation scheduling, group approach towards SRI method rather than individual level for greater adoption.

Evaluating Deficit Irrigation under Drip System for Rice-based Cropping Sequence in Canal Command Area

Project Code: DWM/12/158
Investigators: P. Panigrahi, R.K. Panda, A.K. Thakur, S.K. Rautaray and S. Raychaudhuri

Field experiments were conducted at IIWM research farm, Mendhasal, Bhubaneswar to study the response of rice to drip irrigation and to compare effects of deficit irrigation (DI of 50, 75 and 100% ETc with two lateral layouts, 1.4 and 1.0 m) to capsicum and baby corn under drip system for two rice-based crop sequences viz. rice-capsicum-baby corn and rice-rice-baby corn. Three levels of irrigation were imposed in capsicum and baby corn during November-February and March-May, respectively. The hydraulic performance of the drip system was found satisfactory with mean emitter flow rate variation of only 6% and distribution uniformity of 96% .The water applied to baby corn varied from 190 to 380 mm under different irrigation treatments. The higher soil moisture content at 0-15 cm depth was observed with full irrigation (FI). The higher level of irrigation with 1.0 m lateral layout resulted higher nutrient uptake and better leaf photosynthesis, stomatal conductance and transpiration efficiency. Yield of baby corn with DI of 75% ETc (1.91 t ha^{-1}) was statistically similar to FI (2.04 t ha^{-1}) with 30% higher water productivity.

Rice during rainy season and post-rainy season with drip irrigation at 100% ET_c having 1.0 m lateral layout saved irrigation water by 30-40%, resulting in 60% improvement in water productivity compared to surface irrigation.The grain yield of rice with drip irrigation was statistically at par with that under surface irrigation. In capsicum, the water applied under different drip irrigation treatments (50, 75, 100% ETc and 50% ETc except flowering and fruiting stage) varied from 205 to 410 mm. The higher leaf photosynthesis rate, stomatal conductance and transpiration rate was also observed with fully-irrigated plants. However, the leaf water use efficiency (photosynthesis/ transpiration) was higher under DI at 75% ETc. Irrigation at 75% ETc with 1.0 m lateral spacing saved 25% irrigation water and 15% improvement in water productivity.

Yield and water productivity of capsicum under drip irrigation

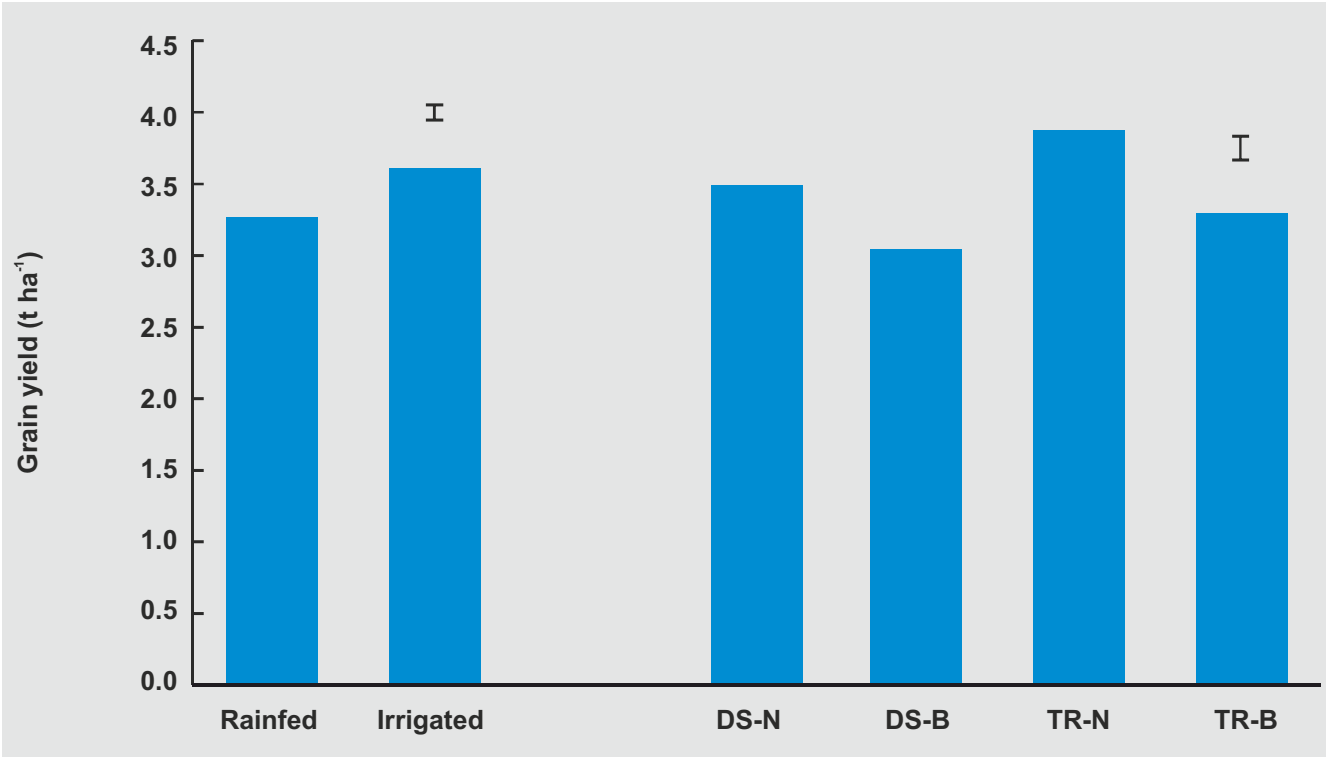
Treatments		Yield parameters				WP ($kg\ m^{-3}$)
		No. of fruits $plant^{-1}$	Av. Fruit weight (g)	Yield ($kg\ plant^{-1}$)	Yield ($t\ ha^{-1}$)	
FI	L_1	5.7	97.1	0.553	26.66	10.8
	L_2	5.6	97.1	0.543	34.65	10.2
DI_{75}	L_1	5.2	98.7	0.513	24.73	12.0
	L_2	5.0	98.3	0.491	33.14	11.5
DI_{50}	L_1	3.8	68.8	0.261	12.58	7.8
	L_2	3.6	68.5	0.246	11.60	7.4
DT_{50EFFS}	L_1	4.6	76.4	0.351	16.92	8.0
	L_2	4.5	76.0	0.342	23.08	7.8
$CD_{0.05}$	I	0.6	0.5	0.02	4.7	——
	L	ns	ns	ns	6.6	
	IxL	0.5	0.3	0.05	7.9	——

Drip irrigation in capsicum

Water Management in Medium and Minor Canal Commands for Rice Production Systems to Enhance Water Use Efficiency and Nutritional Quality

Project Code: IIWM/15/174
Investigators: K.G. Mandal, A.K. Thakur, R.R. Sethi, M. Raychaudhuri and R.K. Panda

A field experiment was conducted at the Institute research farm, under Deras minor command, during *kharif* season 2015 to study the effects of rainfed cultivation and supplementary irrigation to rice systems viz. direct wet seeding (DS) and transplanting (TR) on normal rice (var. 'Pooja') and brown rice. Results from one season trial show that average grain yield of rice (3.61 t ha^{-1}) was marginally higher with supplementary irrigation than rainfed condition (3.26 tha^{-1}). There was no long dry spells during monsoon season, hence no much difference due to irrigation treatment was observed. Further, normal rice yield ranged from 3.25 to 3.68 t ha^{-1} and that of brown rice 2.93 to 3.14 t ha^{-1} across rainfed and irrigated conditions. Yield differences were attributed to more weed growth in direct seeding and differences in SPAD chlorophyll readings, fluorescence efficiency and leaf photosynthesis; measurements of which were made at flag leaf stage and early grain filling stage. SPAD readings ranged from 26 to 39 in DS and 35 to 43 in TR; fluorescence efficiency i.e. *Fv/Fm* values were 0.622 to 0.654 in DS and 0.670 to 0.752 in TR, FPS II 0.451 to 0.523 in DS. Leaf photosynthesis varied from 18.4 to 20.8 μmol $m^{-2}s^{-1}$ in direct seeding and 21.3 to 24.8 μmol $m^{-2}s^{-1}$ in transplanting.



Grain yield of normal (var. 'Pooja') and brown rice (N or B) as influenced by direct seeding (DS) and transplanting (TR) under rainfed and irrigated systems. Vertical bar Vertical lines above bars represents LSD at p=0.05.

A view of rice crop under the experiment at ripening stage

Virtual Water of Agro-based Products under Present and Future Scenarios

Project Code: IIWM/15/173
Investigators: G. Kar, P.K. Panda and R.C. Srivastava

Inter-regional virtual water trade through crops and crop-based products has been standardized under different water management practices in Indian context considering future climate scenarios. 'Virtual water', also known as 'embedded water' or 'exogenous water' or 'ultraviolet' water, referred to the volume of water needed to produce agricultural commodity. Water footprints (WF) indicate direct (the green and blue water footprint) and indirect (greywater footprint) with appropriation of freshwater resources which is lost through evaporation, evapotranspiration, incorporated into a product, contaminated, or returned to the same area where from it was withdrawn. Since water outflows viz., seepage, percolation etc. are not a loss to the catchment, these are not included for water footprint accounting.

Impact of elevated temperature on virtual water of some winter season crops

Increase in global surface temperatures during the period 2081-2100 relative to 1986–2005 is projected to be 0.3 to 1.7°C, 1.1 to 2.6°C, 1.4 to 3.1°C and 2.6 to 4.8°C in IPCC's representative concentration pathways (RCPs) of 2.6, 4.5, 6.0 and 8.5, respectively. Climate change due to increase in temperature rise will demand higher water for irrigation. At the same time the higher temperature will change physiology of crops and shorten crop growth period which in turn will reduce irrigation days. These contradictory phenomena will change total irrigation water demand which is required to quantify for long-term water resources planning and management. As a case study to assess the impacts of elevated temperature on winter season crops and their effects on virtual water, monthly projected climatic parameters viz. T_{max}, T_{min} and rainfall were extracted from the MARKSIM data generator using HadGEM2-ES model under RCP 8.5 scenarios for Dhenkanal, Odisha.

Impact of elevated temperature on virtual water of some winter crops of Dhenkanal, Odisha under RCP 8.5 scenario

Crops	Virtual water (m^3 ton^{-1})			
	Year 2010	Year 2050	Year 2070	Year 2095
Rice	1711	1776 (3.8)	1884 (10.1)	1939 (13.3)
Wheat	1359	1431 (5.3)	1489 (9.6)	1534 (12.9)
Maize	915	955 (4.4)	1002 (9.5)	1038 (13.4)
Chickpea	4034	4228 (4.8)	4381 (8.6)	4482 (11.1)
Black gram	2637	2719 (3.1)	2874 (9.0)	2998 (13.7)
Groundnut	2885	3026 (4.9)	3217 (11.5)	3243 (12.4)
Mustard	4154	4399 (5.9)	4532 (9.1)	4619 (11.2)
Rapeseed	3682	3848 (4.5)	4002 (8.7)	4072 (10.6)
Sunflower	2387	2499 (4.7)	2583 (8.2)	2664 (11.6)
Safflower	3276	3423 (4.5)	3561 (8.7)	3718 (13.5)
Linseed	3881	4063 (4.7)	4277 (10.2)	4354 (12.2)
Potato	335	351 (4.7)	363 (8.3)	376 (12.2)
Tomato	487	512 (5.1)	535 (9.8)	543 (11.6)
Cabbage	533	556 (4.3)	587 (10.2)	594 (11.4)
Cauliflower	504	526 (4.4)	548 (8.8)	573 (13.7)
Okra	440	457 (3.9)	483 (9.8)	496 (12.7)
Carrot	412	432 (4.8)	458 (11.2)	463 (12.4)

Values in parenthesis shows percent increase over year 2010; Sowing time: last week of November; Crop duration: 100-120 days

Impact of elevated temperature on virtual water footprints (m^3 ton^{-1}) of some crop-based products in Odisha under RCP 8.5 scenario

Crop-based products	Virtual water footprints (m^3 ton^{-1})			
	Year 2010	Year 2050	Year 2070	Year 2095
Rice husked	2221	2321 (4.5)	2410 (8.5)	2514 (13.2)
Rice flour	2688	2809 (4.5)	2916 (8.5)	3043 (13.2)
Wheat flour	1375	1462 (6.3)	1507 (9.6)	1552 (12.9)
Maize flour	938	982 (4.7)	1006 (7.3)	1058 (12.8)
Raw sugar	2023	2163 (6.9)	2223 (9.9)	2284 (12.9)
Refined sugar	2164	2313 (6.9)	2378 (9.9)	2443 (12.9)
Groundnut oil	5473	5752 (5.1)	5889 (7.6)	6146 (12.3)
Rapeseed oil	6973	7371 (5.7)	7545 (8.2)	7873 (12.9)
Tomato ketchup	1447	1536 (6.1)	1589 (9.8)	1619 (11.9)
Cotton lint	10224	10837 (6.0)	11052 (8.1)	11563 (13.1)

Values in parenthesis shows percent increase over year 2010

Using the principles of virtual water trade, it indicates that water-rich territory of the country should produce and export water intensive commodities to water-scarce territory, thereby enabling the latter to divert their precious water resources to alternative, higher productivity uses.

GROUNDWATER MANAGEMENT

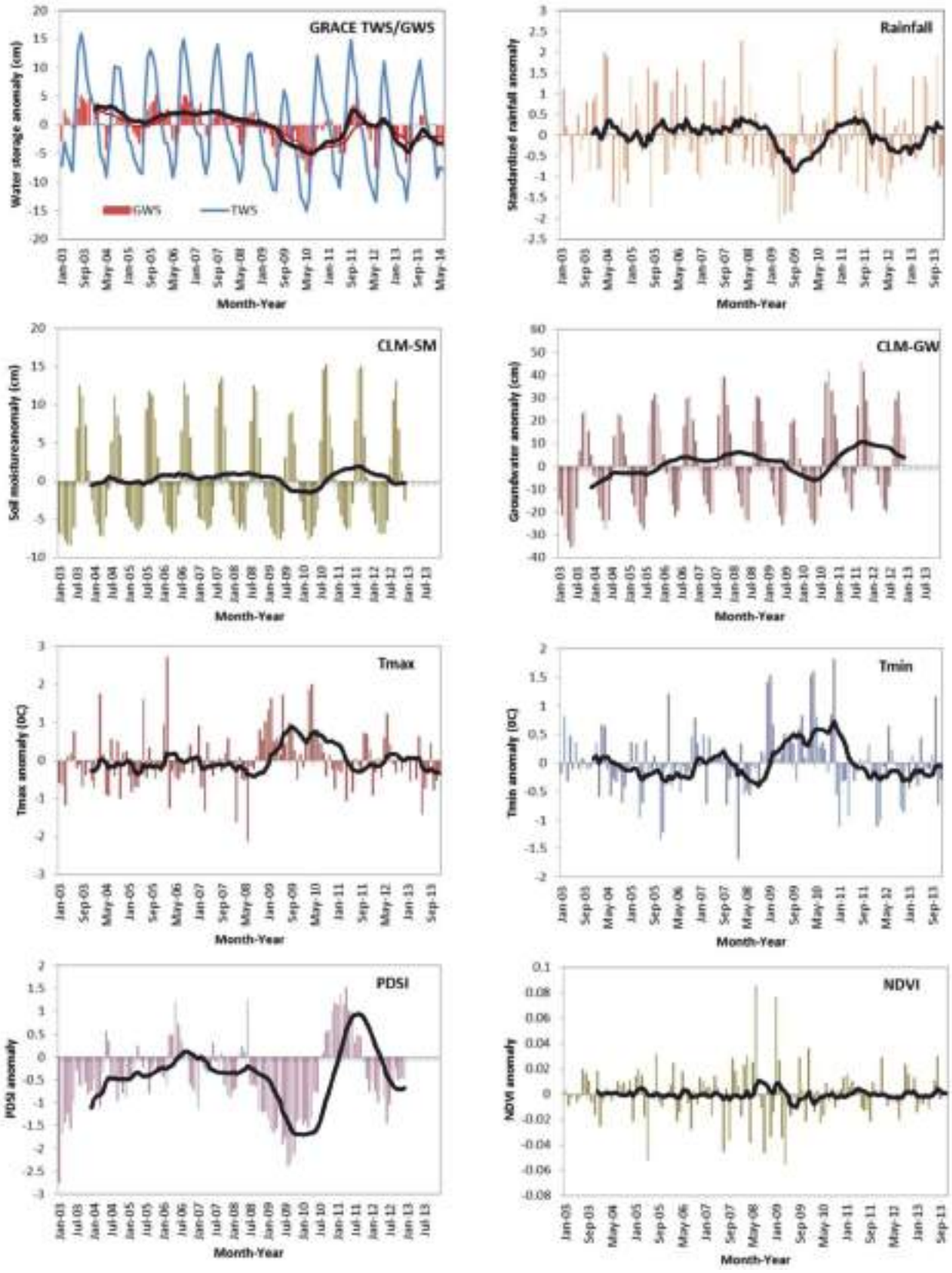
Impact of Climate Variability and Anthropogenic Factor on Groundwater Resources of India

(ICAR Challenge research project associated with LBS award, 2011)
Investigator: Dileep K. Panda

Monthly anomalies of water storage (TWS and GWS, cm) and hydroclimatic variables, such as standardized rainfall, CLM4.5 soil moisture (SM, cm) and groundwater (GW, cm), maximum temperature (T_{max}, ^{0}C), minimum temperature (T_{min}, ^{0}C), Palmer Drought Severity Index (PDSI) and Normalized Difference Vegetation Index (NDVI) during 2003-2013 were derived. In spite of large interannual variability and seasonality, the 12-month running average reflects the concurrent occurrence of drought and hot temperature extremes during 2008–2011. In 2009, the drought propagation from meteorological to a hydrological category, also coincided with the agricultural drought with a marked drop in NDVI resulted in reduction of about 7% food grain production in the country. Moreover, the water scarcity of the country has been accentuated by some anomalously high temperature years since 1901, with the warmest year in 2010 (0.93 ^{0}C higher over the 1961-1990 average), followed by 2009 (0.92 ^{0}C), 2006 (0.60 ^{0}C), 2003 (0.56 ^{0}C), 2007 (0.55 ^{0}C), 2012 (0.49 ^{0}C) and 2011(0.46 ^{0}C).

The Ganges basin of the country, which sustains the rice-wheat cropping system mainly by groundwater withdrawals, has experienced the maximum water storage loss with an estimated volume of 41, 44 and 42 km^3 in drought years 2004, 2009 and 2012, respectively. During the study period the groundwater storage has significantly depleted by 1.25 cm per year. These estimates appears to be reliable as a high linear correlation coefficient of 0.92 observed between the in-situ groundwater levels from the monitoring wells and the GWS anomalies in May, that contains the cumulated signals of anthropogenic withdrawal and climatic stresses in a water year, compared to that of November (0.84).

Moreover, in Punjab which comes under the highest nonrenewable groundwater withdrawal region with annual utilization of 34.66 km^3 compared to a renewable volume of 20.35 km^3, the groundwater storage decline by 2.1 cm per year. However, the mean groundwater level from observation wells shows a decline of 0.46 m per year in the state. Comparison of the GRACE-derived GWS anomalies and in-situ groundwater level anomalies from about 250 observation wells of Punjab reveals a high degree of correspondence, with a correlation coefficient of 0.94. This increases the confidence in the use of GRACE records to monitor large-scale storage changes for sustainable management of groundwater during the recent rise of dry-hot events in India.



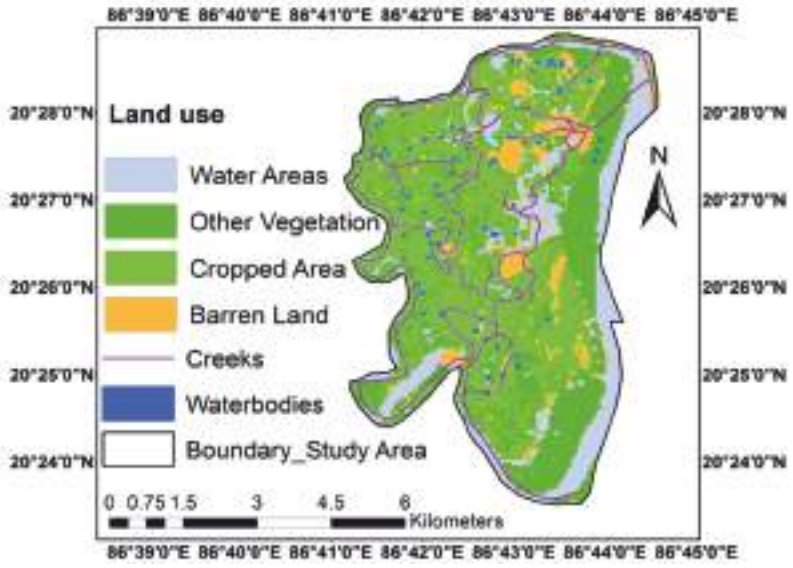
Monthly anomalies averaged over the whole country for the GRACE-derived terrestrial water storage (TWS) and groundwater storage (GWS) denoted by water equivalent thickness (cm), along with meteorological variables. The embedded bold line is the smoothed plot through a 12-month running average.

