2021

# बार्षिक प्रतिबेदन
# Annual Report
# ICAR-MGIFRI


भाकृअनुप-महात्मा गाँधी समेकित कृषि अनुसंधान संस्थान
ICAR-MAHATMA GANDHI INTEGRATED FARMING RESEARCH INSTITUTE
Piprakothi, Motihari, Bihar, India

# Annual Report
# 2021


## Indian Council of Agricultural Research

**Mahatma Gandhi Integrated Farming Research Institute**

**(ICAR-MGIFRI)**

**Piprakothi- 845 429, Motihari, Bihar, India**

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Azadi Ka Amrit Mahotsav


# Preface

Natural resource management is very challenging in the interface of land degradation, water stress, excess water, changing climate, and adverse abiotic stress situations. Flood and waterlogging is one of those challenges. Like other Asian countries, our country is prone to floods in many regions. According to an estimate, major flood-prone area is 41.13 million ha, which is about 13% of 329 million ha of the geographic area of the country. Flood and waterlogging is a misery to about 113 million people i.e., about 9% of the population. It affects agricultural lands, forest lands, crops, livestock, and human life. Major flood-prone states are Uttar Pradesh, Bihar, Assam, West Bengal and Odisha. Floods mostly occur due to high rainfall (i.e., fluvial floods), riverine floods and flash floods (i.e., pluvial floods). The damage due to riverine flood is widespread in Bihar, as the overflow affects rivers in their downstream. The degree of riverine flood is increased over years due to high siltation in the river catchment areas making them disastrous. On average, perennial and seasonal waterlogging is about 11.6 million ha in the country. The low-lying areas are mostly affected. In Bihar, waterlogging problem is the most serious and it occurs in about 0.8 million ha every year; 28 districts out of 38 are flood-prone, and 15 are the most vulnerable.

With this background, Scientists of ICAR-Mahatma Gandhi Integrated Farming Research Institute (MGIFRI), Motihari are working with five major action areas: i) Delineation, situation analysis and mapping of flood-prone, flood-affected and waterlogged areas; ii) Characterization and monitoring of soils and nutrient status of water congested ecologies; iii) Design and development of integrated farming systems (IFS) technology/ packages/ model for water congested ecosystems; iv) Post-flood crop management, design and development of efficient water management technology, and v) Capacity building of all stakeholders including farmers on different components of IFS.

The institute is a new research establishment under the Natural Resource Management Division of the ICAR. Considerable infrastructure development has been made. Creation of some more facilities are in the process, which are essentially required for the research. We have planned a few prospective research projects, which are being started quite systematically so that the mandates of the Institute are met, and impactful technologies are developed for the benefit of farmers. In addition to institute-funded projects, we are working at the farmers field for the welfare of the farmers directly through an external-funded scheme of the Govt of India, SCSP scheme and farmers' FIRST project of the ICAR. Our Scientists are putting all-out efforts for capacity building of farmers and stakeholders through on-campus as well as off-campus training programmes, demonstration, organizing awareness campaigns, Kisan Gosthi, Krishi Mela, Field Days etc.

Significant research achievements for the year 2021 have been included in this annual report under eight institute projects and two externally funded projects. Under the *SCSP* program of the Government of India, our Scientists have played a major role in capacity building and distributing items that helps to our major stake holders. Under *Farmers' FIRST* programme (FFP), our scientists have participated in transfer of technology to different villages across seven blocks in East Champaran. All Scientists and staffs are actively involved in cleanliness drive throughout the year under *Swachh Bharat Abhiyan*.

I acknowledge the valuable guidance, suggestion and support by Dr. T. Mahapatra, Hon'ble Secretary, DARE and Director General, ICAR, Dr. S.K. Chaudhari, Hon'ble Deputy Director General (NRM), Dr. S. Bhaskar, Hon'ble Assistant Director General (A,AF&CC), NRM Division, ICAR, New Delhi and other concerned officials of the Council. I express my sincere thanks to the esteemed Chairman and members of RAC 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 and cooperation. I thank publication committee for putting their in compilation and editing the Annual Report 2021 of the Institute.

Date: 07 April 2022

Motihari, Bihar

**(K.G. Mandal)**
**Director**

# कार्यकारी सारांश

**उधान आधारित कृषि प्रणाली मॉडल का विकास**

जलभराव वाले क्षेत्रों के प्रबंधन के लिए भूमि को आकार देना एक संभावित विकल्प है। संस्थान के अनुसंधान फार्म में अलग-अलग गहराइयों के तालाबों और उठी हुई भूमि को विकसित किया गया है, जिन पर विभिन्न प्रकार की फसलें, बागवानी फसलें और सब्ज़ियाँ उगाई जाती थीं। इसके अतिरिक्त, अधिक आमदनी हेतू तालाबों में मछली, सिंघाड़ा और मखाना को एकीकृत किया गया है। इस तरह से जलभराव के मुद्दों को हल करने के लिए एकीकृत कृषि प्रणाली (IFS) मॉडल विकसित किए जा रहे हैं। इस विकल्प से जलभराव वाले क्षेत्रों की उत्पादकता को कई गुना बढ़ाया जा सकता है। अब तक प्राप्त परिणाम प्रभावी पाए गए हैं।

**प्रमुख फलों और सब्जियों की तुराई उपरांत हानियों का अध्ययन**

भारत में फलों और सब्जियों की कटाई के बाद भारी नुकसान (30-35%) होता है, जो लगभग रु. 2.40 लाख करोड़ सालाना है । इसलिए, आपूर्ति श्रृंखला के विभिन्न चरणों में फसल तुराई उपरांत होने वाले नुकसान की सीमा की जांच करना आवश्यक है। इसके समाधान के लिए, पूर्वी चंपारण के चार अलग-अलग गांवों में किसानों के बीच एक प्रश्नावली आधारित सर्वेक्षण किया गया और परिणाम में परिवहन के दौरान 4-7% यांत्रिक हानि, फूलगोभी, बैंगन और टमाटर में 3-5% शारीरिक हानि जब कि पत्तेदार सब्जियां में यह 15-20% तक जाती है। साथ ही कोल्ड स्टोरेज नहीं होने के कारण किसानों को मजबूरी में उपज बेचनी पड़ी। इस कार्य का परिणाम फसल कटाई के बाद के नुकसान को कम करने के लिए प्रबंधन रणनीतियों और नीतियों को तैयार करने में उपयोगी होगा।

**शीतकालीन मक्का के लिए सिंचाई जल बचत तकनीक**

बाढ़ के पानी के घटने के बाद, फसलें या तो अवशिष्ट मिट्टी की नमी के साथ या पूर्व बुवाई सिंचाई के साथ उगाई जाती हैं। यदि महत्वपूर्ण विकास चरणों के दौरान सिंचाई प्रदान नहीं की जाती है, तो रबी मौसम की फसलें मिट्टी की नमी के तनाव से पीड़ित होती हैं। अत: शीत एवं ग्रीष्म फसलों से अधिक उपज प्राप्त करने के लिए सिंचाई अनिवार्य रूप से आवश्यक है। इस क्षेत्र में सिंचाई की 80% से अधिक मांग भूजल से पूरी होती है। क्षेत्र की प्रमुख फसलों में से एक मक्का के लिए सिंचाई के पानी को बचाने के उद्देश्य से प्रयोग किया जा रहा है। अनाज की उपज को कम किए बिना फसल जल उत्पादकता (CWP) को बढ़ाने के लिए विभिन्न जल-बचत सिंचाई तकनीकों की कोशिश की जा रही है। प्रयोग चल रहा है और भविष्य में उपयोगी सिंचाई बचत विधियों को विकसित किया जाएगा।

**पूर्वी भारत के बाढ़ प्रवण और जलभराव वाले क्षेत्रों की विशेषता**

बिहार अपनी भू-जलवायु परिस्थितियों और विभिन्न अन्य जिम्मेदार कारकों के कारण बाढ़ और जलभराव के प्रति अत्यधिक संवेदनशील है। बाढ़ के लिए अतिसंवेदनशील भूमि के प्रतिशत के मामले में राज्य देश में सबसे अधिक बाढ़ प्रवण है। जल-जमाव दुर्लभ भूमि के साथ-साथ मानव संसाधनों की गुणवत्ता और दक्षता को खराब करता है। इसके परिणामस्वरुप उन क्षेत्रों में या तो कोई फसल नहीं होता है या पैदावार में काफी गिरावट आती है । यह लोगों के सामान्य स्वास्थ्य में गिरावट के अलावा मिट्टी की लवणता भी बनाता है। इस मुद्दे को हल करने के लिए,इस परियोजना को शुरु किया गया जिसमे बाढ़ प्रवण और जलभराव वाले क्षेत्रों को चित्रित और मानचित्रण कर एकीकृत कृषि प्रणाली (आईएफएस) के आलोक में उपयुक्त शोध योजना को अपनाया जा सके ।

### चावल-गेहूँ फसल प्रणाली में अधिकतम उपज और मृदा स्वास्थ्य के लिए इष्टतम अवशेष प्रतिधारण

मृदा स्वास्थ्य को बनाए रखते हुए फसल की उपज को अधिकतम करना टिकाऊ खेती के प्रमुख पहलुओं में से एक है। फसल अवशेष प्रतिधारण संरक्षण कृषि (सीए) के तहत प्रमुख प्रथाओं में से एक है। हालांकि, चावल-गेहूँ फसल प्रणालियों में अधिकतम उपज प्राप्त करने के लिए चूने वाली मिट्टी में अवशेषों की इष्टतम मात्रा शामिल किए जाने का परिमाणीकरण की आवश्यकता होती है। इस प्रकार संस्थान अनुसंधान फार्म में एक क्षेत्र प्रयोग किया जा रहा है जहां चावल-गेहूं फसल प्रणाली से उपज की तुलना संरक्षण कृषि और पारंपरिक जुताई के उपचारों के बीच की गई थी। परिणामों ने संरक्षण खेती में सहवर्ती मृदा स्वास्थ्य सुधार के साथ, सीए और पारंपरिक दृष्टिकोण से तुलनीय उपज दिखाई।

### जैविक खाद के साथ जिंक का प्रयोग कर गन्ने की उत्पादकता बढ़ाना

गन्ने की फसल की उत्पादकता बढ़ाने में जैविक खाद के साथ-साथ जिंक उर्वरक के संयुक्त अनुप्रयोग की प्रभावकारिता का मूल्यांकन किया गया। इस प्रकार एफवाईएम, प्रेसमड केक और सेसबानिया हरी खाद इंटरक्रॉप प्लॉट के रूप में, के साथ जिंक के प्रयोग से प्राप्त गन्ने की उपज जिंक के अनुशंसित अनुप्रयोग की तुलना में 15-20% अधिक थी।-20.0% इसके अतिरिक्त, मिट्टी की उर्वरता की स्थिति को बनाए रखते हुए पहली सिंचाई में जिंक के प्रयोग से अच्छी गुणवत्ता वाले गन्ने का उत्पादन उच्चतम (11.86 t ha-1) पाया गया। इसके साथ ही, सिस्टम ने प्रचलित बाजार कीमतों और शुद्ध रिटर्न के आधार पर अच्छा मौद्रिक लाभ भी दिया।

### उत्तर बिहार के जलभराव की स्थिति में चावल-मछली-बतख IFS मॉडल

उत्तर बिहार में लगभग 76% भूमि बाढ़ प्रभावित है और विभिन्न गहराई के जलभराव के अधीन है। इस क्षेत्र में चावल एक प्रमुख फसल के रूप में उगाया जाता है। हालांकि, कृषि आय बढ़ाने के लिए चावल की फसल को मछली, पशु घटकों, जलीय और बागवानी फसलों जैसी अन्य वस्तुओं के साथ एकीकरण की आवश्यकता होती है। एकीकृत कृषि प्रणाली जलभराव वाले पारिस्थितिक तंत्र में अधिक उपयुक्त है और किसानों को खाद्य और पोषण सुरक्षा सुनिश्चित करेगी। इस तर्क के साथ, उत्तर बिहार जलभराव स्थितियों में चावल-मछली एकीकरण प्रणाली का मूल्यांकन करने के लिए एक प्रयोग शुरू किया गया है।