Development of Technological Options for Comprehensive Water Resource management in Non-exploration Zone (CRZ III) of Coastal Odisha

Project Code: DWM/12/164
Investigators: Ranu Rani Sethi, R.C. Srivastava, Jugal Kishore Tripathy, P.S. Brahmanand and M. Das

A study was conducted for an area of 3900 ha, bounded by natural creeks in Sunity village of Mahakalapada block in Kendrapara district under coastal Odisha. Landsat ETM + satellite image and field survey showed that about 1322 ha is under crops, remaining is under forests, natural shrubs, creek, water bodies, fallow land and settlement. Only 565 ha area is used for *rabi* season crops viz. pulses and vegetable because of non-availability of suitable and sufficient water for irrigation. There are 65 numbers of water harvesting structures/ water bodies with water spread area of 823 to 1804 m^2 within an average depth of 2.1 m; capacity of structures was 2108 to 15765 m^3. It has been worked out that about 374812 m^3 of water can be stored in harvesting structures. However, water availability in these structures is negligible during standard meteorological week 14 to 28. Average water flow from creeks and sub-creeks were measured as 8.81 and 6.38 $m^3 s^{-1}$, thus water availability was estimated as 31.47 and 22.32 million m^3, respectively during November to January. However, most of the creeks remained dry during summer season and the water quality was not suitable for irrigation due to high salinity.

Major crop in *kharif* season is rice (1200 ha) and vegetables (122 ha) followed by pulses viz. green gram and black gram (500 ha), vegetable (65 ha) in *rabi*; rice (50 ha) and vegetables (150 ha) in summer season. Total crop water requirement was estimated at 15.38, 1.96 and 1.75 million m^3 during *kharif*, *rabi* and summer season, respectively. Due to ingression of saline water during high and low tides, available water in the creeks are saline, which is not used for growing crops; almost 57 and 85% of the cropped area remains fallow during *rabi* and summer season, respectively. In order to check the saline water entry through creeks, a sluice gate structure was constructed. The structure was proposed to carry the design discharge of 25 $m^3 s^{-1}$ of water through the creeks from the area of 2000 ha.



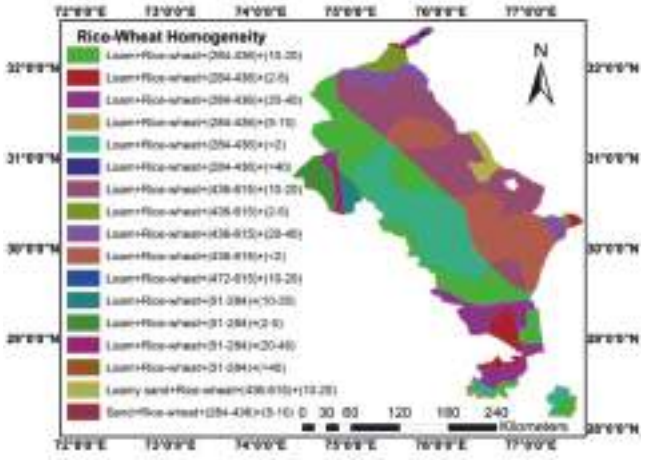
Land use classification of the study area

Based on optimization of land allocation to 3 major crops using LP model, it has been inferred that rice, pulses and vegetables should be grown on 497, 289 and 238 ha, respectively for maximum production from the area. In order to meet the crop water demand, existing water harvesting structures are proposed to be optimized to the average capacity of about 7000 m^3 with the depth of 2.5- 2.8 m.

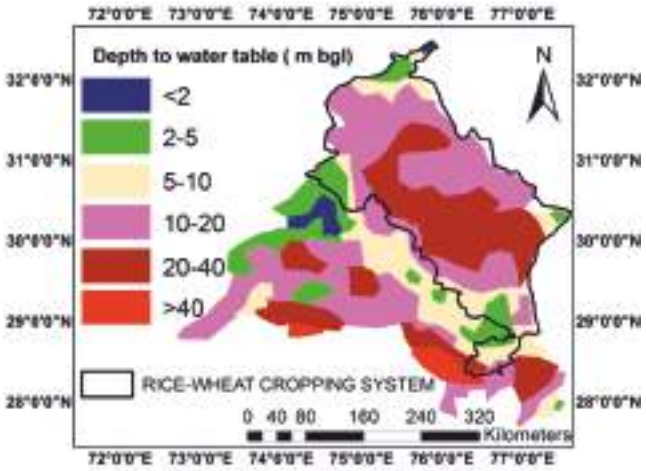
Decision Support System for Enhancing Water Productivity of Irrigated Rice-wheat Cropping System

Collaborative Project: Lead center-WTC, IARI, New Delhi; Cooperating centre-ICAR-IIWM, Bhubaneswar
Investigators: Ranu Rani Sethi, K.G. Mandal, S.K. Ambast, Rajan Agrawal and A.S. Brar

Homogeneous land parcel units (HLPUs) were developed by considering four major thematic layers i.e., soil texture, cropping pattern, rainfall and groundwater table depth for Agro Climatic Region-VI. Out of total 54 HLPUs, only 17 HLP units were identified under rice-wheat cropping system, which covers the states of Punjab and Haryana. Spatial variation of depth to water table in ACR-VI under rice-wheat cropping system was delineated from CGWB report. It showed that groundwater table depth is within 10-20 m for maximum area of 24.67 million ha under rice-wheat cropping system.



Delineated Homogeneous Land Parcel Units (HLPU) in rice-wheat cropping system



Groundwater table depth in ACR-VI (CGWB, 2014)

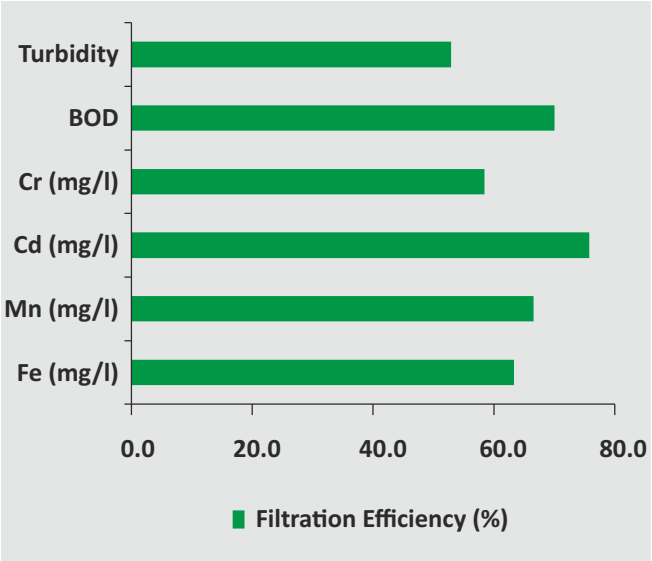
Long-term rainfall analysis was carried out for one of the location i.e. Ludhiana under ACR-VI. The results on onset, withdrawal, longest monsoon period and shortest monsoon period, based on weekly (SMWs) analyses, reveal that onset of monsoon mostly happens in 28th SMW (9th-15th July) and remains active up to 38th SMW (September, 17-23). Hence, mean length of rainy season was found to be of 11 weeks. Probability analysis was made for occurrence of dry and wet spells in the region for appropriate water management and crop planning. Results of initial and conditional probabilities for dry and wet weeks revealed that the probabilities of occurrence of dry spell of one week, *P(D)* was higher (68.18- 90.91%) up to 25th SMW. Again the probability of occurrences of a dry week followed by another dry week and the dry week followed by a wet week varies from 57 to 95 % and 71 to 100 %, respectively during 1st to 25th SMW. From 26th SMW the greater probabilities (>50 %) of occurrence of wet week were observed up to 34th SMW. Hence the probabilities of getting dry week decreases, and and values get lower during the monsoon period. But the chances of getting three consecutive weeks dry i.e., *P (3D)* was less and the probability varied from 7 to 30 % in first 25 weeks of the year; chances of occurrence of consecutive wet weeks i.e., *P (2W)* and *P (3W)* are very less in the corresponding weeks. As the arrival of the monsoon happens in 26th SMW probability of getting two and three consecutive weeks wet increased; and *P (2W)* and *P (3W)* values were very less or zero in the weeks, 39th SMW through 52nd SMW.

Design and Development of Small Filters for Reducing Contaminants in Poor Quality Water at Farmers' Level for Safe Irrigation in Periurban Areas

Project Code: DWM/12/161
Investigators: Mausumi Raychaudhuri, R. C. Srivastava, S. Raychaudhuri and D. U. Patil

The coconut shell charcoal (CSC) was prepared indigenously and further modified by raising the pH to increase its efficiency to adsorb heavy metals from wastewater. The carbon content was 54.11% and the amount of oxygen increased from 10.90 to 37.40% on raising the pH. Further with increase in pH, negative charges were formed on the surface and electrostatic interaction forces played an important role in the adsorption of heavy metals in the wastewater.

The filter design has been modified to optimise the discharge and the efficiency of the filter and the particle size has been standardized. The filter was evaluated at the farmers' field using surface and drip irrigation. Under surface irrigation, the discharge from the filter was recorded as 0.25 l s^{-1} with inlet pressure of 2.1 kg cm^{-3} due to higher loads of suspended solids. It was observed that filter could reduce the sediment in terms of turbidity (36-44 %) and microbial load in terms of BOD (46-52 %). The discharge of the drippers varied from 1.38 to 1.43 l h^{-1} with an average uniformity coefficient of 98.1%. The initial efficiency of filter under drip irrigation is presented in figure.



Initial efficiency of filter evaluated at farmer's field in reducing contaminants

Testing of filter in farmer's field

Developing the Process for Remediation of Chromium from Polluted Water Sources

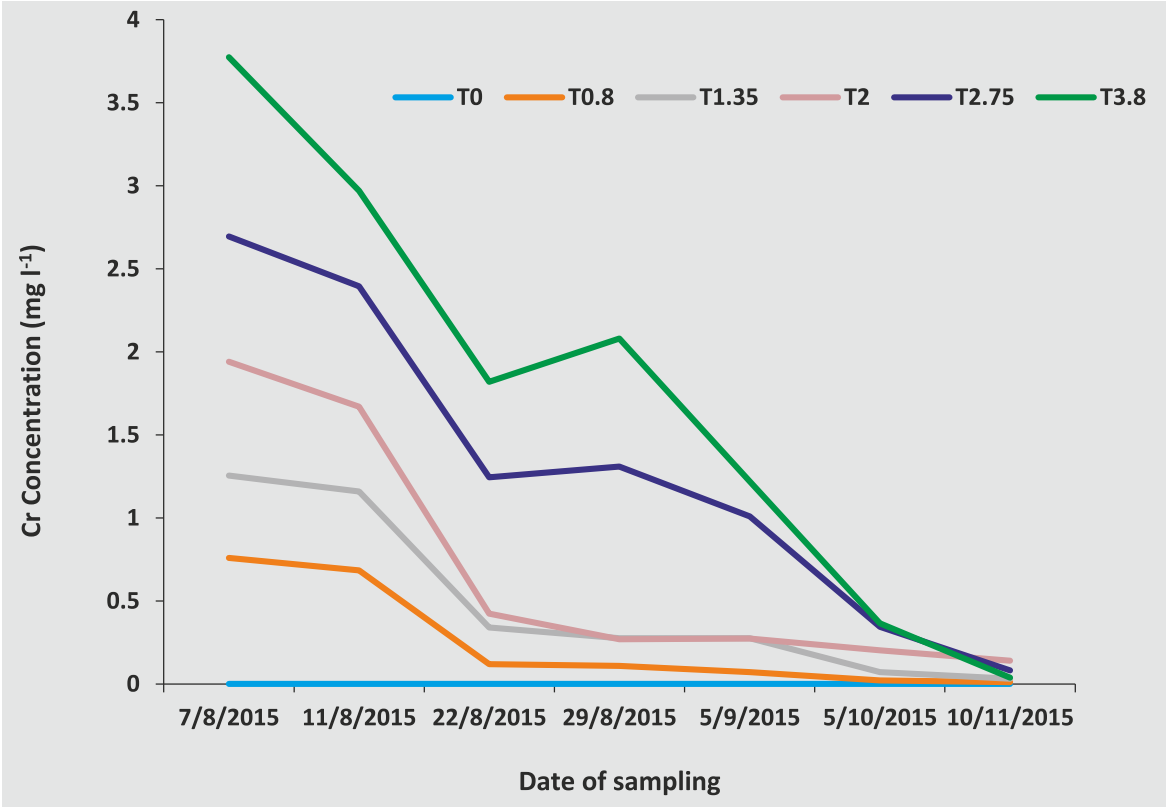
Project Code: IIWM/15/171
Investigators: Madhumita Das, S. Roy Chowdhury, P.S. Brahmanand and K. Laxminarayana

An appraisal of water quality was made for the chromites mine areas at Sukhinda, Odisha. Twenty three water samples were collected from ponds, canal and groundwater sources covering radial distance of 3.1 to 20 km from the surroundings of chromite mine area during April to October 2015. It reveals that most of the samples were acidic to slightly alkaline, non-saline and contained K, Na, Ca, Mg, Cl and Mn at different concentrations. With respect to Cr and Fe, about 11 and 31% samples, respectively were found not suitable for irrigation; soils from 0 to 0.2 m depth were acidic to neutral (pH 4.44-6.43), low to moderate in organic carbon content (0.6-1.26 g per 100 g) and no water soluble Cr. Plant species viz. *Catunaregam spinosa*, *Phyllanthus reticulatus*, *Calotropis gigantea*, *Borrevia articularis, Tephrosia purpurea* were identified, which have natural ecological succession in the mine waste-dump areas; even *Phycus benghalensis* and *Acacia auriculiformis* were growing in deeper areas in open-cast mine along the sub-surface stream of water; tuber crops viz. *Dioscorea alata*, *Amorphophalus* sp. was spotted without apparent sign of Cr.

A pot experiment was carried out at varied concentrations (0.3 to 10 mg L^{-1}) of Cr (VI) i.e., $Cr_2O_7^{-2}$ with water hyacinth (*Eichhornia crassipes*) for a period of 30 days (2 Nov to 1 Dec 2015) under net house condition; in indicates that the threshold level of Cr (VI) tolerance for water hyacinth is 9-10 mg L^{-1}. Water culture experiment was carried out in 0.6 m^3 concrete tanks with water hyacinth at five different concentrations of Cr (VI) as treatments for a period of 90-95 days under net house conditions. The net photosynthesis rate of water hyacinth leaves decreased with increasing Cr concentration.

Periodical monitoring of Cr in water revealed that its concentration was reduced to the tune of 52 to 85% after 16 days of growing of water hyacinth in Cr-polluted

water. Notably the reduction was 1.5-1.63 times more under lower concentration (0.8-2.0 mg L^{-1}) than >2.0 mg L^{-1} because of relatively higher growth rate of plant at lower Cr levels. Elemental analyses of plants reveal that Cr content in roots was 1 to 44 times higher than shoot portion; P and Fe concentration were also higher in roots than shoot portion of the plants.



Trend of decreasing Cr under different concentrations of Cr in aqueous media with time

Development of Decision Support System for Conjunctive Use of Surface and Groundwater

Project Code: DWM/14/165
Investigators: O.P. Verma, R.C. Srivastava, R.R. Sethi and A.K. Nayak

The aim of this study is to enhance the land and water productivity while optimizing the water availability from different sources including groundwater. An open ended conjunctive use model has been conceptualized considering possible variable and constraints for maximization of net returns from different crops using conjunctive use of surface and groundwater. The computed parameters for rice crop are presented. Using the linear programming model, the objective function and constraints were formulated in Microsoft Excel. Input parameters and Excel files for the decision support system (DSS) will be executed to create a SAS input-file that will work on SAS environment for desired output. The development of a user-friendly DSS software is in progress on Visual Basic for conjunctive use of water in agriculture.

Computed parameters of model formulation for rice crop

Variable	Crop activity	Crop period	No. of irrigations	Irrigation method	Cost of Cultivation (Rs ha^{-1})	Total cost of source water (Rs)	Yield (t ha^{-1})	Price (Rs kg^{-1})	Gross Return (Rs ha^{-1})	Net Return (Rs ha^{-1})
X1	*Kharif* rice medium duration (Rainfed)	120	0	Flooding	14000	0	1.82	13.6	24752	10752
X2	*Kharif* rice long duration (Rainfed)	150	0	Flooding	15000	0	1.85	13.6	25160	10160
X3	*Rabi* rice continuous submergence	140	12	Flooding	18000	13050	2.25	13.6	30600	12600
X4	*Rabi* rice 1 day after disappea-rance of ponded water	140	10	Flooding	18000	8700	2.30	13.6	31280	13280
X5	*Rabi* rice 3 day after disappea-rance of ponded water	140	8	Flooding	18000	6960	2.36	13.6	32096	14096

Design and Evaluation of a Portable Drum Based Drip Irrigation System for Sub-marginal Family Farming System

Project Code: IIWM/15/167
Investigators: S. Mohanty, R.C. Srivastava, P.K. Panda and D.U. Patil

Design modification of the portable drum based drip irrigation system was done for air release from the system. The use of velcron tape was standardized for opening and closing of the air release system. The hydraulics of the drip irrigation system was evaluated by use of microtubes and in-line drippers. A 16 mm in-line dripper with a discharge capacity of 2.4 lph was used for the hydraulic study. The hydraulics of the system was studied by measuring the average discharge, reduction in discharge with time, emitter flow variation, coefficient of variation and distribution uniformity. The discharges from the emitters were measured after 5, 20, 35 and 50 minutes after starting operation of the system. The performance of the drip irrigation system with in-line drippers and micro tubes were evaluated. The parameters were found to be within the reasonable limits of drip irrigation system. The portable drum based drip irrigation system was evaluated in cauliflower and brinjal crop.

Evaluated parameters of performance of portable drip irrigation system with in-line drippers and micro tubes

Parameter	Performance under in-line drippers			
	5 min	20 min	35 min	50 min
Average discharge (lph)	0.8	0.79	0.76	0.73
Reduction in discharge of initial discharge (%)	—	1.25%	5%	8.75%
Emitter flow variation	14.2%	17.8%	18.5%	15.4%
Coefficient of variation	6.0%	6.9%	7.2%	6.6%
Distribution uniformity	92.2%	89.3%	89.5%	90.4%
Parameter	**Performance under micro tubes**			
	5 min	20 min	35 min	50 min
Average discharge (lph)	2.1	1.99	1.85	1.72
Reduction in discharge of initial discharge (%)	—	5.20%	11.90%	18%
Emitter flow variation	12.5%	14.3%	15.1%	14.5%
Coefficient of variation	5.4%	6.3%	6.8%	6.7%
Distribution uniformity	93.1%	90.2%	91.1%	90.8%

Portable drum based drip irrigation system irrigating brinjal crop

Efficient groundwater management for enhancing adaptive capacity to climate change in sugarcane farming system in Muzaffarnagar district, UP

Funded by DoAC&FW, Ministry of Agriculture & Farmers Welfare, Govt.of India
Investigators: A. Mishra, S. Mohanty, R.R. Sethi, P. Panigrahi and R.C. Srivastava

The pilot project is undertaken in Muzaffarnagar district of Uttar Pradesh through NMSA, DoAC, Ministry of Agriculture, Govt. of India. ICAR-IIWM is the lead institution; ICAR-IISWC, ICAR-IIFSR, ICAR-CSSRI, ICAR- WTC (IARI), KVK-Muzzaffarnagar and NRM division of ICAR are project partners. The main source of income of the farmers in the district is from sugarcane crop which grows throughout the year. Farmers use groundwater (GW) to irrigate this crop; as a result of which there is a decline in GW table; 3 blocks i.e. Baghra, Sahapur and Budhana are over-exploited out of the 9 revenue blocks. This project has been taken in this area to evaluate the present and future risk to sugarcane-based production system due to depleting groundwater, technological interventions for sustainable use of groundwater for enhancing adaptive capacity to climate change, quantify greenhouse gas emission and develop adaption strategies, develop and evaluate a self-reliant farming system in critical blocks and capacity building of farmers. The project has been taken up mainly in Sahapur block and Baghra block of Muzaffarnagar.

Climatic condition of the district

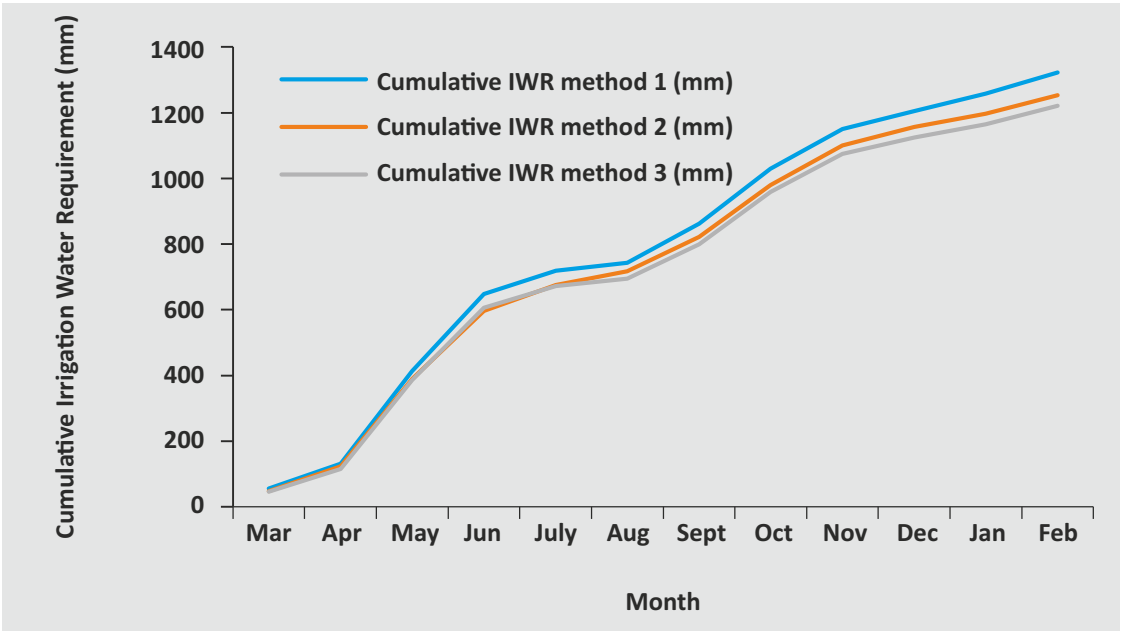
The long-term monthly climatic data analysis of the Muzaffarnagar district, UP for 52 years (1951-2002) showed that the annual average rainfall of the area is 711 mm. The average monthly rainfall varied from 6.26 mm to 235.42 mm in November and August, respectively. The average maximum temperature varied from 21.05°C to 39.37°C during January and May, respectively. The average minimum temperature was 6.89°C in January whereas the maximum was 27.40 °C in June. The average reference crop evapotranspiration varies from 2.34 mm day^{-1} in January to 7.30 mm day^{-1} in May.

In 1st year, different technological interventions for sustainable use of groundwater and climate resilient self-reliant farming system were designed and implemented by lead and partner Institutes. These include:

- In order to check the conveyance losses, the underground pipeline (PVC pipeline with 110 mm diameter, 130 to 170 m length) system was designed and laid out in 15 farmers' fields in well commands.
- For efficient application of water in the sugarcane field, raingun system with 75 mm PVC pipe and 100 m length has been installed in one of the farmer's field of Rasulpur Jattan village.
- One check dam (masonry structure) with 8.86 m span and 2.16 m height has been constructed on Harsauli drain in vicinity of the Rasulpur Jattan village. The water storage capacity and surface water spread area of this check dam are 35022 m^3 and 32428 m^2, respectively. Another similar type of structure is being constructed in upper reach of the same drain near village Harsauli by ICAR-IISWC, Dehradun.

- As a part of the self-reliant farming system, two vermi-compost units have been constructed in of two farmers' fields of Rasulpur Jattan village by ICAR-CIRC, Meerut.
- On-farm demonstration on alternate furrow irrigation system in sugarcane has been conducted in 4 acres land belongs to 4 farmers of Raasulpur Jattan village. Fourteen farmers training programmes were conducted by KVK, Baghra and CIRC, Meerut on various aspects of sugarcane cultivation with a focus on water management.

The net irrigation water requirement for sugarcane crop was 1220 to 1325 mm. The cumulative net irrigation water requirement is shown in figure and this amount of water has to be met either from surface or groundwater sources.



Monthly and cumulative irrigation water requirement of sugarcane estimated by different methods

Impact Assessment Study of using Industrial Wastewater on Sunflower (*Helianthus annus* L.) and Mustard (*Brassica nigra* L.) Grown in Peri-industrial Area of Angul, Odisha

Project Code: IIWM/15/170
Investigators: Rachana Dubey, Mausumi Raychaudhuri, P.S. Brahmanand and R.C. Srivastava

Rapid industrialization has taken place in Angul-Talcher industrial complex of Odisha. Mining and industrial activities have caused significant degradation of environmental quality. Two major small rivers like Tikira and Nandira which carry the urban and industrial wastes, confluence with river Brahmani in the region; now this area is considered as one among 24 hot spots of India by Central Pollution Control Board (CPCB) in 2010. Hence, a study is being carried out to assess the water and soil characteristics of the peri-industrial area of Angul, Odisha. Six sampling sites (Kulad village, Kulad culvert, Bonda-Nalco CPP, Bonda village culvert, Nuahatta and Digi) were selected along the feeder stream

Nandira (Brahmani river) which is considered as most polluted stream. Sites were selected within the critically polluted industrial cluster (CPIC) with a score of 82.01 by CPCB, 2010.

Pre-monsoon and post monsoon surface water and soil samples were collected and analyzed for different chemical characteristics; pH ranged from 7.9-8.8 and 7.5-8.2 in pre-monsoon and post-monsoon, respectively, which showed a decreasing trend from pre-monsoon to post-monsoon; EC was 0.4-0.8 dS m^{-1} in pre-monsoon and 0.3-0.6 dS m^{-1} in post-monsoon which was within permissible limit (0-3 dS m^{-1}). Biological oxygen demand was higher in pre-monsoon compared to post-monsoon. Ca, Mg, NH_4-N, alkalinity, hardness and sodium absorption ratio (SAR) was found to be higher in post-monsoon season compared to pre-monsoon, which indicates that industrial effluents were discharged during monsoon period that might have caused slightly increasing in the water quality parameters.

Characteristics of surface water used for irrigation at peri-industrial site of Angul, Odisha

Parameters	Unit	Pre-monsoon	Post-monsoon
pH	-	8.4±0.4	7.8±0.3
EC	dS m^{-1}	0.4±0.1	0.6±0.2
DO	mg L^{-1}	8.9±0.6	8.6±1.3
BOD	mg L^{-1}	5.9±2.7	4.9±2.1
K	mg L^{-1}	9.3±4.7	2.2±1.4
Na	mg L^{-1}	56.0±11.5	56.7±12.8
NH_4-N	mg L^{-1}	0.38±0.08	1.40±0.07
NO_3-N	mg L^{-1}	22.4±10.2	22.4±10.2
$CaCO_3$	mg L^{-1}	124±25.1	216±74.8
Ca	mg L^{-1}	30.0±5.1	60.8±20.5
Mg	mg L^{-1}	94.0±20.2	155.2±55.2
Total hardness	mg L^{-1}	211.8±46.6	278.2±92.3
SAR	{cmol (p^+) kg^{-1}}$^{1/2}$	3.9±1.1	5.2±2.0

±Standard deviation

Soils were collected from different identified sites up to 15 cm depth and analyzed for assessing soil fertility status of the area Soils of the region was found to be slightly acidic, EC 0.2-0.5 dS m^{-1} and organic carbon (OC) content 0.54-0.94%. At Bonda site OC (%) was found higher (<0.75), but the avail-N was low (<280 kg ha^{-1}) indicating that the soils have wider C: N ratio. Avail-P was very low (3.25-11.90 kg ha^{-1}) while potassium was in the medium range (229-333 kg ha^{-1}).

Soil fertility status of project site at Angul

Site	pH (1:2)	EC_2 (dS m^{-1})	OC (%)	Avail-N (kg ha^{-1})	Avail-P (kg ha^{-1})	Avail-K (kg ha^{-1})
Kulad	6.0	0.5	0.54	439.04	10.73	229.0
Nalco-CPP, Bonda	6.1	0.3	0.94	188.16	3.25	239.4
Bonda village culvert	6.7	0.5	0.81	125.44	7.83	291.5
Nuahaata	6.0	0.2	0.39	156.80	7.54	260.2
Digi	6.0	0.3	0.43	282.24	11.90	333.1

WATERLOGGED AREA MANAGEMENT

Delineation of Waterlogged Areas in Eastern India and Formulating Strategies for Fitting in Suitable Crops and Aquaculture through Harnessing Agro-biodiversity for Enhancing Water Productivity

Project Code: DWM/12/162
Investigators: S. Roy Chowdhury, P.S. Brahmanand, A.K. Nayak, R.K. Mohanty and S.K. Ambast

The delineation of waterlogged areas in Assam was made using land use/ land cover (LULC 2005-06, 1:50,000 scale) data of ISRO for identifying suitable cropping and aquaculture in the areas. Dibrugarh district in Assam, which is flood prone, has the waterlogged area of 78,477 ha. Short and medium duration rice varieties are suggested for waterlogged areas viz. 'Disang' and 'Luit' of 100 days each, 'Kapili' and 'Kolong' of 120 days each. Wet seeding of sprouted seeds @ 75-80 kg ha^{-1}, 50-60 days old over-aged seedlings for var. 'Gitesh' and 'Prafulla', mixed cultivation of deep water rice, locally called as '*Ahu*' and '*Bao*' are suitable flood resilient measures in Assam. Integrated rice-fish farming has ample scope in bunded waterlogged areas.

In Bihar, based on ISRO LULC data of 2005-06, Saran district has the highest total of 37489 ha area under waterlogging including inland wetlands, rivers/ streams/ canals, reservoirs/ lakes/ ponds, followed by Vaishali, Paschim Champaran, Supaul Bhagalpur and Kathihar with 37198, 32968, 32307, 30543 and 23556 ha respectively. The survey and ground truthing were completed for Bhagalpur and Katihar districts in Bihar. The geo-referenced satellite P6-LISS-III imagery (path 106 and row 54) for pre- and post-monsoon period was processed for classification of waterlogged area; thematic maps were prepared for Bhagalpur district.

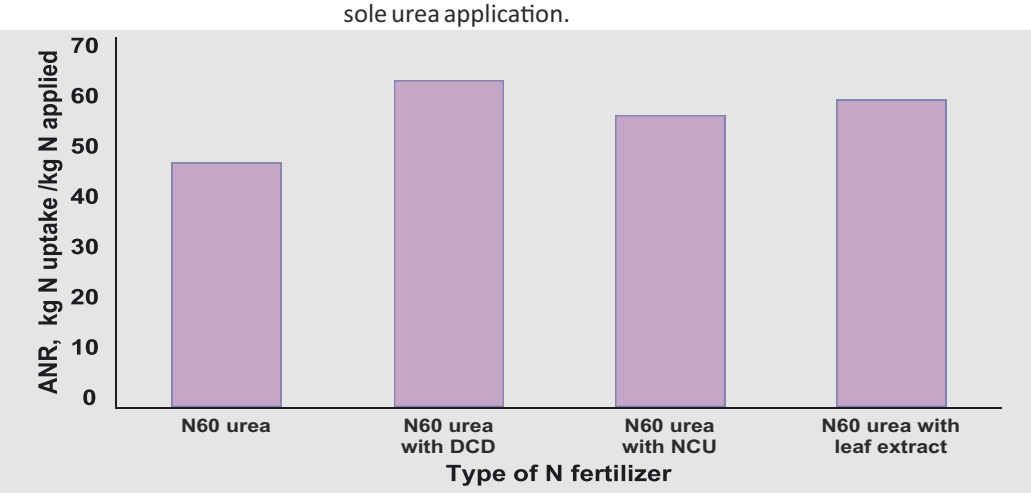
The changes on waterlogging scenarios in pre-monsoon (left; May 15, 2014) and post-monsoon (right; November 23, 2014) period in Bhagalpur district. The ( ) shaded areas are waterlogged areas delineated after monsoon.

Bhagalpur and Katihar districts of Bihar, under middle Gangetic plain region (ACR IV), receive annual rainfall of 1208 and 1298 mm; 11.74 and 14.59% of net sown area for the districts are under waterlogged condition, respectively. The existing cropping intensity is 125 and 169% for the respective districts, which can be enhanced significantly through utilization of waterlogged areas and development of alternate cropping pattern. Suggested measures could be integrated rice-fish farming without-field refuge, growing of over-aged rice seedlings (45-60 days), adopting double transplanting locally called as '*Kharuhan*', and cultivation of flash flood tolerant rice varieties viz. 'Swarna sub-1' for enhancing agricultural productivity.

Eco-efficient Agricultural Practices for Enhancing Nutrient Use Efficiency of Rice (*Oryza sativa*) under Waterlogged Ecosystem

Project Code: DWM/12/163
Investigators: P.S. Brahmanand and S. Roy Chowdhury

An on-farm experiment was conducted in a village, Balisahi of Pipli block of Puri district, Odisha to study on nitrogen use efficiency of rice in waterlogged ecosystem. Fertilizer-N @ 60 kg ha^{-1} was applied either through urea or nitrification inhibitor, dicyandiamide (DCD), or neem coated urea (NCU) or through urea coated with leaf extracts of neem (*Azadirachta indica*) and karanj *(Pongamia pinnata*). The leaf extracts of *A. indica* and *P. pinnata* were used due to their property of slowing down the rate of release of N due to presence of alkaloids viz. azadirachtine and karanjin, respectively. Apparent N-recovery (ANR) fraction from the rice field in a waterlogged ecosystem was 61.5% when N was applied @ 60 kg ha^{-1} through urea in combination with dicyandiamide (DCD), 58.2% when urea was applied after coating with leaf extracts of *A. indica and P. Pinnata.* ANR was 46.3% with sole urea application. On contrary, the highest physiological efficiency of 41.7 kg grain/kg N uptake was obtained in rice with sole urea application. The residual effect of different nutrient treatments was monitored on *rabi* crops viz. green gram, groundnut, potato, brinjal and rice. It is revealed that application of N @ 60 kg ha^{-1} through nitrification inhibitor and urea coated with leaf extracts of *A. indica* and *P. pinnata* have resulted in higher productivity in *rabi* crops compared to sole urea application. The economic analysis indicated that the farmers could generate additional net returns of about 2,700 Rs. ha^{-1} due to practice of eco-efficient nutrient management compared to sole urea application.



Apparent N recovery of rice as influenced by nutrient treatments. Vertical bar represents LSD at p=0.05

Drainage Planning of Eastern Coast Delta using Geoinformatics

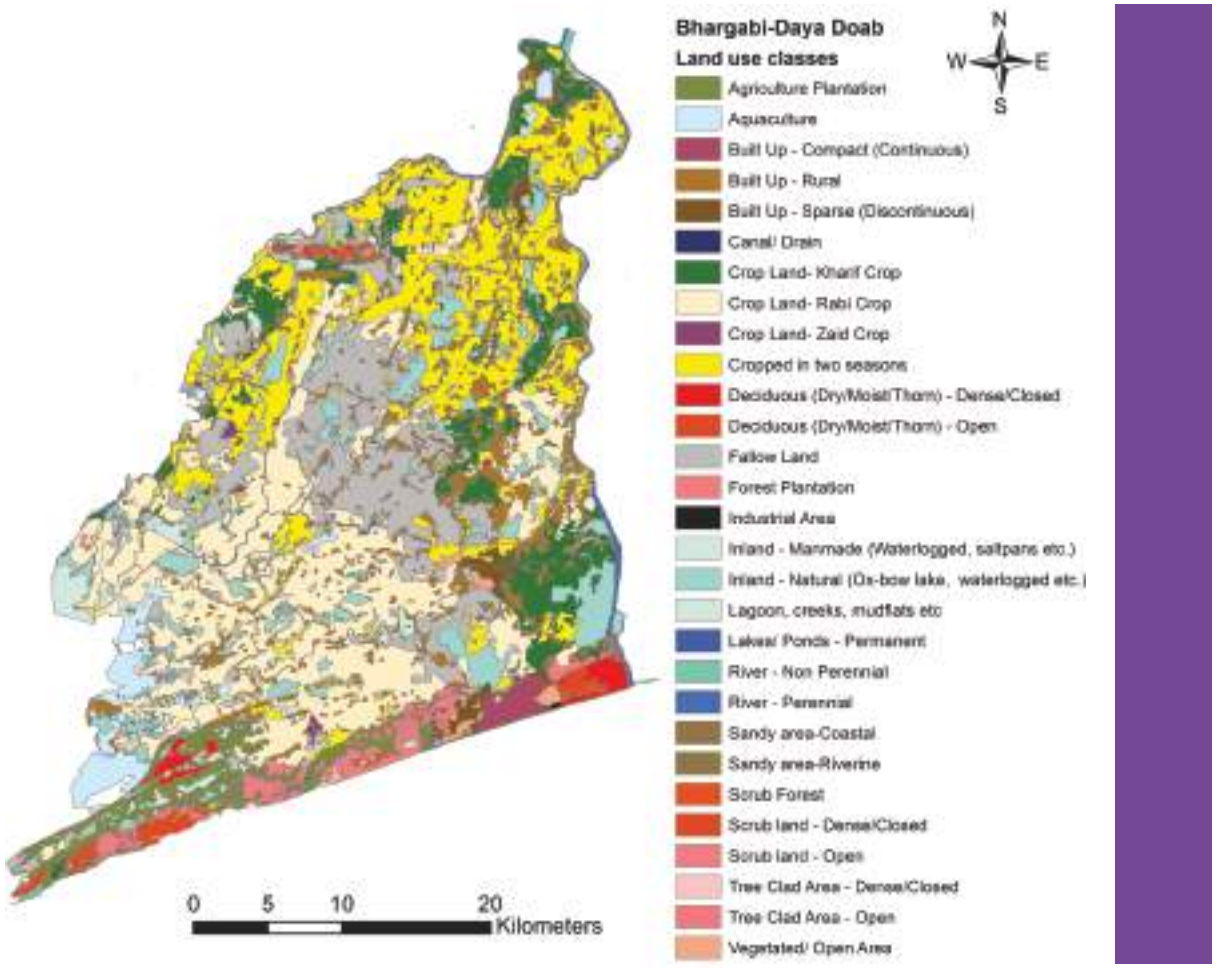
Project Code: IIWM/15/169

Investigators: S.K. Jena, S. Roy Chowdhury, P.S. Brahmanand and A.K. Nayak

Appropriate drainage planning is essential to tackle the problems related to waterlogging and water congestions in Bhargabi-Daya doab under Mahanadi delta. Reconnaissance survey of the area was done. Digital images of Indian remote sensing satellite were processed and analyzed for preparation of land use and land cover map including water resources. The total geographical area of the study area is 126631.88 ha. Upon analyses, it reveals that the area under *kharif* crop is lower and *rabi* crop area is considerably higher. This is due to severe waterlogging and congestions during *kharif* season which results in very less cropping during *kharif* season; farmers grow paddy extensively during *rabi* season after the decrease of standing water. Double crop areas are also more due to availability of canal water or use of residual soil moisture through *paira* cropping after paddy. Ground truthing of the information has been done. The digital elevation data of ASTER (Advanced Space-borne Thermal Emission and Reflection Radiometer) and global DEM (Digital Elevation Model) was obtained from United State Geological Survey (USGS) Earth Explorer data base. The preparation of contour map with 10 m interval and 2 m interval was done separately for the study area.