### जलभराव की स्थितियों के लिए कम लागत वाले उपकरणों और मशीनरी का डिजाइन और विकास

भारत में एक बड़ा क्षेत्र जल-जमाव की स्थिति के तहत है जो ज्यादातर पूर्वी क्षेत्र में विस्तारित है। अतिरिक्त पानी को खेत के तालाबों में संग्रहित किया जा सकता है जहाँ मछली पालन और अन्य जलीय फसलें उगाई जा सकती हैं। इसके साथ ही मछली और जलीय फसलों के समुचित विकास के लिए तालाब के पानी की गुणवत्ता की निगरानी आवश्यक है। इस प्रकार, खेत के तालाबों के लिए एक स्वचालित जल गुणवत्ता निगरानी प्रणाली और स्वचालित सेंसर-आधारित जलवाहक प्रणाली के विकास और डिजाइन के लिए परियोजना शुरू की गई है। क्षेत्र के छोटे किसानों के लिए कम लागत और उपयोगी उपकरण (जैसे, मछली स्केलिंग टूल) और मशीनरी (छोटे कृषि उपकरण) को डिजाइन और विकसित करने के प्रयास किया जा रहा है ।

### पिछवाड़े प्रणाली के तहत पाले गए कुक्कुट पक्षियों का बाधा विश्लेषण और प्रदर्शन मूल्यांकन

बैकयार्ड पोल्ट्री संभावित रूप से छोटे और सीमांत किसानों के लिए फायदेमंद है। सर्वेक्षण-आधारित प्रश्नावली पद्धति का उपयोग करके पूर्वी चंपारण जिले में पिछवाड़े कुक्कुट पक्षियों के पालन में आने वाली बाधाओं का विश्लेषण और इसके प्रदर्शन का मूल्यांकन किया गया है। किसानों द्वारा बताई गई प्रमुख बाधाओं में 1-3 सप्ताह की आयु तक के चूजों में उच्च मृत्यु दर (25-50%), प्रतिकूल श्वसन लक्षण के बाद डायरिया और ब्रॉयलर में अवरुद्ध विकास, उच्च फ़ीड लागत और कम बाजार मूल्य शामिल हैं। उन मुद्दों को हल करने के लिए, अधिकांश किसानों को आईसीएआर-एमजीआईएफआरआई में क्षमता निर्माण के लिए प्रशिक्षण में भाग लेने की सलाह दी गई ताकि वे निवारक उपाय कर सकें और बीमारियों का प्रबंधन कर सकें।

## बाढ प्रणव पारिस्थितिकी तंत्र हेतु मछली आधारित समेकित कृषि प्रणाली का मूल्यांकन

पृथ्वी की सतह का लगभग 10% आर्द्रभूमि से आच्छादित है, जिसमें से 15% बाढ़ प्रक्षेत्र आर्द्रभूमि के अंतर्गत है। चावल और मछली की खेती भारत के बाढ़ के मैदानों में प्रमुख कृषि पद्धति हैं, हालांकि, जिनकी उत्पादकता क्रमशः 1.0-1.5 और 0.05-1.1 टन प्रति हेक्टेयर प्रति वर्ष है, जो चावल और मछली उत्पादकता के राष्ट्रीय औसत से बहुत कम है। एकीकृत मछली पालन प्रणालियाँ उपलब्ध जल संसाधनों, अपशिष्ट पुनर्चक्रण, ऊर्जा की बचत, विविधीकरण, आजीविका सुरक्षा, गुणवत्तापूर्ण भोजन आदि के कुशल उपयोग को सक्षम बनाती हैं। इसलिए जलभराव वाले पारिस्थितिकी तंत्र के तहत एक स्थायी कृषि प्रणाली के रूप में माना जाता है। इसलिए, मछली आधारित विभिन्न IFS मॉडल आजमाए जा रहे हैं।

## फार्मर फर्स्ट कार्यक्रम (एफएफपी) के तहत अच्छी कृषि, मत्स्य पालन और पशुपालन प्रथाओं के माध्यम से छोटे किसानों की आजीविका में सुधार

फार्मर फर्स्ट कार्यक्रम (एफएफपी) के तहत विस्तार गतिविधियां पूर्वी चंपारण जिले के तेतरिया ब्लॉक में की गईं, जो बाढ़ की चपेट में रहता है और कृषि विस्तार गतिविधियों बहुत ही खराब या ना के बराबर है। चार बड़े गाँवों - उझीलपुर, हसनपुर, नरहा मल्लाह टोला और हनुमान नगर में विस्तार गतिविधियाँ संचालित की गईं। गेहूँ के बीजों की दो किस्में जैसे एचडी 2967 और एचडी 3086 को 260 किसानों के बीच वितरित किया गया। इसी प्रकार धान की किस्म (सरजू 52) को 245 किसानों को उपलब्ध कराया गया । इसके अतिरिक्त, अन्य बीज जैसे मूंग (वैरायटी आईपीएम 2-14), और सब्जियों के बीज (भिंडी, चिकनी लौकी, तोरी, कद्दू, ककड़ी) क्रमशः 265 और 185 किसानों को प्रदान किए गए। यूरिया, जिंक सल्फेट और एमओपी जैसे उर्वरक विभिन्न गांवों में 168 किसानों को उनकी जोत के आकार के आधार पर अलग-अलग मात्रा में प्रदान किए गए। यह देखा गया है कि मौजूदा परंपरा बीज और प्रथाओं की तुलना में 15-25% अधिक उपज थी। अनुसूचित जाति के पच्चीस किसानों को SC-SP फंड के तहत दो-दो बकरियां (ब्लैक बंगाल) प्रदान की गईं। एफएफपी गांव में एक पशु स्वास्थ्य शिविर आयोजित किया गया। किसानों के लिए मशरूम की खेती पर दो प्रशिक्षण कार्यक्रम आयोजित किए गए।

## पूर्वी भारत के जलसंकुलित पारिस्थितिकी के लिए मछली आधारित एकीकृत कृषि प्रणाली मॉडल का विकास

एकीकृत मछली पालन के दृष्टिकोण में पशुधन, पक्षियों, या कृषि और बागवानी फसलों के साथ मछली पालन के एकीकरण की परिकल्पना इस तरह से की जाती है कि एक प्रणाली से उत्पन्न कचरे को दूसरे सिस्टम में इनपुट के रूप में इस्तेमाल किया जा सके। पारंपरिक मछली पालन प्रणालियों के माध्यम से, भारत में मछली उत्पादकता 1.0-1.5 t ha-1 yr-1 से भिन्न होती है। हालाँकि, उपयुक्त वैज्ञानिक हस्तक्षेपों के साथ, यह स्पष्ट रूप से कई गुना बढ़ गया है। एकीकृत मछली पालन के लाभों में ग्रामीण रोजगार और आय में वृद्धि, बेहतर भोजन, पोषण और स्वास्थ्य सुरक्षा, विविधीकरण, पानी और पोषक तत्वों का पुनर्चक्रण और पर्यावरण के अनुकूल शामिल हैं।

## बकरी आधारित एकीकृत कृषि मॉडल का विकास और मूल्यांकन

संस्थान के अनुसंधान फार्म में ब्लैक बंगाल बकरियों को पाला गया और अन्य घटकों जैसे फसल, सब्जियां और मछलियां के साथ एकीकृत किया गया। 1.65 के औसत कूड़े के आकार के साथ बकरियों की संख्या 18 से बढ़कर 51 हो गई थी, और नर: मादा बच्चों का अनुपात 0.94: 1 के रूप में पैदा हुआ था। खरीफ धान और मछली के घटक से प्राप्त उपज क्रमशः 2175 किलोग्राम और 284 किलोग्राम थी। इससे बकरी, फसल एवं मछली के घटकों से क्रमशः ₹18875, 55000 एवं 42600 का कुल राजस्व प्राप्त हुआ।

### अनुसंधान परियोजनायें, प्रकाशन, पुरस्कार और मान्यताएं

2021 आईसीएआर-एमजीआईएफआरआई के वैज्ञानिक 8 संस्थान परियोजना, 2 बाह्य वित्त पोषित परियोजनाओं, एससीएसपी परियोजना और 3 नई स्वीकृत परियोजनाओं पर काम कर रहे हैं। 2021 के दौरान, इस संस्थान के वैज्ञानिकों ने 17 शोध पत्र, 11 पुस्तक अध्याय और 5 लोकप्रिय लेख/तकनीकी बुलेटिन प्रकाशित किए हैं। वैज्ञानिकों को पुरस्कारों, सम्मानों और पहचान से नवाजा गया है।

### मानव संसाधन विकास, प्रशिक्षण और क्षमता इमारत

हमारे 3 कर्मचारियों ने विभिन्न संगठनों से विभिन्न विषयों पर प्रशिक्षण प्राप्त किया; भाकृअनुप-एमजीआईएफआरआई ने किसानों के लिए आजादी का अमृत महोत्सव के तहत 2884 किसानों को लाभान्वित करने के लिए 16 प्रशिक्षण/क्षेत्र प्रदर्शन कार्यक्रम, 18 विभिन्न कार्यक्रमों का आयोजन किया

### स्वच्छ भारत अभियान

आईसीएआर-एमजीआईएफआरआई के सभी संबंधित व्यक्तियों ने स्वच्छ भारत अभियान में सक्रिय रूप से भाग लिया और संस्थान परिसर, सार्वजनिक स्थानों और गांवों में 2021 के दौरान 40 सफाई कार्यक्रम, 5 स्वच्छता जागरूकता अभियान चलाए गए। साथ ही आसपास के गांव के लोगों व विद्यार्थियों को स्वच्छता के लिए प्रेरित करने के लिए अभियान चलाए गए।

# EXECUTIVE SUMMARY

| | |
|---|---|
| **Land shaping and horti-based farming system model development** | Land shaping is a potential option for management of waterlogged areas. Different depths of sunken ponds and raised beds have been developed at the Institute Research Farm, on which various field crops, orchard crops and vegetables were grown. Additionally, fish, water chestnut and makhana were integrated in the sunken ponds for generating more income. Thereby, integrated farming system (IFS) models are being developed to address the issues of waterlogging. By this option, productivity of waterlogged areas can be increased many-fold. Results obtained so far is found effective. |
| **Post-harvest losses study of major fruits and vegetables** | There is huge post-harvest losses from fruits and vegetables (30-35%) in India amounting to approximately Rs. 2.40 lakh crore annually. Hence, it is essential to cross-examine the extent of post-harvest losses at various stages of the supply chain. To address this, a questionnaire-based survey was done among the farmers in four different villages of East Champaran and results showed 4-7% mechanical loss during transportation, 3-5% physiological losses in cauliflower, brinjal and tomato, and that of leafy vegetables it goes up to 15-20%. Additionally, farmers had to sell the produce forcefully due to the nonavailability of cold storage. The result of this work will be useful in devising management strategies and policies policies to minimize the post-harvest losses. |
| **Irrigation water saving technique for winter maize** | After receding of flood water, crops are grown either with residual soil moisture or with pre-sowing irrigation. The rabi season crops suffer from soil moisture stress, if irrigation is not provided during the critical growth stages. Hence, irrigation is essentially required to obtain greater yield from winter and summer crops. More than 80% of the irrigation demand is met by groundwater in this region. Experiment is being conducted with the objective to save irrigation water for maize, which is one of the predominant crops in the region. Different water-saving irrigation techniques are being tried to increase the crop water productivity (CWP) without reducing grain yield. The experiment is ongoing and is expected to develop efficient irrigation saving methods in the future. |
| **Characterization of flood-prone and waterlogged areas of Eastern India** | Bihar is highly vulnerable to floods and waterlogging on account of its geo-climatic conditions and various other attributing factors. The state is the most flood prone in the country in terms of percentage of land susceptible to flooding. Waterlogging deteriorates the quality and efficiency of scarce land as well as human resources. It results into either no crop in those areas or a considerable decline in yields. It builds soil salinity also besides deterioration in general health of the people. To address this issue, this project has been initiated to delineate and mapping flood prone and waterlogged areas for adopting appropriate intervention plan in the light of integrated farming system (IFS). |
| **Optimum residue etention for yield maximization and soil health in rice-wheat cropping system** | Maximizing crop yield by maintaining soil health is one of the key aspects of sustainable farming. Crop residue retention is one of the major practices under conservation agriculture (CA). However, the optimum quantity of residue to be incorporated needs quantification in calcareous soil for achieving maximum yield in rice-wheat cropping systems. Thus a field experiment is being conducted at the Institute Research Farm where yield from rice-wheat cropping system was compared between conservation agriculture and conventional tillage treatments. The results showed a comparable yield from CA and conventional approach, with concomitant soil health improvement in conservation farming. |

### Enhancing productivity of sugarcane through zinc application with organic manures

The efficacy of the combined application of Zn fertilizer along with organic manures was assessed in increasing the productivity of sugarcane crop. The cane yield thus obtained under FYM, pressmud cake and *Sesbania* green manure as intercrop plots along with zinc application was 15-20% higher than that of recommended application of zinc. Additionally, good quality cane production was found to be the highest (11.86 t $ha^{-1}$) with the application of zinc at first irrigation with FYM through maintaining soil fertility status. Along with this, the system also gave good monetary benefits on the basis of prevailing market prices and net return.

### Design and development of low-cost equipments and machineries for farming in water logged situations

India occupies a large area under waterlogged conditions which are mostly distributed in the eastern region. Excess water can be stored in farm ponds where fish culture and other aquatic crops can be grown. Simultaneously, monitoring the quality of pond water is essential for proper growth of fish and aquatic crops. Thus, the project has been initiated for developing and designing an automatic water quality monitoring system and automatic sensor-based aerator system for the farm ponds. Efforts are being made to design and develop low cost and useful tools (e.g., fish scaling tool) and machineries (small farm implements) for the small farmers of the region.

### Rice-fish-duck IFS model in waterlogging situations of North Bihar

About 76% of the land in North Bihar is flood-affected and is under waterlogging of different depths. Rice is grown as a major crop in this area. However, rice crop requires integration with other commodities like fishes, animal components, and aquatic and horticultural crops to increase farm income. The integrated system holds promise particularly in the waterlogging areas. This would ensure food and nutrition security to the farmers in waterlogged ecosystems. With this rationale, an experiment has been initiated to evaluate rice–fish integration system in North Bihar waterlogging situations.

### Constraint analysis and performance evaluation of backyard poultry

Backyard poultry is potentially beneficial to small and marginal farmers. An analysis has been made to find out the constraints of adopting backyard poultry and evaluated the performances of poultry birds in East Champaran district using a survey-based questionnaire method. The major constraints reported by the farmers were high mortality rate (25-50%) in chicks up to 1-3 weeks of age, adverse respiratory symptoms followed by diarrhoea and stunted growth in broilers, high feed cost, and the low market price of the product. To address those issues, most of the farmers were advised to attend training for capacity building at ICAR-MGIFRI so that they can take preventive measures and manage diseases.

### Assessment of fish-based integrated farming models under floodplain ecosystems

About 10% of the earth's surface is covered with wetlands, of which 15% is under floodplain wetlands. Rice and fish farming are major farming practices in floodplains of India, however, the productivity of which varies from 1.0-1.5 and 0.05-1.1 t $ha^{-1}$ per year, respectively, those are much less than the national average of rice and fish productivity. The integrated fish farming systems enable efficient utilization of available water resources, waste recycling, energy saving, diversification, livelihood security, quality food, etc., hence considered as a sustainable farming system. Therefore, various fish-based IFS models are being tried.

### Development and assessment of goat-based integrated farming models

Black Bengal goats were reared and integrated with other components viz. crop, vegetables, and fishes at the institute research farm. The number of goats had increased from an initial folk of 18 to 51 with an average litter size of 1.65, and the ratio of male: female kids born at the farm as 0.94:1. Yield obtained from kharif paddy and fish component were 2175 kg, and 284 kg, respectively. From this, total revenue of ₹ 18875, 55000 and 42600 were obtained from the goat, crop and fish components, respectively.

## Improving livelihood of small farmers through good practices in agriculture, fisheries and animal husbandry- FFP

Extension activities under the Farmers FIRST Programme (FFP) were carried out in the Tetariya block of East Champaran district which is highly vulnerable to floods with very poor to non-existent agricultural extension activities. Extension activities were conducted in four large villages – Ujheelpur, Hasanpur, Naraha Mallah Tola and Hanuman Nagar. Two varieties of wheat seeds e.g. HD 2967 and HD 3086 were distributed among 260 farmers. Similarly, paddy variety (Sarju 52) was provided to 245 farmers. Additionally, other seeds like moong (var. IPM 2-14), and vegetable seeds (consisting of okra, smooth gourd, ridged gourd, tori, pumpkin, cucumber) were provided to 265 & 185 farmers, respectively. Fertilizers like urea, zinc sulphate and MOP were provided to 168 farmers in different quantities in different villages, based on their holding size. Twenty-five SC farmers of were provided with two goats (Black Bengal) each under SCSP funds. One animal health camp was conducted in FFP village. Two training programs on mushroom cultivation were organized for farmers.

## Development of fish based integrated farming system model for water congested ecologies of Eastern India

The integrated fish farming approach envisages the integration of fish farming with livestock, birds, or agricultural and horticultural crops in such a manner that allows wastes generated from one system can be used as inputs in another system. Through traditional fish farming systems, fish productivity in India varies from 1.0-1.5 t $ha^{-1}$ $yr^{-1}$. However, with suitable scientific interventions, it has evidently been increased to many folds. The benefits of integrated fish farming include enhanced rural employment and income, improved food, nutritional and health security, diversification, water and nutrient recycling, and environment friendly.

## Research projects Publication, awards and Recognitions

Scientists of ICAR-MGIFRI are working on 8 institute project, 2 externally funded projects, SCSP project and 3 newly approved projects. During 2021, scientists from this institute have published 17 research papers, 11 book chapters, and 5 popular articles/ technical bulletins. Scientists have been recognized with awards, honours and recognitions.

## HRD, training & capacity building

Our 3 staffs received training on various topics from different organizations; ICAR-MGIFRI conducted 16 training/ on field demonstration programs, 18 different events including programs under *Azadi Ka Amrut Mahotsav* for farmers benefiting 2884 farmers.

## Swachha Bharat Abhiyan

All the concerned persons of ICAR-MGIFRI participated actively in *Swachha Bharat Abhiyan* and 40 cleaning events, 5 *Swachhata* awareness campaigns were conducted during 2021 at the Institute premises, public places and villages. Simultaneously, campaigns were organized to motivate neighboring village people and, students for cleanliness.

# *Contents*

# Introduction

The ICAR-Mahatma Gandhi Integrated Farming Research Institute (erstwhile National Research Center on Integrated Farming) was established on 21st August 2015 with the aim to cater the research and development on integrated farming system at the national level. The institute is located at Piprakothi, Bihar on a 25 acre of land along with its main office-cum-laboratory building, guest house and auditorium building. It is situated about 138 km north of Patna railway station and at about 143 km away from Jayprakash Narayan International Airport, Patna. The location of the Institute is at 26°32' N, 84°56' E. The research farm is located within the main institute complex with an area of 8.4 ha. The foundation stone laying ceremony of the Mahatma Gandhi Integrated Farming Research Institute (MGIFRI) was held at Piprakothi, Motihari on 21st August, 2015, and the stakeholders meeting held at Patna on 17th September, 2015. An area of 25 acres (10 ha) was demarcated for the new institute which has been handed over by the state government. The site is adjacent to the national highway leading to Lucknow. Consequent to the transfer of land, the construction of office building and that of the farmer training hall and hostel was initiated by the CPWD and NPCC, respectively. The construction of office-cum-lab building as well as the boundary wall of the institute and farm area development were initiated in June, 2017. The research farm of the Institute has been developed over 5.1 ha area. In May 2017, six scientists joined in the institute and the camp office of the institute was initiated at KVK, Piprakothi, Motihari w.e.f. 1st July 2017. Administration staffs of ICAR-RCER, Patna were handling MGIFRI files at their office. The foundation stone laying ceremony of Farmers Hostel & Training Hall was done. A bronze statue of Mahatma Gandhi was installed at the institute on the eve of his 150th Jayanti on 2nd October, 2018.

Flood is a natural disaster, which causes damage in vast areas, and destruction in the infrastructure, human settlements, public life and the economy. India is particularly prone to floods and the major flood-prone area is about 41.13 million ha, which is about 13% of 329 million ha of the geographic area as per a reliable estimate. It is a misery to about 113 million people i.e., about 9% of the population in India. Major flood-prone states in the country are Uttar Pradesh, Bihar, Assam, West Bengal and Odisha (Fig. 1).

In eastern India, waterlogging problems are associated mainly due to riverine, cyclonic floods and, flash floods. In Bihar, waterlogging problem is the most serious and it occurs in about 0.8 million ha every year due to flooding from Nepal-based rivers viz. Gandak, Burhi Gandak, Bagmati, Koshi, Kamla-Balan etc. In Bihar, 28 districts out of 38 are flood-prone, and 15 are the most vulnerable

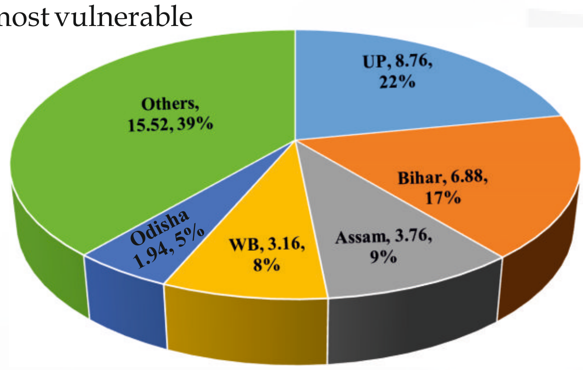



**Fig. 1: Major flood-prone states in the country with area and percent of the total flood-prone area**

accounting for 17% of total flood-affected area of the country. Some of the major causes of waterlogging in the Gandak command include release of excess water during monsoon season in the canal system, superfluous irrigation supplies, over-irrigation, seepage from canals, causing rise in the water table, accumulation of rain and floodwaters in depressed land, silting and weed growth in canals, unfavourable outfall conditions and lack of surface/ subsurface drainage. Hence, natural resource management of these agroecosystems is very challenging for sustainable agricultural development and farmers' welfare. Rivers carry a high volume of discharges and sediments from the Himalayas. South Bihar also is heavily affected by excess discharges in the Ganga tributaries. About 57% of the total flood-affected people in the country belong to Bihar, out of which 76% reside in north Bihar. In north Bihar, about 76% of the land is flood-affected. In Odisha, cyclonic floods are devastating; consequently, large tracts of cultivable lands are under waterlogging of different depths and also the problems of salinity. The productive potential of those lands is lying untapped.

## Objectives

- To develop and demonstrate location-specific and farmer-centric integrated farming system models involving fishery and animal components.
- To act as a repository of information on all aspects of integrated farming.
- To facilitate and promote coordination and dissemination of the technology for integrated farming through network /consortia approach involving ICAR institutes, state agricultural universities, and other agencies.
- To provide scientific leadership and act as a center for vocational as well as advanced training to promote the technologies related to integrated farming.
- To collaborate with relevant national and international agencies in liaison with state and central government departments for technology dissemination.
- To provide need-based consultancy and advisory support in promoting integrated farming.

## Mandates

- Adaptive research for location-specific integrated farming system models, giving emphasis on fishes and animals components for flooded, flood-prone and wetland ecology.
- Centre for vocational and advanced training to the farmers to promote fish-based integrated farming systems.

## Five-major action areas

- Delineation, situation analysis and mapping of flood-prone, flood-affected and waterlogged areas
- Characterization and monitoring of soils and nutrient status of water congested ecologies
- Design and development of IFS technology / packages/ model for water congested ecosystems
- Post-flood crop management, design and development of efficient water management technology
- Capacity building of farmers and other stakeholders on different components of IFS