Land use land cover of Bhargabi-Daya doab under Mahanadi delta

Land use pattern	Area (ha)	% total area
Kharif mono crop	9441.96	7.46
Rabi mono crop	32182.95	25.41
Summer crop	271.40	0.21
Double cropped	22871.05	18.06
Current fallow	15778.34	12.46
Coconut and other plantation crops	4361	3.44
Aquaculture area	4205.88	3.32
Total wetland	12422.21	9.81
Puri town built-up	984.05	-
Rural built up	11762	9.29
Rivers (perennial and non-perennial)	2812.28	2.22
Canal and drain	249.34	-
Deciduous and scrub forest	2644.33	-
Waste land	1900.23	-



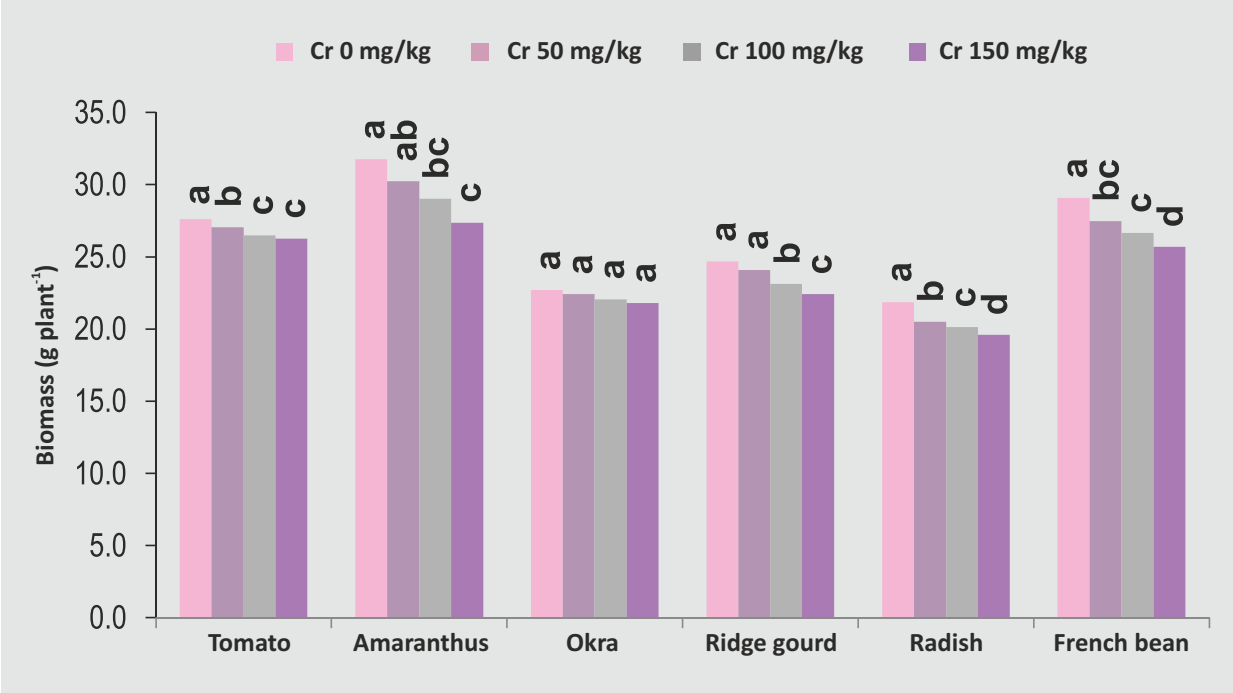
Land use land cover map of Bhargabi-Daya doab for drainage planning

Identification of Suitable Crops for Wastewater Irrigation

Project Code: DWM/12/159
Investigators: S. Raychaudhuri, M. Raychaudhuri, S.K. Rautaray and S. Roy Chowdhury

Effect of soil applied chromium on growth and photosynthesis rate on vegetable crops

Field experiment was conducted at ICAR-IIWM research farm, Mendhasal, Bhubaneswar to study the effects of graded levels of Cr (0, 50, 100 and 150 mg kg^{-1} of soil) on six vegetable crops viz. tomato, *amaranthus,* okra, ridge gourd, radish and french bean. There was decreasing trend of biomass yield with increasing levels of Cr; decreasing trend in biomass yield was more pronounced in amaranth, french bean and radish than okra and tomato. The net photosynthesis rate of vegetable crops at two growth stages showed decreasing trend with increase in Cr level. The extent of decrease at 150 mg/kg compared to control (0 mg kg^{-1}), was the least in okra (20%) followed by french bean (25%) at the first stage of observation; later the decrease was the least in tomato (23%) followed by ridge gourd (28%).



Effect of different Cr levels on biomass of some vegetables

A view of experimental plot at IIWM research farm

In general, the concentration of Cr in plant parts was in the order of roots>shoots>leaves>fruits. The transfer factor (TF i.e. ratio of concentration of Cr in plants to those in soil) of Cr in okra decreased from 0.16 to 0.13 with increasing concentration of Cr in soil. The TF was the highest in roots (0.32), followed by leaves (0.16) and fruits (0.06). Higher accumulation of Cr in plant roots could be due to the immobilization of Cr in vacuoles of root cells.

Effect of Cr and liming on okra

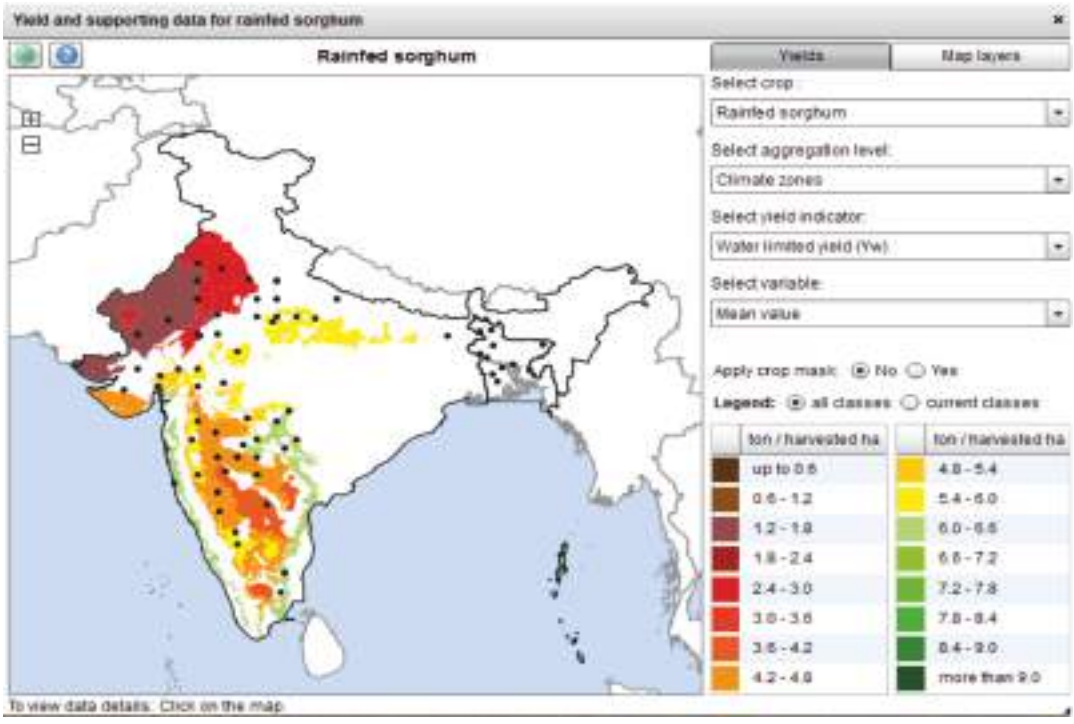
A pot experiment was conducted to study Cr accumulation by okra; different levels of Cr were 0, 150, 300 and 450 mg kg^{-1} of soil with or without liming. Soil

application of Cr @ 150 mg kg^{-1} with liming increased toxicity in okra seeds with decreased germination and retarded growth, even no germination at 300 and 450 mg kg^{-1}. Without lime, seed germination was not affected up to 150 mg kg^{-1}. The DTPA extractible Cr in soil increased with lime, indicating thereby higher solubility and availability to plant.

Global Yield Gap and Water Productivity Atlas (GYGA)

Collaborative Project: ICAR with University of Nebraska, Lincoln, USA
Investigators: P.S. Brahmanand, N. Subash, S.K. Ambast and A.S. Panwar

Yield gap analysis was made using data on actual yield and simulated potential yield for five major crops grown in India viz. maize, rice, wheat, sorghum and pearl millet, and to contribute the information to prepare a global yield gap and water productivity atlas. Based on distribution of crop harvested area and the agro-climatic zones, a total of 20, 13, 16, 14, 18, 26 and 30 reference weather stations (RWS) were selected for irrigated wheat, rainfed wheat, irrigated rice, rainfed rice, maize, sorghum and pearl millet, respectively. District-level data on actual yields for maize, sorghum and pearl millet were retrieved from database of Government of India (http://lus.dacnet.nic.in/). A weighted average yield was calculated at the RWS level from the actual yield of 3 years (2007-08 to 2010-11). For irrigated and rainfed rice and wheat, actual yields were retrieved from Spatial Production Allocation Model (SPAM) 2005. Soil related information within RWS buffer zones were identified based on data collected from national research institutions and bureaus under the ICAR. The mean actual yields of maize, sorghum and pearl millet for a period of ten years (2001-02 to 2010-11) and segregated yields for three year (2008-09 to 2010-11) were estimated for all climatic buffer. The highest mean yield of maize (3.92 t ha^{-1}), sorghum (2.9 t ha^{-1}) and pearl millet (1.7 t ha^{-1}) was estimated for Nizamabad buffer zone of Telangana, Kurnool buffer zone of Andhra Pradesh and Hisar buffer zone of Haryana, respectively.



Potential yield of rainfed sorghum in India

Simulations were performed using WOFOST (WOrld FOod STudies) model for obtaining potential yield of sorghum and pearl millet based on weather, crop and soil information in each RWS buffer. A dynamic sowing rule under each RWS was followed using sowing windows in the model which is based on onset of rains. Soil water, generic parameters and crop management data were used. Model output reveals that potential yield of rainfed sorghum ranged between 4.8 and 7.8 t ha^{-1} in climatic buffer zones of Rajasthan and Maharashtra, respectively. Similarly, water limited yield of sorghum ranged between 1.8 and 5.4 t ha^{-1} in different climatic buffer zones of India. The potential yield and the water limited yield of pearl millet ranged from 4.5 to 6.0 t ha^{-1} and 1.0 to 5.0 t ha^{-1}, respectively in different climatic buffer zones of India.

Development of Agriculture Water Management Portal (AWMP)

Project Code: DWM/12/160
Investigators: A.K. Nayak, R.C. Srivastava, M. Das, P. Nanda, A. Kumar, R.G. Patil, U.M. Khodke and B.S. Yadav

Using information and communications technology (ICT), a web-based information system (Agriculture Water Management Portal, AWMP) has been developed with different modules viz. research, extension, farmers and general information along with a data management module for two-way data communications; option for registering new user with the provision of uploading information, after scrutiny at coordinating unit of AICRP on irrigation water management, on the portal in public domain. The data management module contains various options viz. viewing and/ or changing user profile, uploading financial information, manpower details and submission of monthly or quarterly reports, entering recent news by the coordinating unit. There is an option to upload research achievements, attach research output files, photographs, audit utilization certificates etc. The module was demonstrated at the biennial workshop of the AICRP on IWP at Water Technology Centre, TNAU, Coimbatore for use by scientists of different centers.

Data management module for chief scientists of AICRP on Irrigation Water Management

The web pages were updated with technologies developed by this Institute on rainwater conservation, micro-level water resource development, pond-based integrated farming systems, crop diversification, raised and sunken bed technology, system of rice intensification, sub-surface water harvesting structures for coastal areas etc. The web pages were also created in Hindi language and uploaded in the agriculture water management portal dissemination of information to end users.

Data management module of the web portal for project coordinating unit

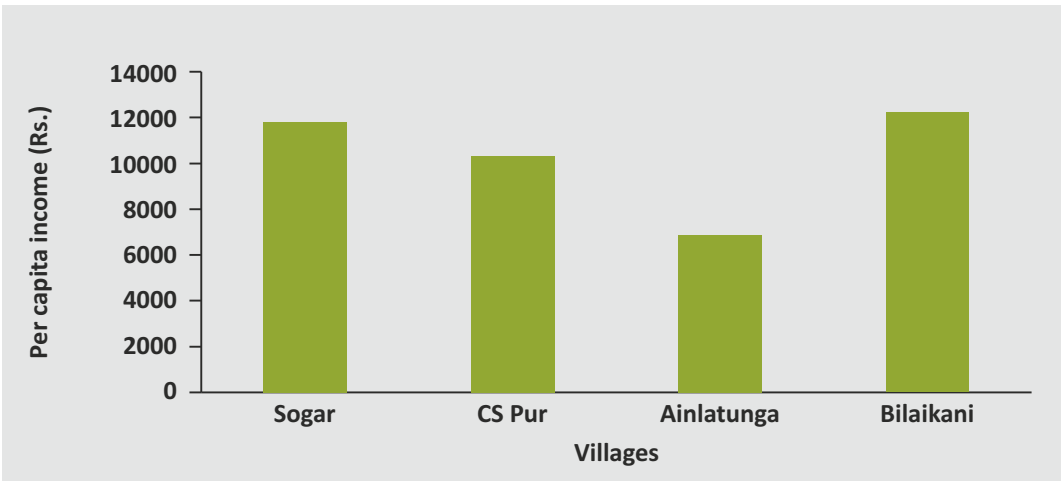
ON-FARM RESEARCH & TECHNOLOGY DISSEMINATION

Tracking Changes in Rural Poverty in Household and Village Economies in South Asia

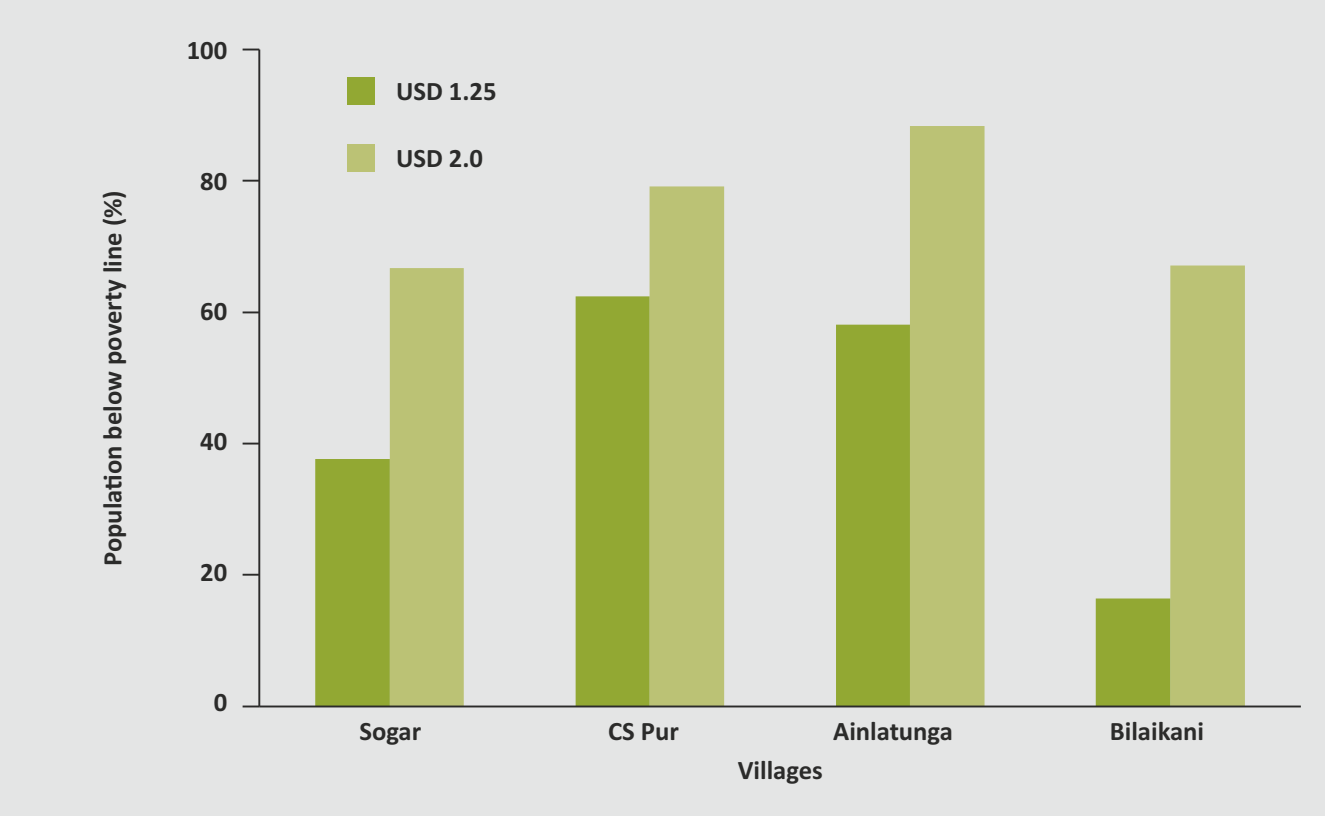
External-funded Project: Bill & Melinda Gates Foundations, USA
Investigators: M.K. Sinha, P. Nanda and S.K.Ambast

Panel household data from farm and non-farm activities documented from identified villages of two distinct agro-ecology of Odisha on monthly basis. Data shows that farm and non-farm activities are very much closely associated in villages of Balangir district, where seasonality of crop production force family to shift towards non-farm activities during lean period. However in villages of Dhenkanal district, both groups of farmers are not interrelated, nor affected with each other. Almost half of working population is engaged in non-farm activities. Out of the total, 64.2% is landless, whereas 41.9% of small farmers earn their livelihood by performing non-farm works. Agriculture comes second while providing livelihoods which is about 27.9%, out of which 21.0% are cultivators and 6.9% are agricultural workers.

An estimated per capita income is still very low, ranges from Rs. 6,884 in Ainlatunga village to Rs. 12,214 in Bilaikani village of Balangir district. It reflects the level of uncertainty and income fluctuation in the area. In contrast, the income of villagers in Dhenkanal district is almost stable ranging from Rs. 10,316 to Rs. 11,800 and balanced with farm and non-farm activities. Considering the criteria of poverty line of $1.25, 16.4 to 62.4 percent family fall under poverty line, and of $2, the people under poverty is from 66.7 to 88.4 % across the study village.



Per capita income of farm respondent



Population below poverty line (%) in the project villages

Assessment of Technological Intervention on Water Management for its Adoption and Sustainability

Project Code: IIWM/15/166
Investigators: M.K. Sinha, G. Kar, R.K. Mohanty, P.S.B. Anand, S. Mohanty, D.K. Panda, M. Das and R.C. Srivastava

The impact and sustainability of created water management technologies of the Institute in different agro-ecosystems has been studied at different project sites. The technologies were two stage rainwater harvesting techniques at Sadeiberini village of Dhenkanal district, Tank cum well system at Daburchua village of Khendujhar district and sub surface water harvesting structure at Ambiki village of Jagatsinghpur district of Odisha. The experience gained by team in these project sites was very diverse based on the physical status of the structures, their present day utilization for irrigation and farmers' response.

The benefit gained by the farmers due to utilization of additional water resources at project site at Sadeiberini and Gajamara villages in Dhenkanal district was quite satisfactory and the sustainability of the lowland pond is significant. In case of refuges, minor damage has been witnessed in Sadeiberini, whereas it was severely damaged at Gajamara site. The farmers could get significant benefit in terms of additional rice and pulse crop productivity and they could also enhance cropping intensity provided rainwater harvesting structure would have been properly maintained. Fish cultivation is also being practiced by some farmers in refuges. After seeing the benefits of this intervention, some more farmers got motivated and adopted the similar structures in nearby villages of Dhenkanal district.

Enhancing Land and Water Productivity through Integrated Farming System (Tribal Sub-plan Project)

Investigators: R.K. Panda, R.R. Sethi, S.K. Rautaray and R.K. Mohanty

Under TSP project, a dug well was constructed in the drainage line near Gadhuamunda service reservoir and a sprinkler system was installed for creating water resources during post-monsoon season at Birjaberna village under Ghurlijore MIP in Sundargarh district, Odisha.

At the project site, technologies like raised and sunken bed, sprinkler system, improved techniques of vegetable production and pisciculture were demonstrated to the tribal farmers. Tomato crop (*Swarna Sampad*) was successfully grown in the *kharif* season on the raised beds along with the paddy in sunken beds. The yield of tomato was 25.4 t ha^{-1}. The yield of brinjal, green chilli, papaya and pointed gourd grown at the project site were 34.5, 8.5, 30.5 and 10.6 t ha^{-1}, respectively. The average mean body weight (MBW) was found as 710.0, 450.0 and 522.5 g for *Catla, Rohu, and Mrigal*, respectively after 210 days of rearing of fish fingerlings and total estimated fish production will be 2.72 t ha^{-1}.

Tomato seedlings and fertilizers were distributed among the farmers and the package of practices of the crop was explained for better production and benefits. Three farmers' exposure training programmes were conducted and about 80 farmers in each occasion (more than 80 % ST farmers) participated in the training programme. Apart from the Birjaberna village, farmers from nearby tribal dominated villages (Kendmal, Bargad and Mahulijore) participated in the training programmes. The farmers were exposed with various water management aspects in agriculture.

Constructed dug well and the command area

Sprinkler irrigation in groundnut crop

AICRP ON IRRIGATION WATER MANAGEMENT

Twenty six centers of AICRP-IWM carried out basic studies on soil, water, plant relationship & their interaction and extension work in the field of assessment of water availability, rainwater management in high rainfall areas, enhancing productivity by multiple use of water, groundwater use at regional level, groundwater assessment and recharge, evaluation of pressurized irrigation system, water management in horticultural and high value crops, conjunctive use of canal and groundwater, and drainage studies for enhancing water productivity. Salient achievements were:

On the basis of rainfall, catchment characteristics and the other relevant data, Udaipur center estimated the runoff yield for ponds and designed appropriate size of ponds for Haroti region of Rajasthan.

An improved water management practice, i.e., 6-cm water per irrigation through checks of 5x10 m, gave 4.09, 4.04 and 3.97 t ha^{-1} wheat yield at head, middle and tail end of Chandpur distributary at Faizabad, which was 30.6-34.5% higher than farmer's practice. The water expense efficiency (WEE) was found highest (176.28 kg ha^{-1} cm^{-1}) at head reach, followed by middle reach and tail end with improved irrigation practice.

It was recommended that for obtaining higher yield, water saving, extra income and greater water use efficiency in medium deep soils of Rahuri, western Maharashtra, summer marigold and *rabi* sorghum should be planted in sequence under drip irrigation at paired row planting of 30-60 x 15 cm with lateral spacing of 90 cm, and marigold should be irrigated at 40% evaporation and *rabi* sorghum at irrigation at 70% ETc on every alternate day.

At Shillong, tomato fruit yield was significantly higher (34.6%) under drip irrigation + black polythene mulching (17.6 t ha^{-1}) than the yield under farmers' practice (11.5 t ha^{-1}).

Maximum fruit yield of brinjal was recorded with 0.8 ETc (54.3 t ha^{-1}), significantly higher than irrigation applied at 0.4 and 0.6 ETc and at par with 1.0 ETc treatment at Sriganganagar. Drip irrigation to brinjal with mulch at 0.8 ETc was found optimum, saved 58.85 % of irrigation water over surface irrigation, and 11.64 % over drip irrigation scheduled at 1.0 ETc without plastic mulch.

During *kharif* 2015, raised bed with plastic mulch gave significantly higher cotton seed yield (2.98 t ha^{-1}) as compared to other treatments -with or without plastic mulch at Sriganganagar. Also, cotton seed yield of 2.54 t ha^{-1} was recorded with the treatment 0.6 ETc, significantly higher than 0.4 ETc and at par with 0.8 and 1.0 ETc treatments.

Irrigation at 0.6 IW/CPE ratio along with 20:40:00::N:P:K kg ha^{-1} fertilization gives highest yield and net profit from cluster bean at Navsari.

Wheat grain yield was significantly higher (5.58 t ha^{-1}) with drip system installed under FIRBS over FIRBS without drip, but it was at par with mini-sprinkler irrigation (5.52 t ha^{-1}) at Hissar.

At Bathinda, maximum yield of cauliflower (20.7 t ha^{-1}), cucumber (13.3 t ha^{-1}) and bottle guard (41.5 t ha^{-1}) were obtained when irrigated with canal water (CW), followed by 1 Canal water: 1 tube-well water and lowest in when it was irrigated with only tube-well water. A similar trend was found for maximum water expense efficiency (WEE).

A land configuration was found suitable and economical option for chronically waterlogged areas located in the bottom reach of terraced topographic situation of Hirakud command. By this configuration of land, 58.64 q ha^{-1} $year^{-1}$ rice equivalent yield was obtained.

Zero tillage with residue retention resulted in significantly higher yield of rice (17.2%) and succeeding *rabi* crops like, mustard (34.6%), pea (16.4%) and buckwheat (27.4%) as compared to conventional tillage with residual removal at Shillong. The water use efficiency (WUE) of succeeding *rabi* crops was greatly influenced by tillage practices. The highest WUE for mustard and pea was recorded under zero tillage for *rabi* crops (residue retention) (8.6 kg ha^{-1} mm^{-1}) and (20.8 kg ha^{-1} mm^{-1}), 35.9% and 16.3% greater as compared to conventional tillage.

At Jorhat, highest drainage coefficient (4.28 cm h^{-1}) was found for PVC pipe with mineral envelope followed by PVC pipe with organic envelope. Bamboo pipe with organic envelop had lowest drainage coefficient of 0.67 cm h^{-1}.

Jalkund at Mawlasnai Village

AGRI-CONSORTIA RESEARCH PLATFORM ON WATER

Development and Management of Integrated Water Resources in Different Agro-ecological Regions of India

Investigators: S.K. Jena, S. Mohanty, P.S. Brahmanand, R.R. Sethi and S.K. Ambast

This project has been initiated under the Agri-Consortia Research Platform on Water (Theme-I) with the objectives: i) to create geo-spatial database on water harvesting potential in different agro-ecological regions of the country, ii) to design the artificial groundwater recharge and rainwater harvesting structures (RWHS) suitable for different agro-ecological regions, iii) to evaluate the innovative RWHS in different agro-ecological regions, and iv) to develop systems for utilization of harvested water for increased water productivity through energy-efficient mechanisms for different regions.

Evaluation of innovative water harvesting structures viz. rubber dams in different agro-ecological regions is made. Impact assessment of ICAR flexi check dam on hydrologic, agricultural and socio-economic aspects will be taken up at different agro-ecological regions (8 states). For installation of rubber dams, desired rubber composite sheets were procured and made available at installation sites of Gujarat, Uttarakhand, Maharashtra and Odisha. In collaboration with IIT, Kharagpur, the construction and evaluation of artificial recharge structures will be made in hard rock aquifers of Odisha and Vidarbha. Integrated Farming System (IFS) models will be developed based on the water harvesting structures. One indigenous DSS will be developed for effective planning and design of rainwater harvesting and artificial recharge systems at catchment and sub-catchment scales. Further, geo-spatial database will be developed on water harvesting potential in different agro-ecological regions of the country. The database will be validated through available experimental results with participating Institutions.

Evaluation of Irrigation System and Improvement Strategy for Higher Water productivity in Canal Commands

Investigators: R.K. Panda, S.K. Rautaray, P. Panigrahi, S. Raychoudhuri, M.K. Sinha, A.K. Thakur, R.K. Mohanty, O.P. Verma and S.K. Ambast

This project has been initiated under the Agri-Consortia Research Platform on Water (Theme-II) with the objective to assess the performance of the existing irrigation system and to improve the irrigation efficiency and water productivity through water resources development and it's efficient management in Puri canal command, Odisha.

A minor canal having CCA 156 ha, length 3.02 km and the design discharge of 0.31 $m^3 s^{-1}$ has been identified in Puri canal command area. Several field visits were made to the project site and discussions were held with the pani-panchayat functionaries and engineers of water resources, Govt. of Odisha regarding various project activities to be taken up. A farmers' friendly questionnaire was prepared along with procedure adopted by INCID for benchmarking of the canal system and base survey has been commenced. Prior to initiation of the project work, soil samples from farmers' fields in the command area were collected and analyzed. The texture of soil was sandy loam with field capacity and permanent wilting point of 0.17–0.31 $cm^3 cm^{-3}$ and 0.05–0.12 $cm^3 cm^{-3}$, respectively. The available N, P and K in the soil were 163 mg kg^{-1}, 7.6 mg kg^{-1} and 66.8 mg kg^{-1}, respectively. The dominant cropping in the command area is rice in *kharif* season and green gram, black gram and vegetables in *rabi* season with irrigation facility.

Automatic Irrigation and Fertigation in Drip-irrigated Banana

Investigators: P. Panigrahi, S. Raychaudhuri, A.K. Thakur, A.K. Nayak, P. Sahu and S.K. Ambast

This project has been initiated under the Agri-Consortia Research Platform on Water (Theme-III- Efficient Water Management in Horticultural Crops) with the objectives: i) to quantify the optimum wetted soil volume under drip irrigation in banana, ii) to study water and nutrients dynamics in soil and plant under different automatic irrigation and fertigation scheduling in banana, and iii) to evaluate the effect of different automatic irrigation and fertigation scheduling on yield, quality of fruits and water productivity in banana. The long term objective of this study is to develop a water and nutrient efficient and profit oriented automatic drip irrigation system for banana.

The study has been planned and designed in Research Farm of the Institute at Deras, Mendhasal. The initial soil sampling has been done and its analysis for physical and chemical charters has been completed. The texture of soil is sandy loam (55% sand, 28% silt and 19% clay) with bulk density of 1.59 g cm^{-3}. The field capacity and permanent wilting point were 0.22-0.31 $cm^3 cm^{-3}$ and 0.09-0.13 $cm^3 cm^{-3}$, respectively with mean pH of 6.1. Organic carbon, available N, P and K are 0.4%, 240 mg kg^{-1} soil, 3.7 mg kg^{-1} soil and 92 mg kg^{-1} soil, respectively.

Strategies for Wastewater Use in Crops and Aquaculture Sectors

Investigators: S. Raychaudhuri, R.C. Srivastava, M. Raychaudhuri and S.K. Rautaray

This project has been initiated under the Agri-Consortia Research Platform on Water (Theme-IV) with the objectives: i) to operationalize emergent & floating macrophyte – consortia based wastewater treatment technologies for safe use of wastewaters in peri-urban agriculture, ii) to quantify and showcase positive impacts of such de-centralized wastewater treatment technologies on the quality and health of crops and aquaculture, and iii) to devise and impart trainings on appropriate livelihood improving business models, integrated with wastewater treatment technologies, for sustainable treatment and use of wastewaters in peri-urban agriculture.

Site has been selected for developing and installation of wastewater treatment system in the drain (size: 18m long, 1.7m wide) at Chandrasekharpur, Bhubaneswar. Based on the calculated time to overflow the structure, designs are made with three compartmentalized gabions. The prototype has been planned and designed and is under development to study the efficiency of structures, structure materials and flow characteristics. Initial observation of the drain water in the identified site is drain water quality deteriorated from morning to peak hours of the day and improved in the afternoon. Discharge rate of wastewater into the drain varied with time.

Water Budgeting and Enhancing Water Productivity by multiple use of Water in Different Aquaculture Production Systems

Investigators: R.K. Mohanty, P. Panigrahi, P. Sahu and S.K. Ambast

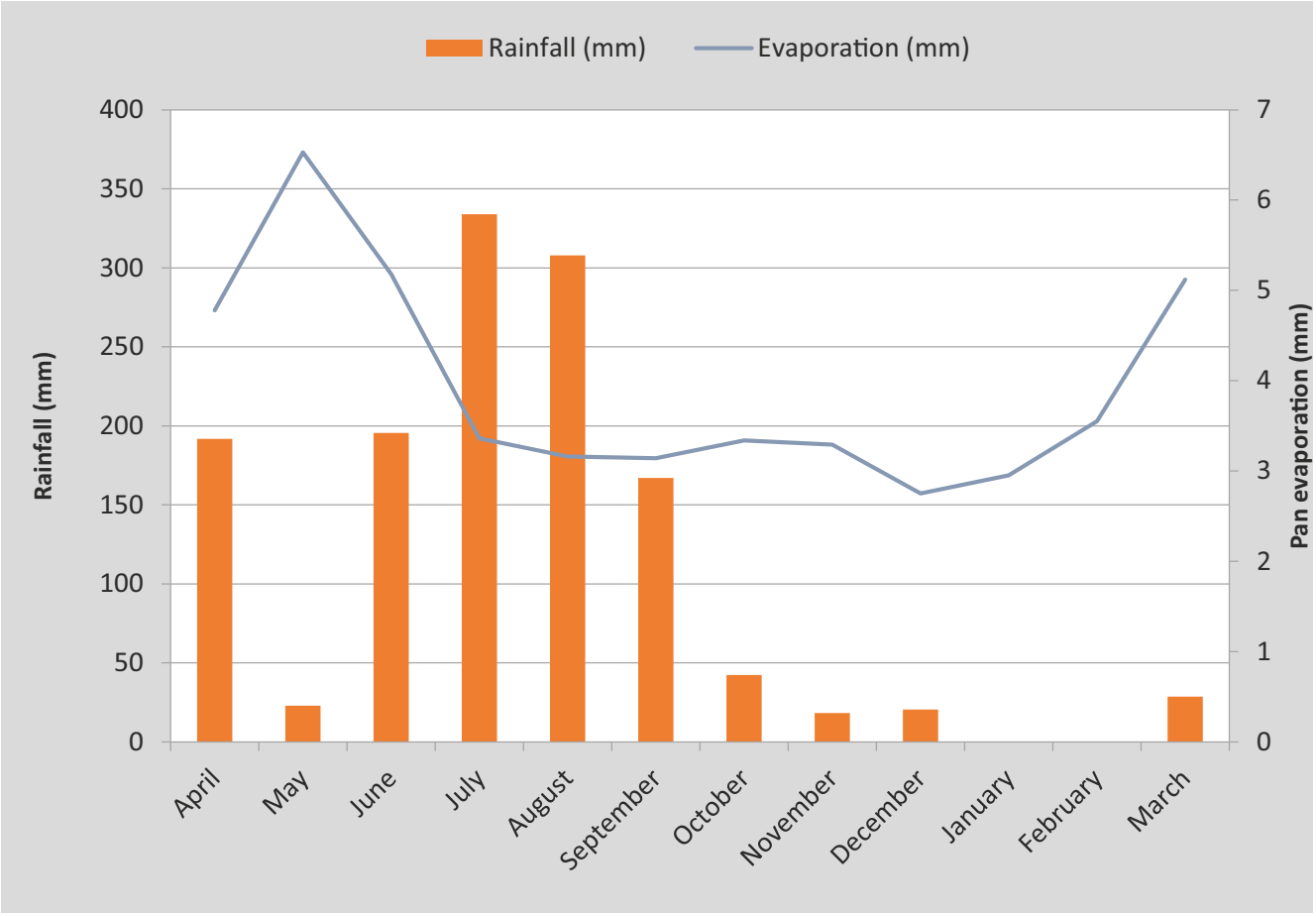
This project has been initiated under the Agri-Consortia Research Platform on Water (Theme-V) with the objectives: i) to study water requirement in different types of carp production systems with varied production levels, ii) to enhance water productivity through culture of diversified fish species (major carps, minor carps, barbs, catfish and murrels), and iii) to budget water requirement for seed production of important freshwater cultured species

Experiments are continuing on Grow-out production of IMC with different production level through varying in cropping pattern, Exploring possibility of enhancing fish yield through culture of minor carps along with IMC, Fry production of Rohu (IMC) with varied water volume, Fingerling production of Catla (IMC) with different inputs, Fry production of Magur and Murrel at varied density in tanks. System-wise water budgeting and water productivity (gross water productivity, net water productivity, consumptive water use index) will be estimated after completion of these experiments.

WEATHER REPORT OF RESEARCH FARM

The daily rainfall and open pan evaporation data was recorded at ICAR-IIWM Central Research Farm, Deras, Mendhasal, Khurda and are presented in Figure. The total annual rainfall was 1328.5 mm during 2015-16 and July month was wettest with the highest rainfall of 333.9 mm. The monthly average pan evaporation data varied from 2.75 mm during December to 6.53 mm during the month of May.

Monthly rainfall and pan evaporation during April 2015-March 2016



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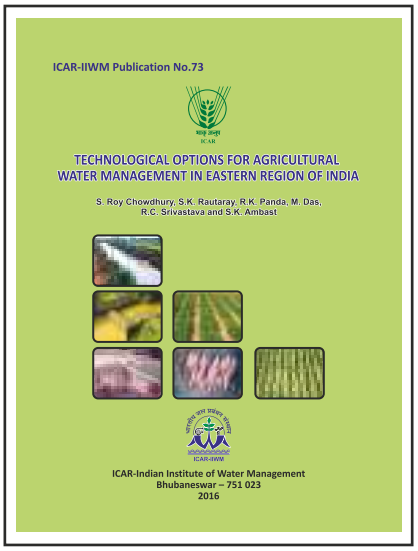

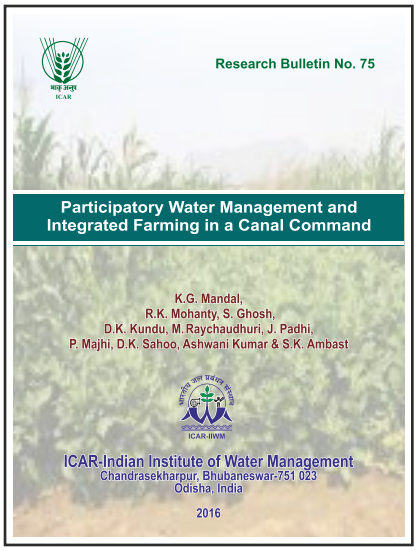

RESEARCH PROJECTS

IN-HOUSE PROJECTS (2015-16)

COMPLETED PROJECTS

Sl.No.	Project Code	Project Title	PI Name
1.	DWM/12/156	System of Rice Intensification: Studies on water management, micronutrient uptake and crop rotation	Dr. A.K. Thakur
2.	DWM/12/160	Development of Agricultural Water Management Portal (AWMP)	Dr. A.K. Nayak
3.	DWM/12/163	Eco-efficient agricultural practices for enhancing nutrient use efficiency of rice (*Oryza sativa*) under waterlogged ecosystem	Dr. P. S. Brahmanand
4.	DWM/12/164	Development of technological options for comprehensive water resource management in non-exploration zone (CRZ III) of coastal Odisha	Dr. R.R. Sethi

ONGOING RESEARCH PROJECTS

Sl.No.	Project Code	Project Title	PI Name
1.	DWM/12/157	Development of runoff recycling model for production and profit enhancement through alternate land and crop management practices	Dr. P. K. Panda
2.	DWM/12/158	Evaluating deficit irrigation under drip system for rice based cropping sequence in canal command area	Dr. P. Panigrahi
3.	DWM/12/159	Identification of suitable crops for wastewater irrigation	Dr. Sachidulal Raychaudhuri
4.	DWM/12/161	Design and development of small filters for reducing undesirable substances in poor quality water at farmers level for safe irrigation in peri-urban areas	Dr. M. Raychaudhuri
5.	DWM/12/162	Delineation of waterlogged areas in eastern India and formulating strategies for fitting in suitable crops and aquaculture through harnessing agro-biodiversity for enhancing water productivity	Dr. Somnath Roy Chowdhury
6.	DWM/14/165	Development of decision support system for conjunctive use of surface and ground water	Dr. O. P. Verma
7.	IIWM/15/166	Assessment of technological intervention on water management for its adoption and sustainability	Dr. M. K. Sinha
8.	IIWM/15/167	Design and evaluation of a portable drum based drip irrigation system	Dr. S. Mohanty / Dr. R.C. Srivastava
9.	IIWM/15/168	Water and nutrient self-reliant farming system for rainfed area under high rainfall zone	Dr. S. K. Rautaray

10.	IIWM/15/169	Drainage planning of eastern coast delta using geoinformatics	Dr. S.K. Jena
11.	IIWM/15/170	Impact assessment study of using industrial wastewater on sunflower (*Helianthus annus* L.) and mustard (*Brassica nigra* L.) grown in peri-industrial area of Angul, Odisha	Mrs. Rachana Dubey
12.	IIWM/15/171	Developing the process for remediation of chromium from polluted water sources	Dr. M. Das
13.	IIWM/15/172	Evaluation of feasibility of enhancing irrigation efficiency in canal command through improved surface and pressurized irrigation methods by adding adjunct service reservoir and open dug well	Dr. R. K. Panda
14.	IIWM/15/173	Virtual water of agro-based products under present and future scenarios	Dr. G. Kar
15.	IIWM/15/174	Water management in medium and minor canal commands for rice-rice systems to enhance water use efficiency and nutritional water productivity	Dr. K. G. Mandal
16.	IIWM/15/175	Density dependent water use in coastal aquaculture of *Litopenaeus vannamei*	Dr. R. K. Mohanty

NEW RESEARCH PROJECTS

Sl.No.	Project Title	PI Name
1.	Enhancing water productivity through intensive horticultural system in degraded land	Mrs. Prativa Sahu
2.	Benchmarking of public irrigation schemes for improving performance of irrigated agriculture	Dr. Atmaram Mishra
3.	Socioeconomic and environmental linkages of groundwater irrigation in coastal aquifers of Eastern India	Dr. D.K. Panda

RESEARCH PROJECTS

EXTERNALLY FUNDED

Title	Budget (Rs. in lakh)	Duration	P.I. / CCPI	Sponsored by
Development and Management of Integrated Water Resources in Different Agro-ecological regions of India	125.00	2015-2017	Dr. S.K. Jena	ICAR- Agri-Consortia Research Platform on Water, ICAR, New Delhi
Evaluation of Irrigation System and Improvement Strategy for Higher Water productivity in Canal Commands	54.00	2015-2017	Dr. R.K. Panda	ICAR- Agri-Consortia Research Platform on Water, ICAR, New Delhi
Automatic Irrigation and Fertigation in Drip-irrigated Banana under Efficient Water Management in Horticultural Crops	56.00	2015-2017	Dr. P. Panigrahi	ICAR- Agri-Consortia Research Platform on Water, ICAR, New Delhi
Water Budgeting and Enhancing Water Productivity by Multiple Use of Water in Different Aquaculture Production Systems	50.32	2015-2017	Dr. R.K. Mohanty	ICAR- Agri-Consortia Research Platform on Water, ICAR, New Delhi
Strategies for Wastewater Use in Crops and Aquaculture Sectors	45.00	2015-2017	Dr. S. Raychaudhuri	ICAR- Agri-Consortia Research Platform on Water, ICAR, New Delhi
Improving Water Productivity under Canal Irrigation Command through Conservation and Recycling of Runoff, Seepage, Rainwater and Groundwater Using Tanks and Wells	36.46	2010-2016	Dr. K.G. Mandal	INCSW (formerly INCID), Ministry of Water Resources, GOI, New Delhi
National Initiative for Climate Resilient Agriculture (NICRA)	600.00	2012-2017	Dr. G. Kar	ICAR, New Delhi
Decision Support System for Enhancing Water Productivity of Irrigated Rice-Wheat Cropping System	54.90	June 2012-May 2016	Dr. R.R. Sethi	National Fund for Basic, Strategic & Frontier Application Research in Agriculture, ICAR, New Delhi
Impact of Climate Variability and Anthropogenic Factor on Groundwater Resources of India	35.00	2012-2016	Dr. D.K. Panda	ICAR-Challenge project
Efficient Groundwater Management for Enhancing Adaptive Capacity to Climate Change in Sugarcane Based Farming System in Muzaffarnagar district, Uttar Pradesh	459.00	2015-2018	Dr. A. Mishra / Dr. R.C. Srivastava	Ministry of Agriculture, Govt. of India

Title	Budget (Rs. in lakh)	Duration	P.I. / CCPI	Sponsored by
Tracking Change in Rural Poverty in Household and Village Economies in South Asia	70.35	May 2010 - July 2015	Dr. M.K. Sinha	Bill and Melinda Gates Foundations, USA
Global Yield Gap and Water Productivity Atlas (Collaborative project of ICAR with University of Nebraska, Lincoln, USA)	$56,000	2013-2015	Dr. P.S. Brahmanand	University of Nebraska, USA and Bill & Melinda Gates Foundation, USA
Enhancing Land and Water Productivity through Integrated Farming System (Tribal Sub Plan Project)	20.00	2014-2017	Dr. R.K. Panda	ICAR, New Delhi

CONSULTANCY

Preparation of District Irrigation Plan for 5 districts of Odisha	20.00	2016	Dr. S.K. Ambast	Odisha Watershed Development Mission, Bhubaneswar

AWARDS, HONOURS, RECOGNITIONS

ICAR-IIWM received **Education Leadership Award 2015** by Vijayavani-Karnataka's largest circulated daily.