# ORGANOGRAM

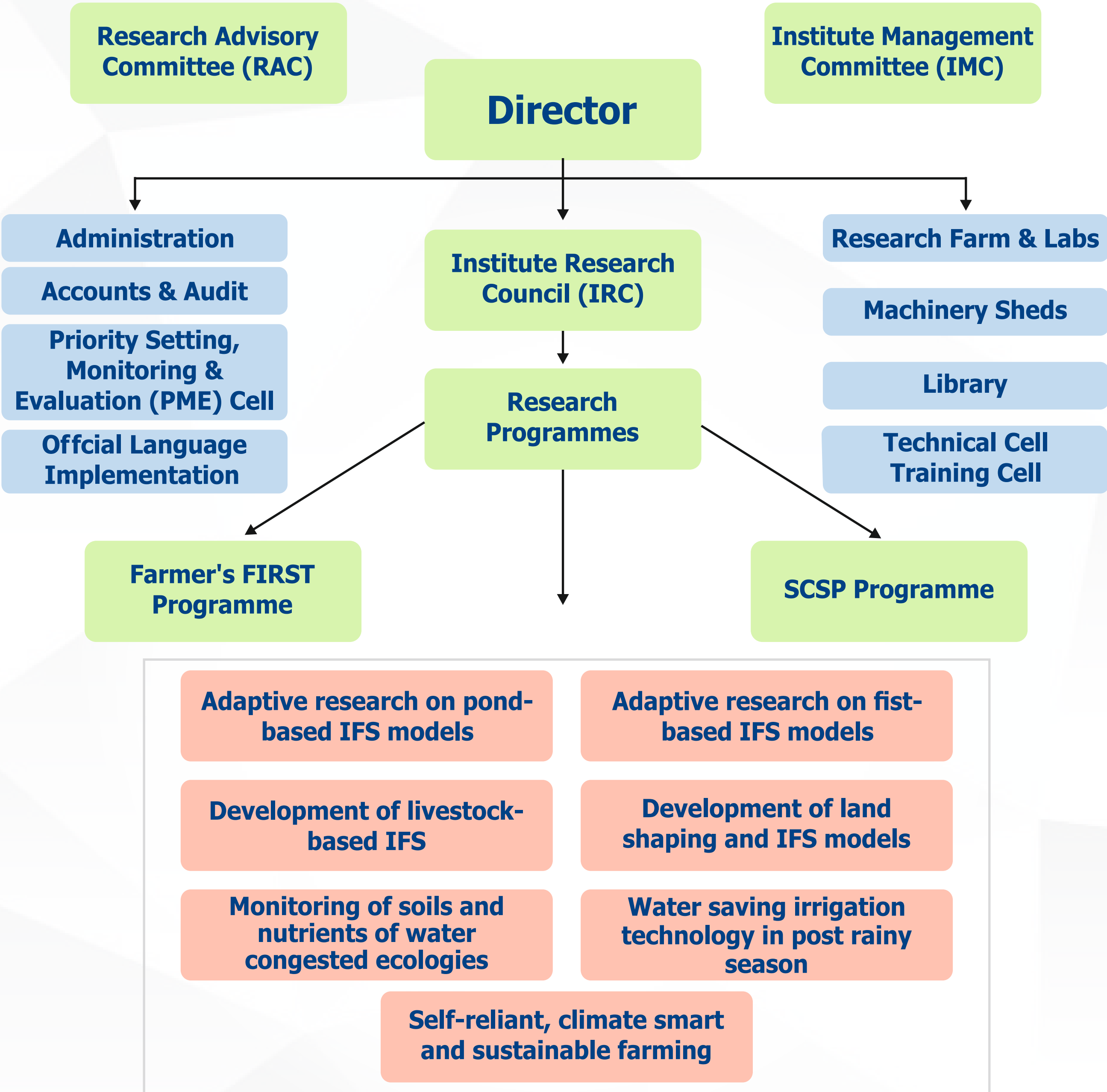



Fig. 2: Organogram of ICAR-MGIFRI

# Research Achievements (Institute Projects)

## Development of Horti-Based Farming System Model for Low-Lying Areas of Bihar

**Principal Investigator: Dr. S.K. Purbey**

**Co-investigators: Dr. P.K. Bharti, Dr. A.K. Singh, Dr. Shreya Nivesh, Er. Vikas Paradkar, Dr. S.K. Samal, Mr. Ravi Kumar, Dr. Koushik Banerjee, Dr. K.G. Mandal**

Due to the geographical position, most of the part of Bihar is under waterlogging conditions. In many places, waterlogging condition is found on permanent or seasonal basis. In low-lying areas, water is available near the earth surface seasonally and remains for 4-5 months. This depth of waterlogging is found more during monsoon season, thus, making lands unproductive during *kharif*. This type of land is used less frequently during *rabi* season as well. Managing this excess water and waterlogged land is challenging. Restoration of such lands is possible through various techniques of land modifications, e.g. surface drainage, making ridges and furrows (Fig. 3 & 4) and recycling of surplus water. Aiming this, a project has been initiated to modify land based on the depth of waterlogging i.e., 1.0 m, 1.4 m, and 1.8 m. Accordingly, three different types of land shaping/ land modification techniques are designed (heights/ depth of raised/ sunken bed/ bund). To get more economic output from the land area, different field crops and vegetables are planted in the raised bed keeping various fruit crops along the boundaries of the raised bed (Fig. 3). Depending on the depth of water, different fish species, water chestnut and *makhana* were integrated into the sunken beds. During the last year, performance of field crops particularly maize and pigeon pea was found better than vegetable crops on newly developed raised beds. However, among the vegetable crops, brinjal and okra showed better performance during *kharif* season in 2021. Due to availability of highest depth of water, the production as well as economic return from field and vegetable crops per unit area from the raised bed having 1.8 m water depth was found more than 1.4 m and 1.0 m water depth. Similarly, total production of fish was also found more in sunken bed with 1.8 m depth of water. The survival and growth of jamun (87.33%, 54.89 cm), guava (92.33%, 45.19 cm), drumstick (83.67%, 124.87 cm) was found better than mango, bael, papaya and citrus. The productivity and profitability of red and green water chestnuts (*Eleocharis dulcis*), was found better in sunken bed having 1 m depth of water (Fig. 4). Around 210 kg of water chestnut fruit was harvested within a period of 5 months from the sunken bed. However, the project is at its initial stage, the output and outcome from the project may be useful in near the future.

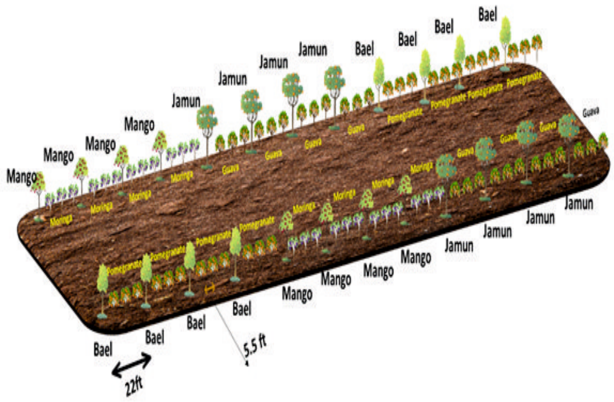



**Fig. 3: Layout of raised bed**

Fig. 4: Water chestnut crop and fish harvesting in sunken bed

## Development and Assessment of Fish-Based Integrated Farming Models Under Floodplain Ecosystems

**Principal Investigator: Mr. Ravi Kumar**

**Co-Investigators: Dr. P.K. Bharti, Dr. S.K. Purbey, Dr. S.K. Samal**

A fish-based IFS model comprised of fish, poultry and on dyke fruit plants (guava, banana and lemon) was established at the research farm of the institute. The total area of the IFS model is 3000 $m^2$, and pond water surface area is 2400 $m^2$. Fish fingerlings of *catla* (30%), *rohu* (20%), grass carp (20%), *mrigal* (15%) & common carp (15%) were stocked together at the rate of 10000 $ha^{-1}$ in the month of March 2021 with an average body weight of 50 g. The chicks ('*Vanraja*') 400 numbers with an average body weight of 120 g were integrated with the IFS model and kept in a *pucca* house constructed over the pond dyke in a corner. The fruit plantation i.e. 15 numbers of guava (var. 'L49'), 20 numbers of lemon (seedless & *kagazi lime*) and 66 numbers of banana (var. 'G9') was done over the pond dyke. Basal dose of fertilizers and manure were applied to the fish pond for the development of plankton. Decomposed poultry manure was also applied in the pond on a quarterly basis for continuous natural fish food production. Supplementary fish feed i.e. rice bran, mustard oilcake and pelleted fish feed were given at the rate of 1% only of the total fish biomass on daily basis. Netting and liming were done following standard practices. Concentrated poultry feed was given at the rate of 30 to 80 g per bird per day. Pond water quality parameters i.e. pH, temperature, alkalinity, hardness, dissolved oxygen and electrical conductivity were measured throughout the culture period (Table 1 & 2). After culture period of one year, the total fish production was recorded as 1362.2 kg, and fish productivity as 5675.81 kg $ha^{-1}$. Further, 350 kg of poultry-meat and 4374 number of eggs were produced. Moreover, fruit crops over the pond dykes produced 50 kg, 15 kg (320 nos.) and 500 dozens of guava, lemon and banana, respectively (Fig. 5, 6, 7 &8).

**Table 1: Pond water parameter**

| Parameter | Mean±SD |
|---|---|
| pH | 8.24±0.36 |
| Temperature (°C) | 23.8±8.61 |
| Alkalinity (ppm) | 168.21±8.27 |
| Hardness (ppm) | [illegible] |
| DO (ppm) | 5.23±0.82 |
| EC (dS/ cm) | 0.0164±0.0046 |

**Table 2: Fish growth, survival and production**

| Fish species | No. stocked | Mean wt at stocking (g) | No. recovered | Survival (%) | Avg. wt. (g) at harvesting | Biomass (kg) |
|---|---|---|---|---|---|---|
| Catla | 720 | 64.4±5.2 | 645 | 89.6 | 810.4±42.1 | 522.71 |
| Rohu | 480 | 55.4±3.8 | 410 | 85.4 | 502.4±26.9 | 205.98 |
| Grass carp | 480 | 75.1±6.1 | 402 | 83.8 | 805.3±36.5 | 323.73 |
| Mrigal/ Naini | 360 | 30.5±3.8 | 320 | 88.9 | 415.5±16.3 | 132.96 |
| Common carp | 360 | 30.0±4.2 | 345 | 95.8 | 512.5±21.4 | 176.81 |
| Total fish biomass (kg) | | | | | | 1362.20 |

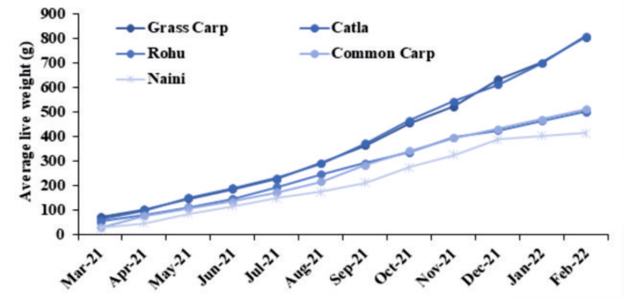



**Fig. 5: Growth of stocked fish species**

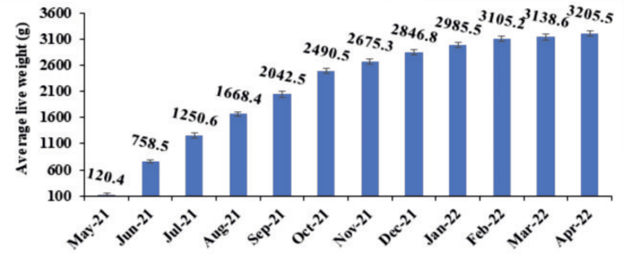



**Fig. 6: Growth of poultry**

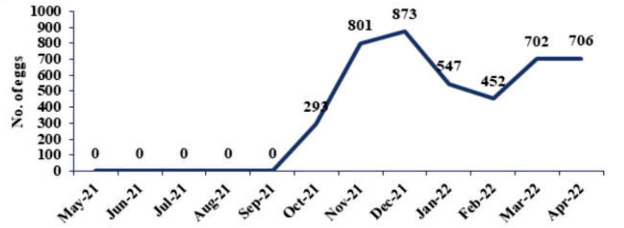



**Fig. 7: Egg production trend**

**Fig. 8: Pictures of different components under fish-based IFS model**

# Development and Assessment of Goat Based Integrated Farming Models in Wetland Ecosystem

**Principle Investigator: Dr. P.K. Bharti**

**Co-Investigators: Mr. Ravi Kumar, Dr. S.K. Samal, Dr. S.K. Purbey, Dr. A.K. Singh**

A study on the development and assessment of goat-based integrated farming system was carried out at the institute research farm. In the IFS model, the goat breed, 'Black Bengal', (Fig. 9) was reared and integrated with other important components viz. crop, vegetables and fish unit. The initial flock strength of goats was 18 (2 males and 16 females). A total of 20 kidding occurred during the reported period and 33 kids were added to the farming system, hence gross flock strength reached 51 with an average litter size of 1.65 and the ratio of new born male: female kids were 0.94:1. The average birth weight of male and female kid was 1.54 kg and 1.38 kg, respectively. The total loss of animals due to mortality and stillbirth was eight (2 adults, 3 kids, 3 stillbirths). The total revenue generated from the sale of live goats was ₹18, 875. In this project, we studied yield potentiality other components, which include field crops, vegetables, and fodder during *rabi*, *zaid* and *kharif* seasons. During *kharif*, paddy was cultivated in 3900 $m^2$ area with a net yield of 2175 kg. In *rabi* season a considerable yield of lentil was obtained. Total revenue generated from crop component was approximately ₹ 55,000/-. Construction of raised and sunken bed, goat housing, grazing area and fish production units were completed (Fig. 10 & 11).A total of 284 kg of fish was harvested which generated an economic return of ₹.42,600/-.

**Fig. 9: Kids of 'Black Bengal' born at farm and grazing in open field**

**Fig. 10: Construction work for raised bed and trenches near goat shed for grazing during water logged condition (total area 900 $m^2$)**

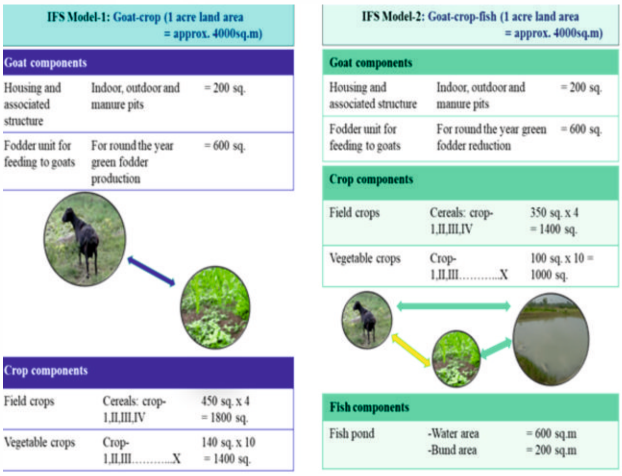



**Fig. 11: Area allocation plan and flow diagram for recycling of nutrients**

## Enhancing Sugarcane (Hybrid Complex) Productivity through Zinc Application with Organic Manures in Calcareous Soil

**Principle Investigator: Dr. A.K. Singh**

**Co-investigators: Dr. Kirti Saurabh**

Field experiments were conducted at the institute research farm during spring, 2018-19 to 2020-21, for three consecutive years. The experimental soil was sandy loam in texture and had pH 8.46, organic carbon 0.67% and available N, P and K 236.03, 6.35 and 71.71 kg $ha^{-1}$, respectively. It had DTPA extractable Zn 0.60 mg $kg^{-1}$. The experiment consisting of twelve treatments, as mentioned in Table 2 was laid out in a randomized block design with three replications using sugarcane variety 'Co 0238'.

### *Growth and yield of sugarcane*

Experimental data revealed that application of zinc at first irrigation in FYM or press mud cake (PMC) applied plots, or application of Zn 15 days after turning of green manure of sesbania (GMS) as an intercrop between sugarcane rows to the soil, being at par, produced significantly higher cane yield compared with other treatments (Table 3). The cane yield thus obtained under FYM, PMC and GMS plots along with Zn application were 20.0, 18.4 and 15.3% higher than that of recommended application of Zn; and 39.7, 37.7 and 34.1% higher than that of control (without Zn application), respectively. A similar trend was obtained for the effect of treatments on number of shoots, millable canes and yield attributes (Fig. 12) viz., cane length, girth and single cane weight, where the application of FYM, PMC or GMS followed by application of Zn proved beneficial (Table 2). Treatment of sugarcane set by dipping in 30% solution of Zn sulphate (33% Zn) for 15 minutes recorded significantly least germination and resulted in significantly least yield which was 53.9% lower than that of recommended application of Zn.

### *Juice quality and sugar yield*

The final product of cane is sugar, which is governed by juice quality. The data (Table 3) on juice quality, viz purity and CCS (%) clearly indicated that it was significantly affected by the different method of zinc application with organic manures. The highest purity (88.28%) and CCS (12.13%) in juice were recorded with the application of Zn at 15 days after turning in green manure of Sesbania as intercrop between sugarcane rows and application of Zn at first irrigation in FYM applied plots, respectively, however it was at par with most of the application method of Zn with organic manures or organic manures alone. The sugar yield, which is a function of quality and cane production was found to be the highest (11.86 t $ha^{-1}$) with application of Zn at first irrigation in FYM applied plots and this method being at par with application of Zn at first irrigation in PMC applied plots and application of Zn at 15 days after turning of green manure of *Sesbania* as intercrop between sugarcane rows, recorded significantly higher sugar content over all other treatments.

### *Soil fertility status of soil*

The fertility status of soil was recorded both initially and after the harvesting of sugarcane. The result showed significant effect in soil fertility status in terms of Zn application with organic manures that of organic manures alone (Table 4). Application of Zn at irrigation in FYM applied plots showed significantly higher soil organic content, available Zn, N, P and K compared to other treatments, however, it was at par with application of Zn at first irrigation in FYM applied plots for soil organic carbon and available soil N. Soil organic content, available soil Zn, N, P and K content under treatment (application of Zn at first irrigation in FYM applied plots, Fig. 12) was 0.85%, 1.64 ppm, 243.99, 10.20 and 112.51 kg ha$^{-1}$, respectively, as against respective initial values of 0.67%, 0.59 ppm, 236.03, 6.35 and 77.71 kg ha$^{-1}$.

### *Economics*

The monetary benefits, calculated on the basis of prevailing market prices and expenditure incurred (Table 5), revealed highest net return (₹ 1,39,353 ha$^{-1}$) as well as B:C ratio (1.88) when Zn was applied at 15 days after turning of green manure of Sesbania as intercrop between sugarcane rows, followed by application of Zn at first irrigation in FYM applied plots in term of net

Cane set treatment before planting

Field view - growth stage-1

Green manuring of Sesbania in sugarcane

Field view at growing stage-2

Field view at maturity stage

Application of Zn at first irrigation in FYM applied plots

Aapplication of Zn at first irrigation in PMC applied plots

Application of Zn 15 days after turning of green manure of *Sesbania* as intercrop between sugarcane rows

**Fig. 12: Different stages of sugarcane development and comparison among the treatments applied**

return (₹13,5597 ha$^{-1}$) and application of Zn at first irrigation in PMC applied plots in terms of B:C ratio (1.79). Thus percent increase in B:C ratio and net return under treatments application of Zn 15 days after turning of green manure of *Sesbania* as intercrop between sugarcane rows, application of Zn at first irrigation in FYM and PMC applied plots was recorded as 8.0 and 27.3, 2.3 and 23.8, and 2.9 and 23.4, respectively, over recommended application of Zn.

### Table 3: Effect of zinc application methods on growth and yield attributes of sugarcane (pooled data of three years)

| Treatment | Germination (%) | No. of shoots ('000/ha) | No. of millable canes ('000/ha) | Cane length (m) | Cane girth (cm) | Single cane weight (kg) |
|---|---|---|---|---|---|---|
| T$_1$- PMC + Zn-1$^{st}$ Irrigation | 46.05$^{ab}$ | 151.1$^{a}$ | 108.4$^{a}$ | 2.90$^{ab}$ | 2.8$^{ab}$ | 1.46$^{ab}$ |
| T$_2$- FYM + Zn-1$^{st}$ Irrigation | 47.54$^{a}$ | 154.8$^{a}$ | 110.8$^{a}$ | 2.97$^{a}$ | 2.9$^{a}$ | 1.52$^{a}$ |
| T$_3$- GM + Zn- 15 DAGMI | 43.12$^{bcd}$ | 148.6$^{a}$ | 106.5$^{a}$ | 2.87$^{abc}$ | 2.8$^{ab}$ | 1.39$^{b}$ |
| T$_4$- Zn-Basal | 44.39$^{abcd}$ | 124.2$^{cde}$ | 86.1$^{cd}$ | 2.74$^{bcde}$ | 2.7$^{bcd}$ | 1.21$^{de}$ |
| T$_5$- Zn-1$^{st}$ Irrigation | 45.48$^{abc}$ | 119.1$^{ef}$ | 82.8$^{d}$ | 2.66$^{def}$ | 2.6$^{cd}$ | 1.18$^{de}$ |
| T$_6$- Zn- 15 DAGMI | 41.69$^{cd}$ | 117.3$^{ef}$ | 81.3$^{d}$ | 2.64$^{ef}$ | 2.6$^{cde}$ | 1.14$^{e}$ |
| T$_7$- Zn- Foliar Spray | 41.60$^{cd}$ | 122.1$^{def}$ | 84.7$^{cd}$ | 2.70$^{cdef}$ | 2.7$^{bcd}$ | 1.20$^{de}$ |
| T$_8$- Zn- Set | 19.27$^{e}$ | 47.3$^{g}$ | 36.1$^{f}$ | 2.65$^{ef}$ | 2.6$^{de}$ | 1.24$^{cd}$ |
| Treatment | | | | | | |
| T$_9$- PMC | 42.44$^{bcd}$ | 133.4$^{bc}$ | 94.2$^{b}$ | 2.81$^{abcde}$ | 2.7$^{abcd}$ | 1.26$^{cd}$ |
| T$_{10}$- FYM | 43.59$^{abcd}$ | 135.5$^{b}$ | 96.4$^{b}$ | 2.83$^{abcd}$ | 2.8$^{abc}$ | 1.30$^{c}$ |
| T$_{11}$- GM | 42.26$^{bcd}$ | 130.7$^{bcd}$ | 91.7$^{bc}$ | 2.77$^{bcde}$ | 2.7$^{abcd}$ | 1.25$^{cd}$ |
| T$_{12}$ - Control (RF) | 40.93$^{d}$ | 111.8$^{f}$ | 73.2$^{e}$ | 2.54$^{f}$ | 2.5$^{e}$ | 1.03$^{f}$ |
| CD (5%) | 4.08 | 10.88 | 7.15 | 0.18 | 0.17 | 0.08 |

**Table 4: Effect of zinc application methods on cane yield, juice quality parameters and sugar yield at harvest of sugarcane (pooled data of three years)**

| Treatment | Cane yield (t ha$^{-1}$) | Brix (%) | Purity (%) | CCS (%) | Sugar yield (t ha$^{-1}$) |
|---|---|---|---|---|---|
| $T_1$- PMC + Zn-1$^{st}$ Irrigation | 96.06$^{a}$ | 19.73 | 88.14$^{ab}$ | 12.02$^{ab}$ | 11.59$^{a}$ |
| $T_2$- FYM + Zn-1$^{st}$ Irrigation | 97.39$^{a}$ | 19.88 | 88.23$^{a}$ | 12.13$^{a}$ | 11.86$^{a}$ |
| $T_3$- GM + Zn- 15 DAGMI | 93.52$^{a}$ | 19.66 | 88.28$^{a}$ | 12.01$^{ab}$ | 11.27$^{a}$ |
| $T_4$- Zn-Basal | 81.13$^{b}$ | 19.49 | 87.81$^{abcd}$ | 11.80$^{abc}$ | 9.60$^{b}$ |
| $T_5$- Zn-1$^{st}$ Irrigation | 79.29$^{b}$ | 19.31 | 87.38$^{cde}$ | 11.61$^{abc}$ | 9.23$^{b}$ |
| $T_6$- Zn- 15 DAGMI | 78.72$^{b}$ | 19.28 | 87.49$^{bcde}$ | 11.62$^{abc}$ | 9.17$^{b}$ |
| $T_7$- Zn- Foliar Spray | 80.13$^{b}$ | 19.46 | 87.84$^{abcd}$ | 11.80$^{abc}$ | 9.47$^{b}$ |
| $T_8$- Zn- Set Treatment | 37.41$^{d}$ | 19.18 | 86.93$^{e}$ | 11.44$^{c}$ | 4.29$^{d}$ |
| $T_9$- PMC | 83.21$^{b}$ | 19.37 | 87.87$^{abcd}$ | 11.74$^{abc}$ | 9.80$^{b}$ |
| $T_{10}$- FYM | 83.94$^{b}$ | 19.49 | 87.99$^{abc}$ | 11.84$^{abc}$ | 9.96$^{b}$ |
| $T_{11}$- GM | 82.39$^{b}$ | 19.33 | 87.72$^{abcd}$ | 11.69$^{abc}$ | 9.65$^{b}$ |
| $T_{12}$ - Control (RF) | 69.73$^{c}$ | 19.22 | 87.28$^{de}$ | 11.54$^{bc}$ | 8.06$^{c}$ |
| CD (5%) | 5.47 | NS | 0.67 | 0.56 | 1.10 |