Dr. Amod Kumar Thakur, Senior Scientist received prestigious **J.J. Chinoy Gold Medal Award** instituted by the Indian Society for Plant Physiology, New Delhi.

Dr. G. Kar, Principal Scientist received the **Ekamara Shree Award** for the significant contribution in the field of Agricultural Sciences.

Dr. S. Roy Chowdhury, Principal Scientist selected as **Fellow of Indian Society of Coastal Agricultural Research**, **2016**

- Dr. S.K. Jena, Principal Scientist was awarded with 'Certificate of appreciation' from Indira Gandhi Panchayati Raj and Gram Vikas Sansthan, Govt of Rajasthan, Jaipur.
- Mrs. Prativa Sahu, Scientist was awarded for best oral presentation for her paper entitled 'Approaches for pomegranate improvement & DUS testing: An overview' Award during National Seminar on Horticulture Diversity for Prosperity from February 10-12, 2016 at OUAT, Bhubaneswar.
- Dr. S.K. Ambast, Director has been nominated as member, Governing Body of the Odisha University of Agriculture and Technology (OUAT), Bhubaneswar
- Dr. S.K. Ambast, Director has been nominated as member, Task Force Committee, Chattisgarh State Planning Commission, Raipur.
- Dr. M. Das, Principal Scientist has been nominated by ICAR as member, Institute Management Committee (IMC) of ICAR-Indian Institute of Soil Science, Bhopal.

- Dr. S.K. Jena, Principal Scientist, has been nominated by ICAR as member, Institute Management Committee (IMC) of ICAR-Indian Institute of Soil & Water Conservation, Dehradun and ICAR Research Complex for NEH Region, Barapani, Meghalaya.

- Dr. R.K. Mohanty, Principal Scientist, has been nominated by ICAR as member, Institute Management Committee (IMC) of ICAR-NRC on Integrated Farming, Motihari, Bihar.

- Dr. K.G. Mandal, Principal Scientist, has been selected as sectional recorder for the Section of Agriculture and Forestry Sciences in the 103rd Indian Science Congress of ISCA, held at University of Mysore, Mysuru during 3-7 January, 2016.

- Dr. S.K. Jena, Principal Scientist, has been nominated by ICAR as Chairman, Assessment Committee of CRIJAF, Kolkata; member, Assessment Committee for promotion; NIRJAFT, Kolkata; expert member, Assessment Committee for promotion of Technical personnel, ICAR-NRRI, Cuttack.

- Dr. G. Kar, Principal Scientist, has been nominated as an expert in the Working Group Meeting of AICRP on Agro-meteorology, held at OUAT, Bhubaneswar during 17-19 November, 2017 to review the progress and technical programme of coordinating centers.

- Dr. S.K. Jena, Principal Scientist, was appointed as an external examiner for evaluation of Ph.D. Thesis of TNAU, Coimbatore & M. Tech. Thesis of MPUAT, Udaipur. Also, he evaluated theory paper of Ph.D. students of Central Agricultural University, Barapani, Meghalaya and M. Tech. Thesis and viva-voce at CAET, OUAT, Bhubaneswar.

- Dr. S. Roy Chowdhury, Principal Scientist, nominated by ICAR as member of selection committee for promotion of ARS scientists of ICAR-NRRI, Cuttack.

- Dr. R.K. Mohanty, Principal Scientist, has been selected as editorial board member of International Journal of Aquaculture and Fishery Science.

- Dr. S. Roy Chowdhury, Principal Scientist and Dr. A.K. Thakur, Senior Scientist has been selected as editors for Indian Journal of Plant Physiology (Springer), ISPP, New Delhi.

- Dr. M. Raychaudhuri, Principal Scientist became women chess runners up and women table tennis runners up during ICAR sports meet for eastern zone 2015 at ICAR-IVRI, Bareily held during October 28-31, 2015.

RESEARCH MANAGEMENT MEETINGS

Institute Research Council (IRC) meetings

During the year 2015-16, Institute's Research Council (IRC) meetings were organized during June 4-5, 2015 and December 8, 2015. IRC meetings were organized by Dr. S.K. Jena, Principal Scientist and Member Secretary, IRC and was chaired by Dr. S.K. Ambast, Director, ICAR-IIWM, Bhubaneswar. The results of the on-going in-house research projects, externally funded projects and AICRP-IWM were presented and deliberated in the meeting. New research project proposals were presented and discussed in the meeting. Director, ICAR-IIWM & Chairman, IRC highlighted about immediate challenges and long term challenges in the field of agricultural water management. He emphasized to take up problem solving research that should ultimately lead towards its upscaling. He also emphasized that research findings must go from research farm to farmers' field. Problem solving research programs are to be taken up. There should be a balance between laboratory/ modeling and field work. Publications should be made in all type of journals such as high rated international journals, in Indian journals as well as popular articles in Indian farming etc. Four new project proposals and RPP II of one project were presented by the scientists during second IRC meeting.

18th Meeting of the Institute Management Committee (IMC) of IIWM

Eighteenth meeting of Institute Management Committee (IMC) of ICAR-IIWM, Bhubaneswar was held on November 17, 2015 under the chairmanship of Director. The following members of the IMC attended the meeting:

1	Dr. S.K. Ambast, Director, ICAR-IIWM, Bhubaneswar	Chairman
2	Dr. P.C. Mohapatra, Principal Scientist, ICAR-NRRI, Cuttack	Member
3	Dr. R.K. Panda, Principal Scientist, ICAR-IIWM, Bhubaneswar	Member
4	Dr. M. Abdul Hassan, Principal Scientist, ICAR-CIFRI, Barrackpore	Member
5	Sr. S.R. Khuntia, Chief F& AO, ICAR-NRRI, Cuttack	Member
6	Dr. R.C. Srivastava, Principal Scientist, ICAR-IIWM, Bhubaneswar	Special Invitee
7	Dr. P.S.B. Anand, Senior Scientist, ICAR-IIWM, Bhubaneswar	Special Invitee
8	Sri N.V.R.N. Murthy, F& AO, ICAR-IIWM, Bhubaneswar	Co-Opt. Member
9	Sri A. Mallick, AAO, ICAR-IIWM, Bhubaneswar	Co-Opt. Member
10	Sri S.C. Sheet, AO, ICAR-IIWM, Bhubaneswar	Member Secretary

Biennial Workshop of AICRP-IWM

The Biennial Workshop of All India Coordinated Research Project on Irrigation Water Management (AICRP on IWM) for 2014-15 was jointly organized by Water Technology Centre, ICAR–Indian Institute of Water Management, Bhubaneswar and AICRP on Irrigation Water Management centre at Tamilnadu Agricultural University, Coimbatore, Tamilnadu during August 22-25, 2015 to review results of experiments conducted by centres of AICRP on IWM and to discuss issues and challenges related to irrigation water management. A total of 150 Scientists participated in the meeting and new projects were discussed and approved.

Meetings under Agri-Consortia Research Platform on Water

A meeting was held under the chairmanship of Dr. A.K. Sikka, DDG (NRM) at the NRM Division, ICAR, New Delhi during April 28-29, 2015 to discuss and finalize the objectives, deliverables, budgets etc. of the projects in different themes of "Agri-Consortia Research Platform on Water". Based on the presentations, the some decisions/ suggestions were made for improvement of the technical program under different themes of the project.

Another meeting was held under the chairmanship of Dr. A.K. Sikka, DDG (NRM) at ICAR-Indian Institute of Water Management, Bhubaneswar on May 30, 2015 to discuss the issues on "Agri-Consortia Research Platform on Water" and AICRP (IWM). Theme-wise objectives and budget for "Agri-CRP on Water" project were finalized. The DDG (NRM) stressed on converging of technical programmes of the centres where both Water management and Ground water utilization schemes under AICRP were operational earlier and now merged as AICRP (IWM).

A review meeting of "Agri-Consortia Research Platform on Water" project for 2015-16 was held at ICAR-IIWM, Bhubaneswar on March 15, 2016 under chairmanship of Dr. A.K. Sikka, DDG (NRM), New Delhi. The Director of ICAR-IIWM, PIs and CCPIs of different projects in different Institutes along with the Programme Leads of ICAR-IIWM were present in the meeting. The achievements so far and technical programmes for 2016–2017 of different themes under the project were discussed.

HRD, TRAINING AND CAPACITY BUILDING

Participation in trainings (Category-wise)

Official	Subject	Organization	Period
Dr. R.K. Mohanty, Principal Scientist	Management Development Programme on Leadership Development	NAARM, Hyderabad	June 16-27, 2015
Mr. R.C. Jena, STA Mr. S. Lenka, STA	Fundamental of Computer and Operation of MS Office	OCAC, Govt. of Odisha	August 17-22, 2015
Dr. S.K. Ambast, Director	Executive Development Programme on Leadership Development	NAARM, Hyderabad	August 18-22, 2015
Dr. Sanatan Pradhan, Scientist	SERB training on 'Agrometeorological Techniques for Risk Assessment and Management of Extreme Events'	ICAR-CRIDA, Hyderabad	September 1-21, 2015
Dr. M. K. Sinha, Principal Scientist	Quantitative Techniques for Scientists and Business Managers	NAARM, Hyderabad	September 7-12, 2015
Mrs. Rachana Dubey, Scientist Mrs. Prativa Sahu, Scientist Mr. Chhotelal, Technical Officer	MTC on 'Improving Water Productivity for livelihood improvement and food security'	ICAR-IIWM, Bhubaneswar	September 21-28, 2015
Mrs. Rachana Dubey, Scientist Mrs. Prativa Sahu, Scientist	MTC on 'Livelihood Improvement of Farm Families through Integrated Farming System'	ICAR-CIWA, Bhubaneswar	November 17-24, 2015
Dr. P. Nanda, Principal Scientist Dr. G. Kar, Principal Scientist	Management Development Programme on Leadership Development	NAARM, Hyderabad	November 30-December 11, 2015
Mr. N. Manikandan	Professional Attachment Training	ICAR-IARI, New Delhi	December 1, 2015 February 29, 2016
Dr. G. Kar, Principal Scientist	Introduction to Soil and Water Assessment Tool (SWAT) using Open Source Tools (QGIS and QSWAT)	IIT, Madras	January 4-9, 2016

Training organized

Subject	Place	Period	Participants
Training on Agricultural Water Management to B. Tech. Students from College of	IIWM, Bhubaneswar	May 1-31, 2015	5
Agricultural Engineering, JNKVV, Jabalpur Summer training program for M. Tech. students of CAET, OUAT, Bhubaneswar on various aspects of water management	IIWM, Bhubaneswar	May 16-June 15, 2015	3
Training on Agricultural Water Management to B. Tech. Students from Dr. D.U.P.C. Agril Eng. and Tech., Bhusawal, Jalgaon, Maharashtra	IIWM, Bhubaneswar	June 1-30 2015	5

Training on 'Development of District Irrigation Plan' under *Pradhan Mantri Krishi Sinchai Yojna* (PMKSY)	IIWM, Bhubaneswar	September 7-11, 2015	14
MTC on 'Improving Water Productivity for Sustainable Livelihood and Food Security'	IIWM, Bhubaneswar	September 21-28, 2015	20
Training program on "Ensuring safe use of water in agriculture for healthy nation"	IIWM, Bhubaneswar	September 29, 2015	52
Subject Matter Interaction/ Exposure Program on Integrated Water Management (PMKSY)	IIWM, Bhubaneswar	November 12-15, 2015	3

Farmers' training programmes organised

Subject	Place	Period	Participants
Farmer's training program on 'Scaling up of Technologies for Enhancing Water Productivity in Coastal Flood-prone and Waterlogged Areas'	Alisha village, Satyabadi Block, Puri	April 18, 2015	98
Field day on 'Mitigating Excess Water Situation in Coastal Seasonal Waterlogged Areas'	Satyabadi Block Puri	May 30, 2015	120
Farmers' interface meet on 'Monsoon Preparedness and Contingency Planning, 2015'	ICAR-IIWM, Bhubaneswar	July 8, 2015	36
Farmers' training on 'Crop Diversification for Livelihood Improvement'	Sogar village, Dhenkanal	July 24, 2015	144
Farmers' training on 'Improving Crop and Water Productivity for Livelihood'	Nuagaon, Dhenkanal	August 13, 2015	104
Farmers' training program on 'Sustainable Water Management Techniques'	Birjaberna Village, Sundergarh	August 18-19, 2015	60
Kisan Goshthi at VDSA project village	Ainlatunga Village, Balangir	September 2, 2015	107
Field visit and farmer's interaction meet	Jaleswar, Balasore	October 9, 2015	50
Farmers' training program on 'Water Management in Coastal Areas"	Sunity village, Kendrapara	October 14, 2015	80
Farmers-Scientists interaction meet	Jaypurpatna Village, Bhubaneswar	December 5, 2015	265
Exposure visit of farmers with cooperative bank officials on *In situ* Water Management	IIWM research farm, Mendhasal	December 23, 2015	25
Farmers Awareness Programme on the occasion of *Jai Kishan Jai Vigyan* Week	Alisa village, Sakhigopal Block, Puri district	December 26, 2015	100
Farmers Awareness Programme on the occasion of *Jai Kishan Jai Vigyan* Week	Khalibandha Village, Dhenkanal district	December 29, 2015	101
Training program under TSP project	Birjaberna Village, Sundargarh	February 4-5, 2016	85
Training program under TSP project	Birjaberna Village, Sundargarh	March 28-29, 2016	80

HRD fund allocation and utilization during 2015 – 2016

(Figures in lakhs)

Budget Head	Non-Plan		Plan	
	Budget	Expenditure	Budget	Expenditure
HRD	0	0	5.00	5.00

Exhibitions

Events	Place	Period
69th Foundation day of ICAR-CRRI	Cuttack, Odisha	April 23, 2015
Foundation of 108th ICAR Institute-NRC on Integrated Farming System	Motihari, Bihar	August 20-21, 2015
5th International Symposium on Cage Aquaculture in Asia (CAA5)	ICAR-CMFRI, Kochi	November 25-28, 2015
Women in Agriculture Day	ICAR-CIWA, Bhubaneswar, Odisha	December 4, 2015
11th National Symposium of ISCAR	ICAR-IIWM, Bhubaneswar, Odisha	January 14-17, 2016
4th ICAR Institutes-SAU-State Departments Interface Meet	OUAT, Bhubaneswar, Odisha	January 27-28, 2016
Inter-state Agri-horti Exhibition	Bargarh, Odisha	February 20-22, 2016
Krishi Mahotsav 2016 (State-level Agriculture Fair)	Baramuda, Bhubaneswar, Odisha	March 11-14, 2016
Krishi Unnati Mela 2016	ICAR-IARI, New Delhi	March 19-21, 2016

WOMEN EMPOWERMENT

Summer training

One month summer training was organized for five B. Tech. students representing 60% by girls from College of Agricultural Engineering, JNKVV, Jabalpur during May 1-31, 2015 in the ICAR-IIWM.

Model training program

A model training program on *"Improving water productivity for sustainable livelihood and food security"* sponsored by Directorate of Extension, Ministry of Agriculture, Govt. of India was organized during September 21-28, 2015 at the institute and 30% of the trainees were women.

Training cum demonstration

A training cum demonstration on 'Mushroom cultivation' for farm women self-help groups (SHGs) was conducted at Erikundal village, Tirtol block of Jagatsinghpur district. A total of 40 women participated in the program.

PARTICIPATIONS

Conferences/Workshops, Meetings, Trainings, Deputations

Official	Name of the Seminar / Workshop / Training / Conference	Organized by	Period
Dr. S.K. Ambast	ICAR-CIFA Foundation Day as Guest of Honour	ICAR-CIFA, Bhubaneswar	April 1, 2015
Dr. S.K. Ambast Dr. M.K. Sinha	VDSA Project Progress Review and Planning Meeting for East India 2015-16	International Crop Reserach Institute for Semi Arid Tropics (ICRISAT), Hyderabad	April 2-3, 2015
Dr. S.K. Jena	Workshop on 'Making Engineering scientists contribution more meaningful to stake holders and the nation'	ICAR, New Delhi	April 13-14, 2015
Dr. M. Raychaudhuri Dr. S. Raychaudhuri	36th Annual Convention of Indian Society of Soil Science Bhubaneswar Chapter	Soil Science Division, OUAT, Bhubaneswar	April 17, 2015
Dr. M. Raychaudhuri Dr. S. Raychaudhuri	Symposium on soil health	Soil Science Division, OUAT, Bhubaneswar	April 18, 2015
All scientists of IIWM	Brain storming session on Application of Modern tools for R & D in Agricultural Water Management	ICAR-Indian Institute of Water Management, Bhubaneswar	May 12, 2015
Dr. S.K. Ambast	Annual Conference of the VC's of SAU's and Directors of ICAR Institutes	NASC, New Delhi	May 14-16, 2015
Dr. S.K. Ambast	Biennial Workshop of AICRP on Management of Salt affected Soils and Use of Saline Water in Agriculture	ICAR-CIRG, Makhdoom, Mathura	June 6-7, 2015
Dr. A.K. Thakur	Workshop on experimental with indigenous varieties using SRI method	Sambhav, Nayagarh, Odisha	June 11, 2015
Dr. S.K. Ambast	CIFA-Industry-Stakeholders Workshop	ICAR-CIFA, Bhubaneswar	June 27, 2015
Dr. S.K. Ambast	State Level Steering Committee meet on Climate change network program	Odisha Agricultural Department at IMAGE, Bhubaneswar	July 2, 2015
Dr. R.R. Sethi	Presented a invited talk on Groundwater Recharge in the training programme on climate change and climate induced natural disasters held at farmers hostel, OUAT, Bhubaneswar	NSS, Bhubaneswar, Odisha	July 4, 2015
Dr. S. Roy Chowdhury Dr. R.K. Mohanty	National Fish Farmers' Day	ICAR-CIFA with Dept. of F & ARD, Govt. of Odisha, Angul, Odisha	July 10, 2015
Dr. M. Das	XXXIX Institute Management Committee Meeting of ICAR-IISS	ICAR-IISS, Bhopal	July 13, 2015
Dr. S.K. Ambast	87th ICAR Foundation Day and National Conference on KVK	Patna	July 25-26, 2015
Dr. S.K. Ambast	Inception workshop on Flood hazard indexing based crop insurance	IWMI, Patna	August 1-2, 2015
Dr. M. Raychaudhuri Dr. S. Raychaudhuri	19th Annual Convention and National Conference on 'Application of Clay Science in Agriculture, Environment and Industry'	The Clay Minerals Society of India (CMSI) & ICAR-NBSS & LUP, Parivesh Bhawan, Kolkata	August 7-8, 2015