**Table 5: Effect of zinc application methods on nutrient content in soil at harvest of sugarcane (pooled data of three years)**

| Treatment | OC (%) | Zn (ppm) | N (kg ha$^{-1}$) | P (kg ha$^{-1}$) | K kg ha$^{-1}$) |
|---|---|---|---|---|---|
| Initial mean value | 0.67 | 0.59 | 236.03 | 6.35 | 77.71 |
| T1- PMC + Zn-1st Irrigation | 0.83$^{ab}$ | 1.64$^{b}$ | 243.99$^{ab}$ | 10.20$^{c}$ | 112.51$^{b}$ |
| T2 - FYM + Zn-1st Irrigation | 0.85$^{a}$ | 1.70$^{a}$ | 249.98$^{a}$ | 11.76$^{a}$ | 118.82$^{a}$ |
| T3 - GM + Zn- 15 DAGMI | 0.81$^{bc}$ | 1.60$^{b}$ | 237.18$^{bc}$ | 9.17$^{d}$ | 104.62$^{c}$ |
| T4 - Zn-Basal | 0.73$^{f}$ | 1.31$^{e}$ | 205.92$^{f}$ | 6.97$^{g}$ | 83.59$^{f}$ |
| T5 - Zn-1st Irrigation | 0.70$^{g}$ | 1.15$^{f}$ | 197.45$^{g}$ | 6.54$^{h}$ | 80.50$^{fg}$ |
| T6 - Zn- 15 DAGMI | 0.69$^{gh}$ | 1.08$^{g}$ | 195.04$^{gh}$ | 6.35$^{hi}$ | 79.02$^{g}$ |
| T7 - Zn- Foliar Spray | 0.70$^{g}$ | 1.05$^{g}$ | 199.01$^{fg}$ | 6.14$^{i}$ | 74.89$^{h}$ |
| T8 - Zn- Set Treatment | 0.67$^{hi}$ | 0.87$^{h}$ | 193.47$^{gh}$ | 6.07$^{i}$ | 70.79$^{i}$ |
| T9 - PMC | 0.78$^{de}$ | 1.42$^{d}$ | 222.81$^{d}$ | 8.78$^{e}$ | 96.96$^{d}$ |
| T10 - FYM | 0.80$^{cd}$ | 1.47$^{c}$ | 230.43$^{c}$ | 11.25$^{b}$ | 101.48$^{c}$ |
| T11 - GM | 0.77$^{e}$ | 1.38$^{d}$ | 215.16$^{e}$ | 8.05$^{f}$ | 93.04$^{e}$ |
| T12 - Control (RF) | 0.66$^{i}$ | 0.50$^{i}$ | 189.88$^{h}$ | 5.62$^{j}$ | 75.33$^{h}$ |
| CD (5%) | 0.02 | 0.04 | 7.31 | 0.31 | 3.61 |

**Table 6: Economics of different Zn application methods in sugarcane (mean of three years)**

| Treatments | Cost of cultivation (₹/ha) | Net returns (₹/ha) | B:C ratio |
|---|---|---|---|
| $T_1$- PMC + Zn-1$^{st}$ Irrigation | 1,70,846 | 1,35,105 | 1.79 |
| $T_2$- FYM + Zn-1$^{st}$ Irrigation | 1,74,610 | 1,35,597 | 1.78 |
| $T_3$- GM + Zn- 15 DAGMI | 1,58,395 | 1,39,353 | 1.88 |
| $T_4$- Zn-Basal | 1,48,148 | 1,09,493 | 1.74 |
| $T_5$- Zn-1$^{st}$ Irrigation | 1,47,532 | 1,04,117 | 1.71 |

| | | | |
|---|---|---|---|
| $T_6$ - Zn- 15 DAGMI | 1,47,336 | 1,02,424 | 1.70 |
| $T_7$ - Zn- Foliar Spray | 1,47,416 | 1,06,957 | 1.73 |
| $T_8$ - Zn- Set Treatment | 1,33,792 | -15,004 | 0.88 |
| $T_9$ - PMC | 1,64,327 | 1,00,041 | 1.61 |
| $T_{10}$ - FYM | 1,67,905 | 98,870 | 1.59 |
| $T_{11}$ - GM | 1,52,444 | 1,09,288 | 1.72 |
| $T_{12}$ - Control (RF) | 1,42,149 | 78,743 | 1.56 |

**Selling Price:**
**2018-19: Sugarcane- ₹ 300/100 kg, Sugarcane top: ₹ 65/100kg**
**2019-20: Sugarcane- ₹ 310/100 kg, sugarcane top- ₹ 67/100 kg**
**2020-21: Sugarcane- ₹ 320/100 kg, sugarcane top- ₹ 70/100 kg**

## Development of Organic Rice-Fish-Duck IFS Model in Waterlogging Situations of North Bihar

**Principle Investigator: Dr. A.K. Singh**

**Co-Investigator: Mr. Ravi Kumar, Dr. S.K. Purbey, Dr, S.K. Samal, Dr. Shreya Nivesh, Dr. K.G. Mandal**

In North Bihar, about 76% of the land is flood-affected and waterlogged condition resulting into large tracts of cultivable lands unproductive. Flooding and waterlogging of different depths and duration also creates the problem of salinity. Rice is grown in rainfed uplands to deep-water areas with many intermediate situations. The diverse ecological situations, varying climatic conditions along with socio-economic diversities make rice cultivation a risky option, resulting in overall poor productivity of land in the state as compared to its high potentiality. The productive potential of those lands is lying untapped. Managing waterlogging situations is one of the challenging tasks under natural resource management. Integration of fishes, animal component, aquatic and horticultural crops hold promise ensuring food and nutrition security to farmers in waterlogged ecosystems

There are very little information available on organic farming of rice-fish culture, suitable location-specific varieties/species of rice and fish system in waterlogged condition of North Bihar. Moreover, inconvenience faced in pesticide application, design and management strategies to enhance the system productivity of rice-fish farming need to be addressed for varying ecosystems. Keeping these in view, a research project has been proposed and was approved in 3rd IRC meeting to evaluate rice–fish integration system in North Bihar waterlogging situations with special reference to organic farming along with developing rice-fish based IFS model with following objectives:

- To evaluate organic farming in rice-fish-duck integrated culture.
- To assess the fish growth, survival, production, productivity, plankton abundance and occurrence.
- To study the soil-water environment, productivity, economics and energy efficiency of rice-fish-duck co-culture.

Activity for developing an experimental IFS model has been initiated having components of crop production, fish production, duckery, vegetables, and fruit plants and composting unit. The model will be developed and evaluated. The experimental model layout design includes wide bunds (dykes) all around the IFS model (Fig. 13), a pond refuge (water harvesting come fish refuge system), rice/other crop in main crop land and composting/ vermicomposting unit.

The project site was selected to establish the IFS model. Integrated organic rice–fish-duck production system may help to compensate for the economic losses in rice production brought about by natural calamities as well as it may generate additional income from the system. It may also optimize water and land productivity; and may help in food, nutritional and livelihood security without bringing about environmental degradation.

**Fig. 13**: **Developing organic rice-fish-duck IFS model at MGIFRI**

## Delineation and Characterization of Flood-Prone and Waterlogged Areas of Eastern India and Development of IFS Plans

**Principle Investigator: Dr. Koushik Banerjee Co-Investigators: Dr. Shreya Nivesh, Er. Vikas Paradkar, Dr. S.K. Samal, Mr. Ravi Kumar, Dr. S.K. Purbey, Dr. K.G. Mandal**

Agricultural interference in waterlogged/ flood-prone areas is challenging. It is a major researchable issue as waterlogging causes land degradation making it unproductive. Excess water changes the physical, chemical and microbiological properties of waterlogged soils. India has approximately 11.6 M ha i.e. 8.3% of its net sown area under waterlogged condition (Planning Commission 2011) out of which more than 20% falls in the eastern region where surface waterlogging is a major cause rendering the area unproductive. Eastern India, especially the entire states of Bihar, West Bengal and parts of Odisha constitute a significant chunk of the Ganga- Meghna-Brahmaputra (GMB) basin, and a home to 500 million of the world's poorest people (Planning Commission of India). Waterlogging deteriorates the quality and efficiency of scarce land resources as well as human resources. It results in considerable decline in crop yields and salinity of soil besides deterioration in the general health of the people residing in the waterlogged areas. Thus, in order to maintain the quality and efficiency of land and human resources, the study of the problem of waterlogged areas is very important. A proper assessment of these waterlogged areas is a prerequisite for finding a solution to the problem. Delineation of waterlogged areas in Eastern Indian states and implementation of an integrated farming system model in waterlogged areas warrants attention. Remote sensing tools along with Geographical Information Systems (GIS) provide a powerful alternative to conventional mapping techniques in the assessment and mapping of surface waterlogged areas. Simultaneously, characterization of waterlogged areas in Eastern India is crucial for adopting integrated farming strategy which otherwise remains fallow or has poor productivity. Horticultural plants with shorter duration and high water requiring crops can be used to remove excess water from recharge zone or to lower the water table in waterlogged areas. Simultaneously fish farming using in the waterlogged areas will be a suitable alternative in increasing productivity of both the land and water. Therefore, this project was selected to delineate and characterize flood-prone and waterlogged areas of Eastern India.

# Evaluation of Irrigation Water Saving Techniques in Winter Maize Under N Bihar Conditions

**Principle Investigator: Dr. Shreya Nivesh**

**Co-Investigators: Dr. Koushik Banerjee, Dr. A.K. Singh, Dr. S.K.Samal, Er. Vikas Paradkar**

The plains of North Bihar, drained by numerous rivers originating in the Himalayas also experience a reasonably high rainfall of ~1200 mm per year. However, more than 80% of the irrigation demand in this region is met by groundwater resources. Maize is one of the dominating crops of Bihar after rice and wheat. Bihar is the third largest maize producing state contributing around 14% to national production. Cultivation of maize provides livelihood to about 1.3 million farmers in Bihar, majority of whom are marginal and small farmers. Maize is sensitive to both moisture stress and excessive moisture. Therefore, water-saving irrigation methods are required to increase crop water productivity (CWP) without reducing grain yield and nutrient uptake.

Maize crop at 120 days

Maize crop at 40 days

Maize crop at 20 days

Maize crop at 90 days

Maize crop at 60 days

Maize crop at Harvesting stage of crop

**Fig. 14: Different stages of Maize grown using water saving techniques**

Field experiment was conducted with aim to identify the effective combination of furrow method and irrigation level to achieve maximum benefits in terms of water use efficiency and crop yield at ICAR-MGIFRI research farm during *rabi* season 2021-2022. The experiment consisted of total 15 treatment combinations having five irrigation methods and three irrigation levels with three replications in split plot design. Maize crop was sown on 26th November, 2021 with package of practices, and with application of 120 kg N, 60 kg $P_2O_5$ and 40 kg $K_2O$ ha$^{-1}$. Full dose of $P_2O_5$ and $K_2O$ and half of Nitrogen was applied (Fig. 14).

## Design and Development of Low-Cost Equipment and Machineries for Waterlogged Situations

**Principal Investigator: Er. Vikas Paradkar**

**Co-Investigators: Mr. Ravi Kumar, Dr. Shreya Nivesh**

In general, waterlogging condition refers to situation which happens due to presence of excess water within the crop root zone. This results in decrease in the oxygen level within the rhizosphere and creates problems of soil aeration. Hence, twin problems are observed in this ecosystem include low agricultural productivity and under-utilization of excess water. The low productivity is due to excess water stress during wet season and deficit water stress in dry season. The operational farm area in India is declining. On the other hand, to feed about 1.6 billion population by 2050, country will have to increase its food production by more than 32% of the present level. The food-producing enterprises like agriculture, horticulture, aquaculture etc. are mostly dominated by the small and marginal farmers in India. To adopt the enterprises such as aquaculture, horticulture and agriculture, needs low-cost equipment and machineries. With increasing fish production, pond water management is very much essential which demands an increase in agricultural, industrial and other requirements. Under this project, low-cost equipment and machineries for waterlogged situations will be developed.

## Estimation of Optimum Residue Retention in Rice-Wheat Cropping System Raised on Calcareous Soil of Middle Indo-Gangetic Plains

**Principle Investigator: Dr. S.K. Samal**

**Co-Investigators: Dr. A.K. Singh**

The yield of rice and wheat crop under different residue retention levels under conservation agriculture (CA) practice was compared with that of conventional tillage treatments using RBD design with three replications. The conventional tillage treatments without residue retention include farmers practice, balanced fertilization, mungbean residue incorporation and sesbania incorporation. The yield of wheat crop grown during 2020-21 varied from 3.96 to 4.81 Mg ha$^{-1}$ under different treatments (Table 7). The yield of wheat under all the CA treatments was found to be significantly lower than that of the conventional treatments except in case of farmers' practice. The yield of rice crop grown during 2021-22 varied from 3.98 to 4.47 kg ha$^{-1}$ (Table 7). The rice grain yield in all the treatments were found to be statistically at par except in case of T1, in which a significantly lower grain yield was recorded (Fig. 15).