Dr. G. Kar	Workshop on 'Assessment of crop damage due to extreme weather events using high resolution remote sensing data'	ICAR, New Delhi	August 17, 2015
Dr. S.K. Ambast Dr. P. Nanda Dr. M. Raychaudhuri Dr. A.K. Nayak	Biennial Workshop - AICRP on Irrigation Water Management	Water Technology Centre, TNAU, Coimbatore	August 22-25, 2015
Dr. S.K. Jena	National workshop on 'Community based water management in Rajasthan: Forgotten glory or future hope'	IGPR & GVS, Govt. of Rajasthan, Jaipur	August 24-26, 2015
Dr. S.K. Ambast	1st training programme under PMKSY	Pune	August 25, 2015
Dr. M.K. Sinha Dr. P.S. Brahmanand	Divisional committee meeting for monitoring and reviewing the progress of Foreign Aided Projects	NRM Division, ICAR, New Delhi	August 28, 2015
Dr. P.S. Brahmanand	Workshop on 'Waterlogging and salinity in irrigated agriculture'	ICAR, Central Board of Irrigation and Power and CWC, Chandigarh, Haryana	September 3-4, 2016
All Scientists of IIWM	Invited lecture in 2nd Training Programme under PMKSY	ICAR-IIWM, Bhubaneswar	September 7-11, 2015
Dr. S.K. Ambast Dr. R.R. Sethi	Invited lecture in 3rd Training programme under PMKSY	NIRD, Hyderabad	September 15, 2015
Dr. S.K. Ambast	Stakeholders meeting of NRC on Integrated Farming System / Mid-term Review meeting	ICAR-RCER, Patna / Barrackpore, W.B.	September 17-19, 2015
Dr. S.K. Ambast	Invited lecture in 4th training programme under PMKSY	Dehradun	September 21-22, 2015
Dr. S.K. Jena	Model training course on 'Improving water productivity for livelihood improvement and food security'	Ministry of Agriculture, GOI, New Delhi	September 21-28, 2015
Dr. S.K. Ambast	Invited lecture in 5th training programme under PMKSY	ICAR-RCNEH, Shillong, Barapani	October 5, 2015
Dr. S. Raychaudhuri	National Seminar on 'Soil Health Management and Food Security: Role of Soil Science Research and Education'	Indian Society of Soil Science, Kolkata Chapter	October 8-10, 2015
Dr. S.K. Ambast	Invited lecture in 6th training programme under PMKSY	ICAR-IARI, New Delhi	October 12, 2015
Dr. M. Das	Sensitization Workshop on *Mera Gaon Mera Gaurav* (MGMG)	ICAR-ATARI, Zone VII Jabalpur	October 14, 2015
Dr. S.K. Ambast	Agro ecosystem workshop-East coast plains and Hilly regions	ICAR-CIBA, Chennai	October 29, 2015
Dr. S.K. Ambast	Meeting for Model District Irrigation Plans / ASRB Foundation day and meeting on CRP on Water / Meeting on quick study on suitable crop plan under PMKSY	CWC, New Delhi	November 2-4, 2015
Dr. R.R. Sethi Dr. K.G. Mandal	Training Programme under PMKSY National Seminar on 'Soil Health : Key to Sustainable Agriculture'	SIRD, Chennai, Tamil Nadu *Palli Siksha Bhavana* (Institute of Agriculture), Visva-Bharati, West Bengal	November 4, 2015 November 14-15, 2015
Dr. P.S. Brahmanand	All India *Rajbhasha* Conference	*Vishwamukhti Samsthan*, Visakhapatnam, Andhra Pradesh	November 14-16, 2015
Dr. S.K. Jena	Model training course on 'Livelihood improvement of farm families through IFS'	Ministry of Agriculture, GOI, New Delhi	November 17-24, 2015
Dr. S.K. Ambast	Workshop on Developing strategies for improvement of the farmers of the Eastern Hill and Plateau Region	ICAR-CIFA, Bhubaneswar	November 23, 2015

Dr. M. Das Dr. M. Raychaudhuri Dr. S. Raychaudhuri	Brain Storming Session on the occasion of 'International year of Soils'	NRM division of ICAR, New Delhi	November 23-24, 2015
Dr. R.K. Mohanty Dr. A.K. Nayak	5th International Symposium on Cage Aquaculture in Asia (CAA5)	Asian Fisheries Society and ICAR-Central Marine Fisheries Research Institute (CMFRI), Kochi	November 25-28, 2015
Dr. S.K. Ambast	NAAS Golden Jubilee function / Meeting for Agri-CRP on Water / Institute Management Committee	ICAR-IARI, New Delhi / ICAR-NIASM, Malegaon	November 27-28, 2015
Dr. R.R. Sethi	Displayed Institute publication on occasion of Women in Agriculture day	IACR-Central Institute for Women in Agriculture, BBSR	December 4, 2015
Dr. M. Raychaudhuri	National Seminar on 'Sustaining Hill Agriculture in Changing Climate (SHACC)'	Indian Association of Hill Farming and ICAR Research Complex for NEH Region, Umiam, Meghalaya	December 5-7, 2015
Dr. M. Das	80th Annual Convention of ISSS	Indian Society of Soil Science, New Delhi at UAS, Bangalore	December 5-8, 2015
Dr. S.K. Ambast	Workshop of Global Yield Gap Atlas	ICRISAT, Hyderabad at New Delhi	December 11, 2015
Dr. K.G. Mandal Dr. A.K. Thakur	3rd International Plant Physiology Congress	JNU and Indian Society for Plant Physiology, New Delhi	December 11-14, 2015
Dr. S. Roy Chowdhury	Regional Advisory Group (RAG) for Farms, Farmers and Rural Areas-Second Consultative Meet	NABARD, Bhubaneswar	December 15, 2015
Dr. S. Roy Chowdhury	Seminar on 30th Anniversary celebration of Department of Biotechnology, New Delhi and Institute of Life Sciences, Bhubaneswar	Institute of Life Sciences, Bhubaneswar at Institute of Physics, Bhubaneswar	December 16, 2015
Dr. A.K. Nayak	Awareness workshop on usage on 'Unified Messaging Solution'	ICAR-IASRI, New Delhi held at ICAR-CIFRI, Barrackpore	December 18, 2015
Dr. M. Das	12th Scientific Advisory Committee Meeting	KVK, Sonepur, Odisha	December 22, 2015
Dr. K.G. Mandal	103rd Indian Science Congress	The Indian Science Congress Association (ISCA) & University of Mysore, Mysuru	January 3-7, 2016
Dr. R.R. Sethi	Training Programme under PMKSY	Bhopal	January 7, 2016
All Scientists of IIWM	11th National Symposium on 'Innovations in Coastal Agriculture- Current Status and Potential under Changing Environment'	ISCAR, ICAR-CSSRI, Regional Research Station, Canning Town, West Bengal & ICAR-IIWM, Bhubaneswar	January 14-17, 2016
Dr. S.K. Ambast	National Conference on Sustainable Agriculture and Farmer's Welfare	Gangtok, Sikkim	January 17-19, 2016
Dr. R.K. Panda Dr. S.K. Jena Dr. S. Mohanty Dr. R.R. Sethi	50th Annual convention of ISAE and Symposium on 'Agricultural Engineering in Nation Building : Contributions and Challenges'	CAET, OUAT, Bhubaneswar	January 19-21, 2016
Dr. A.K. Nayak	4th NKN Annual Workshop on 'NKN at the core of Cyber Space'	Jawaharlal Nehru Technical University, Hyderabad	January 21-22, 2016
Mrs. Prativa Sahu	National seminar on 'Plant Genomics and biotechnology: Challenges and Opportunities in 21st Century'	Dept. of Biotechnology, OUAT, Bhubaneswar	January 23-24, 2016
Dr. S.K. Ambast Dr. S.K. Jena Dr. K.G. Mandal	4th ICAR Institutes-SAU-State Departments Interface Meet 2015-16	ICAR-NRRI, Cuttack & OUAT, Bhubaneswar	January 27-28, 2016
Dr. R.R. Sethi	Training Programme under PMKSY	SIRD, Bhubaneswar, Odisha	January 27 and February 9, 2016
Dr. P.S. Brahmanand	Brainstorming Session on 'Technological interventions for agricultural water management'	WTC, ICAR-IARI, New Delhi	January 28, 2016

Dr. S.K. Jena	Meeting with research organizations	Dept. of Agriculture, Govt. of Odisha	January 29, 2016
Dr. R.R. Sethi	Training Programme under PMKSY	BAMETI, Patna	February 6, 2016
Dr. S.K. Ambast	Invited lecture in State Level Training Programme on preparation of DIP under PMKSY	Kolkata, W.B.	February 8, 2016
Dr. P.S. Brahmanand	Divisional Review meeting of foreign aided projects	NRM division, ICAR, New Delhi	February 9, 2016
Dr. R.R. Sethi	Training Programme under PMKSY	SIRD, Pune	February 10, 2016
Dr. M. Das	Training workshop on 'Competency development for Human Resource Development Nodal Officer of ICAR'	NAARM, Hyderabad	February 10-12, 2016
Mrs. Prativa Sahu	National seminar on 'Horticulture Diversity For Prosperity'	Orissa Horticulture Society & OUAT, Bhubaneswar	February 10-12, 2016
Dr. R.R. Sethi	Training Programme under PMKSY	Sikkim Institute of Rural Development, Gangtok	February 16, 2016
Dr. S.K. Ambast	ICAR-CIWA Foundation Day as Guest of Honour	ICAR-CIWA, Bhubaneswar	February 17, 2016
Dr. P.K. Panda	Agri-Horti Exhibition and Farmers- Scientist Interaction Meet	National Horticulture Board & ICAR	February 20-22, 2016
Dr. S. Roy Chowdhury	Meetings between Research organizations and Directorate of Agriculture and food production, Govt. of Odisha	Directorate of Agriculture and food production, Govt. of Odisha at IMAGE, Bhubaneswar	February 26, 2016
Dr. P.K. Panda	National Science Day celebrations with theme Make in India : Science and Technology Driven Innovations	ISCA Bhubaneswar Chapter	February 27, 2016
Dr. S.K. Jena	Workshop on 'Awareness generation on Intellectual property rights'	Odisha Bigyan Academy, Bhubaneswar	March 11, 2016
All scientist of IIWM	Review Meeting of Agri-consortia Research Platform on Water	ICAR-IIWM Bhubaneswar	March 15, 2016
Dr. S.K. Rautaray Dr. A.K. Thakur Dr. O. P. Verma	*Sayunkt Rajbhasha Vaigyanik Sangoshthi*	ICAR- CIWA, Bhubaneswar	March 17, 2016
Dr. S.K. Jena	*Rashtriya Krishi Unnati Mela*	DAC, GOI & ICAR	March 19-21, 2016
Dr. M. Das	World Water Day	Regional Science Centre, Ministry of Culture, GoI, Bhubaneswar	March 22, 2016
Dr. G. Kar	Stakeholders workshop on impact of climate change on water resources	TNAU, Coimbatore	March 29,2016
Dr. S. Roy Chowdhury	Meetings between Research organizations and Directorate of Agriculture and food production, Govt. of Odisha and presentation	Directorate of Agriculture and food production, Govt. of Odisha at IMAGE, Bhubaneswar	March 30,2016

MAJOR EVENTS 2015-16

Secretary DARE and Director General, ICAR, Dr. S. Ayyappan visited ICAR-IIWM on May 12, 2015 during 28th Foundation Day Celebration of ICAR-IIWM

Dr. A.K. Sikka, DDG (NRM), ICAR, New Delhi visited ICAR-IIWM in review meeting of 'Consortia Research Platform on Water and AICRP on Irrigation Water Management' during May 30-June 1, 2015

Interface Meeting on 'Monsoon Preparedness and Contingency Planning 2015' on July 8, 2015

69th Independence Day at ICAR-IIWM

Hindi Pakhwada **at ICAR-IIWM during September 14-28, 2015**

MTC on Improving Water Productivity for Sustainable Livelihood and Food Security at ICAR-IIWM during September 21-28, 2015

Vigilance Awareness Week 2015 during October 26-31, 2015

Exposure Program for Assistant Secretaries on 'Integrated Water Management' during November 12-15, 2015 at ICAR-IIWM

Review Meeting of National Innovations on Climate Resilient Agriculture (NICRA) Project on November 17, 2015 at ICAR-IIWM

Dr. (Prof.) Prasanna Kumar Patasani, Hon'ble MP, Bhubaneswar on World Soil Day 2015 at Jaypurpatna village, Bhubaneswar distributing Soil Health Card to farmers

ICAR-IIWM celebrated '*Jai Kisan Jai Vigyan*' Week during December 23-29, 2015

ICAR-IIWM organized 11th National Symposium of ISCAR during January 14-17, 2016

PRADHAN MANTRI KRISHI SINCHAYEE YOJANA (PMKSY)

Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) has been formulated with the vision of extending the coverage of irrigation **'***Har Khet ko pani'* and improving water use efficiency- **'**More crop per drop' in a focused manner with end to end solution on source creation, distribution, management, field application and extension activities.

- Under PMKSY, scientists of ICAR-Indian Institute of Water Management, Bhubaneswar trained All India Service officers, district agricultural officers and soil conservation officers of Uttar Pradesh, Uttarakhand, Madhya Pradesh, Jharkhand, Bihar, Telengana, Andhra Pradesh, Meghalaya and other Indian states.
- ICAR-IIWM also provided a major role in capacity development to All India Service officers (IAS and IFS) of eastern Indian states, i.e. Odisha, Bihar, Jharkhand and West Bengal on 'preparation of District Irrigation Plan (DIP) under PMKSY.
- Scientists of ICAR-IIWM prepared District Irrigation Plan (DIP) for five districts of Odisha namely, Kendrapada, Nayagarh, Jagatsinghpur, Cuttack and Sundergarh under consultancy project with Odisha Watershed Development Mission.
- ICAR-IIWM prepared a quick study report on 'Analysis of existing and traditional cropping pattern for optimal utilization of water resources under PMKSY'

Programmes conducted at ICAR-IIWM

Subject	Place	Period	Participants
Training on 'Development of District Irrigation Plan' under *Pradhan Mantri Krishi Sinchai Yojna* (PMKSY)	IIWM, Bhubaneswar	September 7-11, 2015	14
Subject Matter Interaction/ Exposure Program on Integrated Water Management (PMKSY)	IIWM, Bhubaneswar	November 12-15, 2015	3

Training provided on preparation of DIP under PMKSY

Trainees	Place	Period	Participants
IAS, IFS	NIRD, Hyderabad	September 5, 2015	25
IAS, IFS (Odisha, West Bengal, Bihar, Jharkhand)	ICAR-IIWM, Bhubaneswar	September 7-11, 2015	14
State Government officials	SIRD (State Institute of rural Development), Chennai	November 4, 2015	80
State Government officials	BAMETI, Patna	November 10, 2015	150
State Government officials	Administrative Academy, Bhopal	January 7, 2016	150
State Government officials	SIRD, Bhubaneswar	January 27, 2016	100
State Government officials	BAMETI, Patna	February 6, 2016	150
State Government officials	Kolkata, W.B.	February 8, 2016	80
State Government officials	SIRD, Pune	February 10, 2016	100
State Government officials	SIRD, Bhubaneswar	February 9, 2016	100
State Government officials	SIRD, Gangtok	February 16, 2016	100

Training programme on Development of district irrigation plan under *Pradhan Mantri Krishi Sinchai Yojna* (PMKSY) for All India Service Officers (IAS and IFS) at ICAR-IIWM during September 7-11, 2015

MERA GAON MERA GAURAV

Six groups of scientists of ICAR-IIWM adopted thirty villages across seven blocks spreading over five districts of Odisha under the '*Mera Gaon Mera Gaurav*' program. Farmers' have been given mobile based services for pest and disease control in crops, literature supports for soil collection, water storage and use, *in-situ* rainwater conservation technique along with creating general awareness and imparted need based training on various aspects of farming. Linkages have been established with state government offices (seed production, *Udyaan* fresh, Organic farming, state agriculture and horticulture departments etc.), OUAT, Bhubaneswar, KVKs, ICAR-CIFA, Bhubaneswar and other allied organizations.

Information on villages adopted under MGMG Program

Group ID	Name of the villages	Name of Block and District	No. of farm families
Group A	Khalibandha, Nuagaon, Sadeiberini, Gajamara, Saptasajyapada	Block-Dhenkanal Sadar District- Dhenkanal	631
Group B	Bhakrasahi, Poijhari, Haladibasanta, Naranpur, Sarata	Block-Balipatna District-Khorda	439
Group C	Sukala aisanyapara, Alisha, Churali, Parimanoipur, Sukalapara	Block-Satyabadi & Kanas District-Puri	674
Group D	Chhatabar, Durgapur, Giringaput, Haridamada, Jammujhari	Block- Bhubaneswar & Jatni, District-Khorda	755
Group E	Khadal, Irikundal, Hasim Nagar, Dhinkia, Bindhapada	Block-Tirtol District- Jagatsinghpur	271
Group F	Madana, Naindipur, Chandapalla, Patakura, Jagannathpur	Block-Garadpur District- Kendrapara	820

Information on general awareness created

Sl. No.	Subject matter	No. of Farmers
i)	Scheduling of irrigation in field crops	11
ii)	Suitable time of planting / sowing for *rabi* crops like green gram and groundnut	5
iii)	Pest management in rice, pulses, groundnut and brinjal crops	15
iv)	Integrated weed management	4
vi)	*Swaccha Bharat Aaviyan*, Soil health card, *Jai Kisan Jai Vigyan* week awareness campaign	673
vii)	Soil sample collection and water conservation techniques	190
viii)	Biofertlizer application	21
ix)	*Udyan* fresh activities	29
x)	*Krusaka punjikarana*	75
xi)	Integrated SRI, rainwater conservation and rice-fish farming	30
xii)	Pond lining, Integrated fish-water chestnut co-production system	30
xiii)	Micro-irrigation	60
xiv)	Benefit of quality seed production	28
xv)	Benefit of mushroom cultivation	24
xvi)	Use of seed drills, sprayers and other farm implements	35
	Total	**1170**

Training and interaction meeting organized under adopted villages

Detail of programs	Place and date	No. of beneficiary farmers
Kisan Goshthi on 'Improving crop and water productivity for livelihood'	Nuagaon village (August 13, 2015)	70
Exposure to benefit and subsidy component of combined harvester and its demonstration at farmers (paddy) fields	Jammujhari, Durgapur & Chhatabar village (November 9, 2015)	93
Exposure to the importance of avenue plantation and supplying *Acacia mangium* saplings	Madana Village (November 27, 2015)	15
A Scientist-farmer interaction meeting program	Bhakarasahi (November 27, 2015)	60
Farmer-scientist interaction on water management and demonstration of vermi-compost preparation	Hasimnagar Village (November 28, 2015)	30
Method demonstration on mushroom cultivation for	Erikundal village (December 16, 2015)	40
Farm Women self-help groups (SHGs), awareness on water conservation techniques		
Farmers training programme on drip irrigation, water management practices, farm implements and vermi-compost techniques	Dhinkia, Hasimnagar, Bindhapada & Khadala Villages (December 16, 2015)	25
Demonstration on soil health card and bio-fertilizer	Khalibandha, Nuagaon, Sadeiberini, Gajamara, Saptasajyapada Villages (December 23, 2015)	58
Training on use of bio-fertilizers, soil health card and vermi-compost technology	Bhakarasahi (December 26, 2015)	48
Farmers – scientists' interaction on water management issues on the occasion of '*Jai Kishan Jai Vigyan*' week	Puri (December 26, 2015)	100
Training on improved water management strategies for sustainable crop productivity	Madana Village (December 31, 2015)	35
Scientist-farmer interaction meet on on-going crop activity and integrated SRI	Khalibandha, Nuagaon, Sadeiberini, Gajamara, Saptasajyapada Villages (January 22, 2016)	70
Farmer-scientist interaction on management of residual soil moisture, seed production of pulses, use of bio fertilizers in pulses and oil seeds and composting of paddy straw	Khadala Village (January 30, 2016)	20
Farmers- scientist interaction meet on soil testing and irrigation scheduling of *rabi* and summer rice	Alisha Village (February 16, 2016)	20
Scientist-farmer interaction meet on on-going crop activity and rice-fish farming	Khalibandha, Nuagaon, Sadeiberini, Gajamara, Saptasajyapada Villages (February 29, 2016)	90
Seed production training in paddy	Jammujhari Village (February 29, 2016)	40
Farmer-Scientist interaction meeting on water management problems, role of *pani panchayat*, management of crop residues and micro-irrigation system	Khadala Village (March 4, 2016)	15
Demonstration of mushroom production technology	Haridamada (March 30, 2016)	29

SWACHHA BHARAT ABHIYAN

ICAR-IIWM actively participated in *Swachh Bharat Abhiyan* and 15 number of campaigns were conducted during 2015-16 covering institute campus, residential colony at Sailashree vihar, on-farm research sites in Kendrapara and Sundargarh districts of Odisha. Director and staff of the institute initiated the *Swachh Bharat Abhiyan* at its main campus by taking pledge and conducting intensive cleanliness drive. The Director and staff of the institute participated in cleanliness drives organized at the institute on 18 April and 20 June, 2015. Under intensive campaign of *Swachh Bharat Abhiyan* directed by Government of India, one day training programme on 'Ensuring Safe Water Use in Agriculture for Healthy Nation' was organized for school and college children on 29th September at the institute. Forty children participated and Dr. S.K. Ambast, Director, ICAR-IIWM graced the occasion as Chief Guest and Dr. Buddhadev Mishra, Former dean, OUAT was the Guest of the Honour.