**Table 7: Grain yield of rice and wheat as affected by different conventional CA treatment**

| Treatments | Treatment details | Wheat (kg ha$^{-1}$) | Rice (kg ha$^{-1}$) |
|---|---|---|---|
| **T1: CT-FP** | Con till; Farmers' fertilizer (NPK: 70-37-6) | 3960$^{c}$ | 3980$^{b}$ |
| **T2: CT-BF** | Con till; Bal ferti (NPKZn: 120-60-40-25) | 4810$^{a}$ | 4280$^{a}$ |
| **T3: CT-M** | T2 + mung bean green manuring | 4660$^{a}$ | 4400$^{a}$ |
| **T4: CT-S** | T2 + Sesbania green manuring | 4620$^{ab}$ | 4090$^{a}$ |
| **T5: NT-RL1** | No till; Bal ferti; rice (30%), wheat (30%), mungbean (100%) residue | 4000$^{c}$ | 4470$^{a}$ |
| **T6: NT-RL2** | No till; Bal ferti; rice (40%), wheat (40%), mungbean (100%) residue | 4010$^{c}$ | 4240$^{a}$ |
| **T7: NT-RL3** | No till; Bal ferti; rice (50%), wheat (50%), mungbean (100%) residue | 4140$^{bc}$ | 4380$^{a}$ |
| **T8: NT-RL4** | No till; Bal ferti; rice (60%), wheat (60%), mungbean (100%) residue | 4110$^{c}$ | 4000$^{ab}$ |
| **T9: CT-RL5** | T2 + 30% rice residue incorporation | 4110$^{c}$ | 4250$^{a}$ |

Fig. 15: Field view of the crops grown and residue retention

## Constraints Analysis and Performance Evaluation of Poultry Birds Reared Under Backyard System in East Chamaparan District of Bihar

**Principle Investigator: Dr. P.K. Bharti**

**Co-Investigators: Dr. S.K. Samal. Mr. Ravi Kumar**

A large part of rural people in Bihar generates their livelihood through backyard poultry farming. It is less expensive having lesser risk and high capital growth in less time. However, there is a huge gap between demand and supply of egg and poultry meat. In order to understand the constraints in backyard poultry production, the current project was imitated. As per the technical programme, village survey in East Champaran district of Bihar was carried out and farmers/poultry keepers were interviewed on various aspects of poultry production system including present status and constraints faced by them. Economic parameters like source of livelihood, land holding, family size, income from livestock and poultry, total family income and expenditure etc. were taken into consideration to study the livelihood status of the farmers. Similarly, performance parameters were identified like growth rate, dressing percentage, disease incidences, egg quality and problems faced by the farmers. The major constraints reported by the farmers were high mortality rate which ranges from 25-50% in chicks up to 1-3 weeks of age. The main disease or health problem was respiratory symptoms followed by *diarrhoea* and stunted growth in broilers. The farmers belonging to small and marginal categories reported high feed cost and low market prices of the product as the major constraints in poultry production. More than 80% farmers have not undergone training and almost all were found interested to have training or capacity building programme on scientific poultry management from state/central institution.

## Post-Harvest Losses Study of Major Fruits and Vegetables in East Champaran District of Bihar

**Principal Investigator: Dr. S.K. Purbey**

**Co-Investigators: Dr. A. Raizada**

Fruits and vegetables, in general, are perishable in nature. Due to lack of storage facilities, huge losses of fruits and vegetables are taking place over the year. It has been quantified as 30-35% accounting for an economic drain of ₹. 2.40 lakh crore annually. It has been observed that the farm gate price available to the farmers is only 25% of the retail price in India, which is much less as compared to the Netherlands and the USA (70%). Therefore, it is of paramount importance to minimize the extent of post-harvest losses at various stages of the supply chain so that management techniques, strategies and policies can be developed. Therefore, the present study is taken based on tested structural schedule i.e. questionnaire based survey. under this project, two wholesale markets at Chhatauni, Motihar and Kotwa, Motihari were surveyed and it was found that there was about 4-7% mechanical loss during transportation. Due to lack of cold storage facility at wholesale market, producers are forced to sale their produce at very low prices. The physiological losses were found around 3-5% in cauliflower, brinjal and tomato, whereas, in case of leafy vegetables it went up to 15-20%. Additionally, 30 farmers from Pipra and Chakiya block under East Champaran district were surveyed and it was found that around 11-15% losses at field level was due to attack of various insect-pest and diseases, whereas, physiological and mechanical losses were less than 5%. Socio-demographic data reveals that most of the farmers were male in the age group of 25-45 years having educational qualification up to middle school.

# Research Achievements (External Funded Projects)

## Development of Fish-Based Integrated Farming System Models for Water Congested Ecologies of Eastern India.

**Principle Investigator: Mr. Ravi Kumar**

Following fish-based IFS models have been developed at farmers' fields at different villages under flood-affected/ waterlogged areas in East Champaran district of Bihar.

### *Crop+fish+duck IFS Model*

A crop-fish-duck IFS model is established at Machhargawa village, Sangrampur, East Champaran district of Bihar. The total area of the model is 1200 $m^2$. The geographical location of the model is $26^0$ 32' N and $84^0$46' E. The selected site and its nearby areas are locally classified as *chaur* (extremely low lying area) where rainwater/ flood water remains 6-8 months. A pond of an area of 600 $m^2$ with 5 feet depth was constructed and remaining 600 $m^2$ area levelled up by 3 feet from its ground level for the crop production. The strengthening and heightening of dykes from all the sides by 8 feet was also done. A new duck shed was constructed over the dyke. Fish fingerlings of *catla*, *rohu*, grass carp and common carp with an average live weight i.e. 12.5 g were stocked together @ 10000 fingerlings $ha^{-1}$ and integrated with khaki campbell ducklings (100 nos.) with an average live weight of 150 g. The crops like rice (*var*. Rajendra Bhagwati) and maize (*var*. DM RH 1301) were cultivated in the remaining raised area (Fig. 16). The parameters for the assessment of production, productivity and economics of the model are being collected.

### *Fish+poultry IFS model*

An old existing pond of an area about 1200 $m^2$ was developed as a fish-cum-poultry IFS model at Hardiyabaad village, Chakia, East Champaran, Bihar. The geographical location of the model is $26^0$ 48' N latitude and $84^0$ 95'E longitude. In the IFS model the fish stocking density was kept @ 10000 fingerlings $ha^{-1}$, and integrated with the poultry birds (*Vanaraja* 100 nos. Fig. 17). The parameters for the assessment of production, productivity, economics of the model are being collected and to be analyzed.

**Land modification**

**Land modified into pond-raised bed**

Paddy transplantation

Fish fingerlings to be released into pond

Ducklings to be integrated with the IFS model

Fig. 16: Crop+fish+ duck IFS model and its different complements

An old refuged pond adopted and developed as fish-cum-poultry IFS model


RAC Members visited the fish-cum-poultry IFS model site

Fig. 17: Fish Poultry based IFS model and project site

## *Fish+buffalo IFS model*

An old existing pond of 3000 $m^2$ under flood affected area was adopted and developed as a fish-cum-buffalo IFS model at Bedivan Madhuban village, Pipra, East Champaran, Bihar. The geographical location of the model is $26^0$51'41.77" NL and $85^0$00'19.65" EL (Fig. 18). The name of the beneficiary farmer is Sh. Baua Pandey. The fish stocking density was kept at the rate of 10000 fingerlings $ha^{-1}$ and integrated with buffalo (02 nos. Murrah). The parameters for the assessment of production, productivity and economics of the model are being collected for further analysis.


**Fish+buffalo IFS model**

**Fish fingerlings being released**

**Fig. 18: Fish+buffalo IFS model**

## *Fish-cattle IFS model*

Fish-cum-cattle IFS model of an area i.e. 1200 $m^2$ was at developed at Surajpur village, Piprakothi, East Champaran, Bihar (Fig. 19). The geographical location of the site is $26^0$34'31.32" NL and $84^0$56'11.45" EL. The name of the farmer is Sh. Rajesh Kumar Singh.

**New pond construction**

**New cattle shed**

**Fig. 19: Fish+ cattle IFS model**

## *Fish-goat IFS model*

A fish-cum-goat IFS model was developed at Bariariya, Sangrampur, East Champaran, Bihar. An old existing pond was renovated and a new goat shed is being constructed in order to establish fish-goat IFS model (Fig. 20). The geographical location of the IFS model is 26029' N and $84^0$42' E. The area of the pond is 1000 $m^2$. The fish stocking density was kept at the rate of 10000 fingerlings $ha^{-1}$ and integrated with goats (08 nos. Black Bengal). The parameters for the assessment of production, productivity and economics of the model are being collected and analyzed.

## *Fish-based IFS model*

A fish-cum-poultry-fruit crops IFS model was established and assessed at the research farm of ICAR-MGIFRI, Piprakothi ($26^0$32' N and $84^0$56'17.60" E). Fish fingerlings were stocked @10000 $ha^{-1}$, along with the integration of poultry birds (*Vanraja*, 300 nos.) and fruit crops (lemon, guava and banana) on dyke of the pond. The growth, survival, productivity, economics and energy use efficiency have been assessed along with physico-chemical water parameters (Fig. 21).

Fig. 20: Fish-goat IFS model

Fig. 21: Fish+poultry+fruits IFS model at research farm of MGIFRI

## Improving Livelihood of Small Farmers through Good Practices in Agriculture, Fisheries and Animal Husbandry in the East Champaran Region

**Principal Investigator: Dr. A. Raizada**

**Co-Investigators: Dr. S.K. Purbey, Dr. A. K. Singh, Dr. P.K. Bharti, Dr. S.K. Samal, Mr. Ravi Kumar, Dr. Shreya Nivesh, Dr. Koushik Banerjee, Er. Vikas Paradkar.**

**Funded by: Farmers FIRST project**

Extension activities under Farmers First Programme were carried over in *Tetariya* block of East Champaran district which is a backward area, highly vulnerable to floods with very poor to non-existent agricultural extension activities. Extension activities covered four large villages – *Ujheelpur, Hasanpur, Naraha Mallah Tola* and *Hanuman Nagar* (Fig. 22). In general, the topography is flat with gentle undulations and is well drained with numerous streams and rivulets that transport runoff water and drain out into rivers like the *Baghmati, Gandhak* and *Burhi Gandhak*. The total area in the *Tetariya* block fit for agriculture is about 3.031 lakh ha with irrigation being available for only 1.76 lakh ha, leaving nearly 42% agricultural area totally rainfed. Floods are a recurring phenomenon and a mild drought in the winters is frequent, leading to uncertainty of yields from the both- *kharif* and *rabi*. Major findings of the extension activities are given below:

### *Performance of paddy*

Agricultural production in Bihar is affected by several factors out of which the seed replacement with improved and high yielding suitable crop variety is one of the important technological gaps in the region in achieving higher sustained production, income and livelihood. Rice-wheat and rice-maize is prominent cropping system of the region. High yielding suitable crop varieties of paddy and wheat were made available to selected farmers. Crops like lentil and mustard were introduced, where farmers keep their land fallow after the harvest of paddy, for more income and food security.

In this direction, a total of 1250 kg of paddy seed (*Sarju 52*) which matures in 130-135 days with yield potential of 5000-60000 kg ha$^{-1}$, medium-long type of paddy and resistant to bacterial blight with a 70% rice hulling was made available to 250 farmers, covering all the four villages in the project area. Several farmers also raised hybrid rice variety – *Arize 6444*.

Crop cutting survey was carried out in 10 randomly located paddy plots from each village and data collected after harvesting and threshing is presented in Table 8. Results indicate that while yields from hybrid rice were 78% more over *Sarju 52*, the latter was more resilient to flooding and yielded 3200 kg ha$^{-1}$even under partial flooding while the hybrid rice yielded only 1330 kg ha$^{-1}$.



**Fig.22: Seed distribution of paddy to farmers &performance of paddy (Saraju 52) at farmer's field**

**Table 8: Performance of paddy var. *Saraju 52* (yield, kg ha$^{-1}$)**

| Village | Sarju 52 | | Arize 6444 | |
|---|---|---|---|---|
| | Grain | Straw | Grain | Straw |
| Hanuman Nagar | 4020 | 1850 | 7150 | 16880 |
| Naraha Mallahtola | 4900 | 1680 | - | - |
| Ujheelpur | 3250* | 1270* | 1340* | 940* |
| Hasanpur | - | - | - | - |

# not planted in this village; $ - flood affected and entire crop destroyed, *Partially flooded

## *Performance of lentil and maize*

Lentil (var. PL 08 which matures in 130-135 days and has yield potential of 2400-2800 kg $ha^{-1}$ with moderately resistant to rust and wilt) and mustard (var. RH 749, maturing in 145-150 days, suitable for irrigated condition with a yield potential of 1.5-1.6 t/ha and more than 39% oil content, Fig. 23) were made available to selected farmers as an introduction in rice fallow.