A human chain was formed and pledge was taken by staff of IIWM for cleanliness of our surrounding on 2nd October, 2015, birth anniversary of Mahatma Gandhi and Lal Bahadur Shastri. A cleanliness drive was organized in the premises of ICAR-IIWM main campus and residential quarter premises on the occasion of Birth Anniversary of Shri Jayprakash Narayan on 11th October and on 31st October on the occasion of Birth Anniversary of Sardar Vallabhai Patel. *Swachha Bharat Abhiyan* was also undertaken in Birjaberna village on October 6, 2015. Scientists, village youths along with the women farmers actively participated.

PERSONNEL

As on 31-03-2016

Dr. Sunil Kumar Ambast, Director

SCIENTIFIC

Sl. No.	Name	Designation
1	Dr. R.C. Srivastava[a]	Principal Scientist
2	Dr. Atmaram Mishra	Principal Scientist
3	Dr. M. Das	Principal Scientist
4	Dr. S. Roy Chowdhury	Principal Scientist
5	Dr. P. Nanda	Principal Scientist
6	Dr. R.K. Panda	Principal Scientist
7	Dr. S.K. Rautaray	Principal Scientist
8	Dr. G. Kar	Principal Scientist
9	Dr. S.K. Jena	Principal Scientist
10	Dr.(Mrs.) M.Raychaudhuri	Principal Scientist
11	Dr. S. Raychaudhuri	Principal Scientist
12	Dr. R.K. Mohanty	Principal Scientist
13	Dr. M. K. Sinha	Principal Scientist
14	Dr. K.G. Mandal	Principal Scientist
15	Dr. S. Mohanty	Senior Scientist
16	Dr. P.K. Panda	Senior Scientist
17	Dr. A.K. Thakur	Senior Scientist
18	Dr. P.S. Brahmanand	Senior Scientist
19	Dr. D.K. Panda	Senior Scientist
20	Dr. A.K. Nayak	Senior Scientist
21	Dr. Ranu Rani Sethi	Senior Scientist
22	Dr. P. Panigrahi	Senior Scientist
23	Dr. O.P. Verma	Scientist
24	Dr. Sanatan Pradhan	Scientist
25	Mrs. Rachana Dubey	Scientist
26	Mrs. Prativa Sahu	Scientist
27	Mr. N. Manikandan	Scientist

TECHNICAL

Sl. No.	Name	Designation
1	Er. D.U. Patil	Chief Technical Officer
2	Mrs. Sunanda Naik	Asst. Chief Technical Officer
3	Dr. V.K. Tripathi[b]	Technical Officer
4	Mr. Chhote Lal	Technical Officer
5	Mr. R.C. Jena	Senior Technical Assistant
6	Mr. P.C. Singh Tiyu	Senior Technical Assistant
7	Mr. S.K. Dash	Senior Technical Assistant
8	Mr. B.K. Acharya	Senior Technical Assistant
9	Mr. S. Lenka	Senior Technical Assistant
10	Mr. P. Barda	Senior Technical Assistant
11	Mr. A.K. Binakar	Technical Assistant
12	Mr. L. Singh Tiyu	Technical Assistant
13	Mr. A. Parida	Senior Technician

ADMINISTRATION

Sl. No.	Name	Designation
1	Mr. A. Mallik	Asst. Admn. Officer
2	Mrs. M. Padhi	Private Secretary
3	Mr. Trilochan Raut	Personal Assistant
4	Mr. J. Nayak	Assistant
5	Mr. R.K. Dalai	Assistant
6	Mr. A.K. Pradhan	Upper Division Clerk
7	Mr. N.K. Mallick	Upper Division Clerk
8	Mr. C.R. Khuntia	Lower Division Clerk
9	Mr. B.S. Upadhyaya	Lower Division Clerk
10	Mr. S.C. Das	Lower Division Clerk

SUPPORTING

Sl. No.	Name	Designation
1	Mr. Sanatan Das	Skilled Support Staff
2	Mr. H.K. Bal	Skilled Support Staff
3	Mr. B.N. Naik	Skilled Support Staff
4	Mr. B. Bhoi	Skilled Support Staff
5	Mr. S.K. Panda	Skilled Support Staff
6	Mr. B. Dutta	Skilled Support Staff

[a]-deputation ; [b]-lien

JOINING, PROMOTION, TRANSFER, RETIREMENT

- Mrs. Prativa Sahu, Scientist (Fruit Science) transferred from ICAR-NRC on Pomegranate, Solapur and joined to ICAR- IIWM on May 11 2015 (FN)
- Mr. N. Manikandan, Scientist (Agricultural Meteorology) joined this institute on October 9, 2015
- Dr. Sanatan Pradhan, Scientist (Soil Physics and Soil & Water Conservation) transferred from ICAR-IARI, New Delhi and joined this institute on December 7, 2015.
- Dr. M. K. Sinha and Dr. K. G. Mandal has been promoted to Principal Scientist through CAS of the ICAR w.e.f. 15.06.2013 and 26.07.2013, respectively
- Mr. P. Barda has been promoted to Senior Technical Assistant w.e.f. 12.12.2014.
- Dr. R. C. Srivastava, Principal Scientist joined as Vice-Chancellor, Rajendra Agricultural University, Pusa, Bihar on deputation.
- Mr. S. C. Sheet, Administrative Officer superannuated on November 30, 2015

BUDGET & EXPENDITURE 2015-16

The Budget & Expenditure under Non-Plan & Plan for the financial year 2015-16 in respect of ICAR-IIWM, Bhubaneswar (Figures in lakhs)

Budget Head	Non-Plan		Plan	
	Budget	Expenditure	Budget	Expenditure
Establishment Charges	567.00	567.00	0	0
O.T.A.	0	0	0	0
T.A.	3.00	3.00	12.00	11.98
Other charges including equipment	0	0	30.00	29.91
Other charges-IT	0	0	2.85	2.85
Repair & maintenance of building	5.00	4.66	0	0
Works	0	0	30.15	30.15
Library Books & Journals	0	0	7.00	7.00
H.R.D.	0	0	5.00	5.00
Others including loan & Advances	40.50	38.70	98.00	97.98
Total	**615.50**	**613.36**	**185.00**	**184.87**
AICRP on Irrigation Water Management	0	0	**2265.00**	**2265.00**
Agri-CRP on Water	0	0	**560.00**	**456.96**

AICRP IWM-PC Unit

Budget Head	Sanctioned	Actual Expenditure
Establishment	50.00	49.98
T.A.	1.00	0.97
Other charges including equipment	0	0
Total	**51.00**	**50.95**

APPENDIX

RESULTS-FRAMEWORK DOCUMENT FOR ICAR-INDIAN INSTITUTE OF WATER MANAGEMENT (2014-2015)

भाकृ अनुप
ICAR

RFD
Results-Framework Document
For
ICAR- Indian Institute of Water Management
(2014-2015)

Section 1
Vision, Mission, Objectives and Functions

Vision

Sustainable development of on-farm water management technologies for enhanced agricultural productivity and improved livelihood under different agro-ecological regions.

Mission

Basic, applied and strategic research activities to address diversified water management issues with institutional linkages, infrastructural support and capacity building to achieve sustainability and growth.

Objectives

- Integrated water management and conservation measures
- Enhancing water productivity
- Capacity building and human resources development

Function

- To develop efficient utilization, management and conservation of on-farm water resources for sustainable agricultural production.
- To manage excess water in agricultural lands.
- To develop sustainable cropping systems in relation to the availability of water.
- Devising multiple uses of water in agricultural production programmes to enhance water productivity.
- To reuse poor quality groundwater, industrial and municipal waste waters.
- To disseminate technologies through peoples' participation.

Section 2
Inter se Priorities among Key Objectives, Success Indicators and Targets

Sl. No.	Objectives	Weight	Actions	Success Indicators	Unit	Weight	Target / Criteria Value				
							Excellent 100%	Very Good 90%	Good 80%	Fair 70%	Poor 60%
1.	Agricultural water management and conservation measures	40	Improving irrigation practices	Technologies for enhancing irrigation efficiency to be developed	No.	14	3	2	1	0	-
			Judicious use of water	Technologies for enhancing water use efficiency to be developed through network projects and adaptive research	No.	13	3	2	1	0	-
			Water harvesting and groundwater recharge	Technologies for rainwater conservation and augmenting groundwater through recharge to be developed	No.	13	4	3	2	1	0
2	Enhancing water productivity	20	Multiple water uses	Models for improved water productivity to be developed	Date	13	Jan 31, 2015	Feb 15 2015	Feb 28 2015	Mar15, 2015	Mar31, 2015
				Strategies for use of wastewater in agriculture to be developed	Date	7	Jan 31, 2015	Feb 15 2015	Feb 28 2015	Mar15, 2015	Mar31, 2015
3	Capacity building and human resources development	20	Transfer of technology	Skill up-gradation of farmers and students	No.	14	18	15	12	9	6
				Knowledge of the scientists & officials to be updated	No.	6	6	5	4	3	2
*	Publication/Documentation	5	Publication of the research articles in the journals having the NAAS rating of 6.0 and above	Research articles published	No.	3	23	19	15	11	7
			Timely publication of the Institute Annual Report (2013-2014)	Annual Report published	Date	2	June30, 2014	July02	July04	July07	July09 2014
*	Fiscal resource management	2	Utilization of released plan fund	Plan fund utilized	%	2	98	96	94	92	90
*	Efficient Functioning of the RFD System	3	Timely submission of Draft RFD for 2014-2015 for Approval	On-time submission	Date	2	May15 2014	May16, 2014	May19, 2014	May20, 2014	May21, 2014

			Timely submission of Results for 2013-2014	On-time submission	Date	1	May 1 2014	May 2 2014	May 5 2014	May 6 2014	May 7 2014
*	Enhanced Transparency / Improved Service delivery of Ministry/Department	3	Rating from Independent Audit of implementation of Citizens' / Clients' Charter (CCC)	Degree of implementation of commitments in CCC	%	2	100	95	90	85	80
			Independent Audit of implement-ation of Grievance Redress Management (GRM) system	Degree of success in implementing GRM	%	1	100	95	90	85	80
*	Administrative Reforms	7	Update organizational strategy to align with revised priorities	Date	Date	2	Nov.1	Nov.2	Nov.3	Nov.4	Nov.5
			Implementation of agreed milestones of approved Mitigating Strategies for Reduction of potential risk of corruption (MSC)	% of Implementation	%	1	100	90	80	70	60
			Implementation of agreed milestones for ISO 9001	% of implementation	%	2	100	95	90	85	80
			Implementation of milestones of approved Innovation Action Plans (IAPs)	% of implementation	%	2	100	90	80	70	60

Section 3
Trend Values of the Success Indicators

Sl. No.	Objectives	Actions	Success Indicators	Unit	Actual value 2012-13	Actual value 2013-14	Target value 2014-15	Projected value 2015-16	Projected value 2016-17
1	Agricultural water management and conservation measures	Improving irrigation practices	Technologies for enhancing irrigation efficiency to be developed	No.	2	2	2	3	3
		Judicious use of water	Technologies for enhancing water use efficiency to be developed through network projects and adaptive research	No.	1	1	2	3	3
		Water harvesting & groundwater recharge	Technologies for rainwater conservation and augmenting groundwater through recharge to be developed	No.	3	3	3	3	3
2	Enhancing water productivity	Multiple uses of water	Models for improved water productivity to be developed	Date	-	-	Feb 15, 2015	Feb 15, 2016	Feb 15, 2017
			Strategies for use of wastewater in agriculture to be developed	Date Date	- -	- -	Feb 15, 2015	Feb 15, 2016	Feb 15, 2017
3	Capacity building and human resources development	Transfer of technology	Skill up-gradation of farmers and students	No.	15	15	15	16	17
			Knowledge of the scientists & officials to be updated	No.	_	4	5	5	5
*	Publication/Documentation	Publication of the research articles in the journals having the NAAS rating of 6.0 and above	Research articles published	No.	24	19	19	20	21
		Timely publication of the Institute Annual Report (2013-2014)	Annual Report published	Date	-	-	02.07.2014	-	-
*	Fiscal resource management	Utilization of released plan fund	Plan fund utilized	%	100	100	96	96	96
*	Efficient Functioning of the RFD System	Timely submission of Draft RFD for 2014-2015 for Approval	On-time submission	Date	-	-	May 16, 2014	-	-

		Timely submission of Results for 2013-2014	On-time submission	Date	-	-	May 22014	-	-
*	Enhanced Transparency / Improved Service delivery of Ministry/Department	Rating from Independent Audit of implementation of Citizens' / Clients' Charter (CCC)	Degree of implementation of commitments in CCC	%	-	-	95	-	-
		Independent Audit of implementation of Grievance Redress Management (GRM) system	Degree of success in implementing GRM	%	-	-	95	-	-
*	Administrative Reforms	Update organizational strategy to align with revised priorities	Date	Date	-	-	Nov.2 2014	-	-
		Implementation of agreed milestones of approved Mitigating Strategies for Reduction of potential risk of corruption (MSC)	% of Implementation	%	-	-	90	-	-
		Implementation of agreed milestones for ISO 9001	% of implementation	%	-	-	95	-	-
		Implementation of milestones of approved Innovation Action Plans (IAPs)	% of implementation	%	-	-	90	-	-

Section 4
Description and Definition of Success Indicators and Proposed Measurement Methodology

S. No.	Success Indicator	Description	Definition	Measurement	General Comments
1	Technologies for enhancing irrigation efficiency to be developed	Pressurized irrigation systems like drip and sprinkler irrigation methods shall be evaluated.	Irrigation efficiency is to characterize irrigation performance, evaluate irrigation water use, and to promote better or improved use of water resources in agriculture.	Irrigation efficiencies will be measured through study of irrigation performance, irrigation water use etc.	Modern irrigation practices and management will yield better irrigation water use efficiency over the farmers' practices in agriculture.
2	Technologies for enhancing water use efficiency to be developed through network projects and adaptive research	Engineering with bio-engineering propositions shall be developed to enhance water use efficiency	Water use efficiency is defined as yield of plant product per unit of crop water use.	Water use efficiency will be measured through crop performance against total water use through evapo-transpiration.	This will help in enhancing agricultural crop water productivity and profitability.
3	Technologies for rainwater conservation and augmenting groundwater through recharge to be developed	Low cost location specific ground water recharge techniques shall be developed	Groundwater recharge is a hydrologic process where water moves downward from surface water to groundwater.	Groundwater recharge measurement will be studied through development of location specific filter systems.	Groundwater recharge technique shall help in augmenting the groundwater table through minimization of surface runoff.
4	Models for improved water productivity to be developed	Models shall be conceptualized, developed and evaluated for multiple uses of water	Multiple use of water are low-cost, equitable water use models that provide water for both domestic needs and high-value agricultural production including rearing of livestock.	Under multiple use managements total water use against production of various components will be measured.	This system will help in livelihood improvement, assured production in adverse conditions as well as creation of water resources.
5	Strategies for use of wastewater in agriculture to be developed	The use of waste water in agriculture shall be addressed to enhance water productivity	Waste water is the marginally polluted water having potentiality of reusing in agriculture.	Waste water quality parameters will be measured using standard methods following recommended guidelines.	To reduce dependency on surface and groundwater, use of treated waste water in agriculture can be a viable proposition.
6	Skill up-gradation of farmers and students	In order to disseminate the various developed on-farm technologies, the training programmes for the farmers and students shall be undertaken.	Transfer of technology through training and demonstration is the process of transferring skills, knowledge, technologies, methods etc. to a wider range of users.	Impact assessment of training and demonstration will be measured through systematic questionnaire feedback approach.	Training and demonstration are the effective tools in rapid dissemination of technologies to end user level for enhancing agricultural productivity.
7	Knowledge of the scientists & officials to be updated	Knowledge of the scientists and officials shall be developed on recent advancement techniques through various training programmes.	Human resource development is a framework for the expansion of human capital within an organization through the development of both the organization and the individual to achieve performance improvement.	Enhanced knowledge will be measured through aided trainings on new and emerging subjects/ tools.	This will update and enhance the existing knowledge level of scientific and other officials of the organization.

Performance Evaluation Report
RFD (April 1, 2014 to March 31, 2015)

Name of the Division : Natural Resources Management
Name of the Institution : ICAR-Indian Institute of Water Management, Bhubaneswar
RFD Nodal Officer of the RSC : Dr. R.K. Panda, Principal Scientist

Sl. No.	Objective(s)	Weight	Action (s)	Success Indicator (s)	Unit	Weight	Target / Criteria Value					Achievements	Performance		Percent Achievements against target values of 90% col.	Reasons for shortfals or excessive achievements, if applicable
							Excellent 100%	Very Good 90%	Good 80%	Fair 70%	Poor 60%		Raw Score	Weighted Score		
1	Integrated water management and conservation measures	40	Improving irrigation practices	Technologies for enhancing irrigation efficiency to be developed	No.	14	3	2	1	-	-	3	100	14	150	Achieved as targeted (100%)
			Judicious use of water	Technologies for enhancing water use efficiency to be developed through network projects and adaptive research	No.	13	3	2	1	-	-	3	100	13	150	Achieved as targeted (100%)
			Water harvesting and groundwater recharge	Technologies for rainwater conservation and augmenting groundwater through recharge to be developed	No.	13	4	3	2	1	-	4	100	13	133	Achieved as targeted (100%)
2	Enhancing water productivity	20	Multiple water uses	Models for improved water productivity to be developed	Date	13	Jan 31, 2015	Feb 15, 2015	Feb 28, 2015	March 15, 2015	March 31, 2015	May 2014 & Sept 2014	100	13	-	Achieved in time
				Strategies for use of wastewater in agriculture to be developed	Date	7	Jan 31, 2015	Feb 15, 2015	Feb 28, 2015	March 15, 2015	March 31, 2015	June 2014	100	7	-	Achieved in time
3	Capacity building and human resources development	20	Transfer of technology	Skill up-gradation farmers and students	No.	14	18	15	12	9	6	18	100	14	120	Achieved as targeted (100%)
				Knowledge of the scientists and officials to be updated	No.	6	6	5	4	3	2	6	100	6	120	Achieved as targeted (100%)
*	Publication/ Documentation	5	Publication of the research articles in the journals having the NAAS rating of	Research articles published	No.	3	23	19	15	11	7	25	100	3	131.6	Achieved (100%)

			Timely publication of the Institute Annual Report (2013-2014)	Annual Report published	Date	2	June 30 2014	July 02, 2014	July 04, 2014	July 07, 2014	July 09, 2014	June 1, 2014	100	2	-	Published timely
*	Fiscal resource management	2	Utilization of released plan fund	Plan fund utilized	%	2	98	96	94	92	90	96	90	1.95	-	Achieved as targeted under 90%
*	Efficient functioning of the RFD system	3	Timely submission of Draft RFD for 2014-15 for approval	On-time submission	Date	2	May 15, 2014	May 16, 2014	May 19, 2014	May 20, 2014	May 21, 2014	April 21, 2014	100	2	-	Achieved in time
			Timely submission of Results for 2013-14	On-time submission	Date	1	May 1 2014	May 2, 2014	May 5, 2014	May 6, 2014	May 7, 2014	April 21, 2014	100	1	-	Achieved in time
*	Enhanced Transparency/ Improved Service delivery of Ministry/ Department	3	Rating from Independent Audit of implementation of Citizen's / Clients 'Charter (CCC)	Degree of implementation commitment in CCC	%	2	100	95	90	85	80	95	95	1.9	-	Achieved as targeted under 90%
			Independent Audit of implementation of Grievance Redress Manage-ment (GRM) system	Degree of success in implementing GRM	%	1	100	95	90	85	80	100	100	1	-	Achieved as (100%)
*	Administrative Reforms	7	Update organiza-tional strategy to align with revised priorities	Date	Date	2	Nov 1, 2014	Nov 2, 2014	Nov 3, 2014	Nov 4, 2014	Nov 5, 2014	Oct 24, 2014	100	2	-	Achieved in time
			Implementation of agreed milestones of approved Mitigating Strategies for Reduction of potential risk of corruption (MSC)	% of Implementation	%	1	100	90	80	70	60	90	90	0.9	-	Achieved as targeted under 90%
			Implementation of agreed milestones for ISO 9001	% of implementation	%	2	100	95	90	85	80	100	100	2	-	Achieved as targeted under 100%
			Implementation of milestones of approved Innovation Action Plans (IAPs)	% of implementation	%	2	100	90	80	70	60	95	95	1.9	-	Achieved 95%

Total composite score : 99.40
Rating : Excellent

जय किसान

जय विज्ञान

भाकृअनुप - भारतीय जल प्रबंधन संस्थान

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