A total of 200 kg seed of lentil and 500 kg seed of mustard was made available to 42 and 127 farmers, respectively, covering all the four villages in the project area. Village wise average yields are reported in Table 9.

**Fig. 23: Seed distribution of lentil for demonstration to farmers & performance of mustard crop at village-Ujheelpur**

**Table 9: Performance of lentil and mustard (grain yield, kg $ha^{-1}$)**

| Village | Lentil (PL 08) | Mustard (RH 749) |
|---|---|---|
| Hanuman Nagar | 650 | 460 |
| Naraha Mallahtola | 500 | 520 |
| Ujheelpur | 980 | 680 |
| Hasanpur | 850 | 590 |
| **Mean yield** | **750** | **560** |

Lower yield of lentil and mustard was recorded. In general, low plant density and poor weed management practices in lentil and delayed sowing and poor management of irrigation water and nutrient in mustard resulted in lower yields. In case of mustard, it was observed that fertilizers applied @ urea 170 kg $ha^{-1}$ and DAP 127.5 kg $ha^{-1}$ along with sulphur in village *Ujheelpur* resulted in comparatively higher yield

## *Making availability of other inputs to farmers*

- For balance use of fertilizers in *kharif* crops, a total of 100 bag Urea, 200 bag MOP and 470 kg Zinc Sulphate to 168 farmers on 09.07.2021, and for *rabi* and summer crops, total 250 bag urea, 125 bag DAP and 1000 kg Zinc Sulphate to 379 Farmers during February – March, 2022 were distributed (Fig. 24).
- For seed replacement of wheat and mungbean with improved and high yielding suitable varieties, 4300 kg of HD 2967 and 100 kg of DBW -187 of wheat were made available on 02.11.2021 to 254 and 5 farmers, respectively. Seeds of mungbean var. IPM – 205-7 (300 kg)) were provided to 81 farmers during February 2022 (Fig. 25).
- For diversification towards 'high value – low volume' crop, seeds of summer vegetables like Onion (var. *AFLR*), okra (var. *Pusa 5, Kashi Lalima*) and bottle gourd

Fig. 24: Distribution of fertilizers to beneficiary farmers

Fig. 25: Making availability of seed of wheat, mungbean and vegetables to farmers

### *Fish rearing*

Integration of fish rearing was done in existing ponds or by shaping and repairing the old ponds, and suitable and quality fingerlings and production techniques was provided to farmers. An existing fish pond of Mr. Rameshwar Sahni (Fig. 26) of village Hanuman Nagar was suitably repaired and embankments shaped out in March 2021. A total of 2175 fingerlings (rohu, catla, common carp and mrigal) were provided to four farmers including Mr. Rameshwar Sahni. A combined yield of 120 kg was obtained from pond of Mr. Rameshwar Sahni which was sold off for₹. 14000 only, since all sizes were sold off in one lot.

### *Reshaping and strengthening of dykes of a community pond in village Ujheelpur*

The pond was filled with water hyacinth which was removed manually. With the help of a JCB machine (Fig. 27), pond was reshaped and dykes were strengthened. It is proposed to construct a low-cost shed and then introduce *Khaki Campbell* ducks in the pond along with fish rearing in the coming rainy season.

**Table 10: Input supply to the farmers under Farmers' FIRST project**

| Date | Input | Quantity | No. of Beneficiary |
|---|---|---|---|
| 02.04.2021 | Vegetable Seeds | 240 pkt | 240 |
| 06.04.2021 | Moong Seeds | 5.5 Qtl | 110 |
| 28.05.2021 | Paddy Seeds | 12.5 Qtl | 245 |
| 09.07.2021 | Fertilizer | Urea-100 bags, Mops-200 bags, ZnSo4-300 bags | 100 |
| 11.08.2021 | Fish | 8.5 kg | 3 |
| 02.11.2021 | Wheat seeds | 44 Qt l | 220 |
| 02.11.2021 | Lentil | 2 Qt l | 40 |
| 02.11.2021 | Mustard | 5 Qt l | 100 |

**Fig. 26: View of a renovated pond and Distribution of fingerlings & harvested fish from pond**


**Fig. 27: Reshaping and improving dykes in a community owned pond in Ujheelpur village**

### *Creating awareness through organizing "Animal Health Camp" for good animal health for better productivity and income*

Animal husbandry is an important secondary occupation and farmers make serious efforts to keep their animals healthy. Although technical knowledge of farmers on animal health is lacking. Their economic status also does not permit them to invest in medication and obtaining the services of a veterinary doctor. In this direction, an "Animal Health Camp" was organized at village Hanuman Nagar on 14th March 2022 (Fig. 28 ). A total of 150 farmers attended the camp along with their animal and medical care were provided to 38 buffaloes, 93 cows, 418 goats and15 poultry birds. These animals were affected by a wide range of diseases ranging from false pregnancies to indigestion, weight loss, poor growth, stomach infection, parasitic infection etc. For development of the micro-enterprises at the village level, a hand on training programs on "Button Mushroom Production" was organized on 14.11.2021 with participation of 20 participants from the four villages (Table 11). Filling of wheat compost in plastic bags, application of spawn in multi-layers and casing with cow dung was demonstrated and then participants did the job themselves (Fig. 29). On an average each packet weighed about 14 kg.

### *Promotion of micro-enterprise activities for landless and marginal farmers in integration with existing production system*

Trend of production of mushroom is depicted in table 3 and results indicated that on an average 2.66 kg of button mushrooms were harvested within 45 days of packing the bags.


Fig. 28: Views of the Animal Health Camp conducted at village *Hanuman Nagar*

## Table 11: Mushroom production from poly bags raised indoors by farmers

| Name of farmer | Number of harvests | Duration (days) | Total (kg) Fresh weight |
|---|---|---|---|
| Santosh Kumar | 13 | 45 | 4.85 |
| Deepak Kumar | 10 | 45 | 2.40 |
| Pintu Kumar | 10 | 45 | 2.05 |
| Mukesh Kumar | 9 | 45 | 2.10 |
| Sikandar Kumar | 11 | 40 | 3.45 |
| Sandhya Kumari | 7 | 26 | 1.25 |
| Shailendra Singh | 10 | 40 | 2.55 |

Fig. 29: Views of the hands on training program on Button Mushroom Production conducted at *Hanuman Nagar*

## Schedule Cast Sub Plan (SCSP)–Scheme

**Principle Investigators: Mr. Ravi Kumar**

**Co-Investigators: Dr. A. Raizada, Dr. S.K. Purbey, Dr. A.K. Singh, Dr. P.K. Bharti, Dr. S.K. Samal, Dr. Shreya Nivesh, Dr. Koushik Banerjee, Er Vikas Paradkar**

During the year 2021, ICAR-MGIFRI actively executed Scheduled Caste Sub-Plan (SCSP) initiated by the Government of India in the heads discussed below. More than 15 number of blocks in the East Champaran district was benefitted by ICAR- MGIFRI, Piprakothi, Bihar.

### 1. *Training/ Awareness / Kishan Goshthi/ Exposure visits organized*

ICAR-MGIFRI provided During April 2021-2022 a total of five training program (Table 12) of duration three days were organized for the Scheduled Castes (SC) farmers under SCSP. The training programs focused on the skill development of the farmers on various aspects/ components of the integrated farming systems (IFS) viz. goat farming, poultry farming, fish farming, value addition to the various farm produces etc (Fig. 30). Two mass awareness campaign and exposure visits and two farmers-scientists interaction meet were also organized for the SC farmers of east Champaran district of Bihar. A total of 1601 SC farmers benefitted including 1068 male (67%) and 533 female (33%) participants.

**Table 12: Details of the training and awareness programme conducted in SCSP**

| SN | Training and other program | No. | Beneficiary (No.) | | | FY |
|---|---|---|---|---|---|---|
| | | | Total | Male | Female | |
| 1 | Awareness campaign on plantation organized on (16 Jul 2021) | 1 | 150 | 125 | 25 | 2021-22 |
| 2 | कृषक-वैज्ञानिक संगोष्ठी एवं कृषि उपकरणों/ सामग्रियों का वितरण (16 Aug 2021) | 1 | 700 | 500 | 200 | 2021-22 |
| 3 | Livelihood improvement of farmers through goat farming under waterlogged ecosystems (28-30 Sep 2021) | 1 | 217 | 123 | 94 | 2021-22 |
| 4 | Farmers- Scientists interaction meet and exposure visit on National Farmers Day (23 Dec 2021) | 1 | 205 | 120 | 85 | 2021-22 |
| 5 | Awareness-cum-exposure visit and distribution of farm tools/ implements (25 Feb 2022) | 1 | 300 | 200 | 100 | 2021-22 |
| | **Total** | 5 | **1601** | **1068** | **533** | |


**Training program on 'goat farming' under waterlogged ecosystems 28-30 September 2021**


तीन दिवसीय बकरी पालन प्रशिक्षण का हुआ समापन

***Dainik Jagran*, 29 September 2021**

कृषक-वैज्ञानिक संगोष्ठी एवं कृषि उपकरणों/ सामग्रियों का वितरण

Distribution of input

Farmers-scientists interaction & exposure visit on 'National Farmers Day' 23.12.2021

राष्ट्रीय किसान दिवस पर किसान वैज्ञानिक वार्ता का आयोजन

*Hindustan*, 24 December 2021

**Fig. 30: Few glimpses of training and awareness programme and published news paper report**

## 2. *Distribution of farm tools/ implements/ machineries*

A total of 1032 number of farm tools/ implements/ machineries etc (Table 13). were distributed during 2021- 2022 among SC farmers of East Champaran, Bihar. Details of the distribution of various tools/ implements/ machineries etc. and number of beneficiaries are mentioned in the table below (Fig. 31). And, a total of 1032 Scheduled Caste farmers have benefitted including male (798 nos.) and female (234 nos.).

**Table 13: Details of the items distributed in SCSP**

| SN | Tools/ implements/ machineries etc. | No. | Beneficiary (No.) | | | FY |
|---|---|---|---|---|---|---|
| | | | Total | Male | Female | |
| 1 | Grain storage bins (capacity 100 kg) | 400 | 400 | 267 | 133 | 2021-22 |
| 2 | Steel buckets | 300 | 300 | 249 | 51 | 2021-22 |
| 3 | Steel mugs | 300 | 300 | 250 | 50 | 2021-22 |
| 4 | Chaff cutter | 7 | 7 | 7 | 0 | 2021-22 |
| 5 | 2 HP electric motor | 25 | 25 | 25 | 0 | 2021-22 |
| | **Total** | **1032** | **1032** | **798** | **234** | |

Distribution of chaff cutter machine

Distribution of winnowing fan & paddy thresher

Distribution of Tarpaulin

Distribution of knapsack sprayer machine

Distribution of grain storage bins/ maize sheller/ weeder etc.

Distribution of plastic crates

Distribution of rice-wheat seeders

Distribution of grain storage bins (capacity 500 kg)

Distribution of manual wheel hoe weeders

Distribution of 2 HP electric motor for irrigation purpose

Fig. 31: Few glimpses of distribution of farm tools/ implements/ machineries

### *3. Distribution of livestocks (goats/ poultry)*

The goatery and backyard poultry farming are the major source of income and livelihood of the landless/ marginal SC communities in east Champaran, Bihar. Therefore, as per need the goat (Black Bengal & Sirohi), 164 number, and chicks (Vanraja), 3200 number were distributed among the Scheduled Caste farmer under SCSP scheme in various villages of east Champaran district of Bihar (Fig. 32). A total of 181 SC farmers benefitted including male (133 nos.) and female (48 nos.).

### *4. Distribution of fertilizers/ seeds/ feed/ saplings*

The quality seed material of wheat, maize, mustard, moong bean and vegetables etc. was distributed among the SC farmers in various villages of east Champaran Bihar under SCSP scheme (Table 14). Other inputs like fertilizers (urea and DAP), plant saplings and poultry feed were also distributed (Fig. 33). A total of 1280 SC farmers have benefitted including male 1039 and female 241 numbers. Details of the inputs and number beneficiaries are mentioned in the table below.

**Distribution of goats**

**Vaccination against goat disease**

**Distribution of goats**

**Distribution of chicks, feeder, waterer, poultry feed along with plastic crates**

**Fig. 32: Few glimpses of distribution of livestocks (goats/ poultry)**

**Table 14: Details of the fertilizers/ seeds/ feed/ saplings distributed in SCSP**

| SN | Fertilizers/ seed/ feed etc. distribution | Quantity | No. of Beneficiary | | | Year |
|---|---|---|---|---|---|---|
| | | | Total | Male | Female | |
| 1 | Wheat HD-2967 & DBW 187 (kg) | 3000 | 152 | 134 | 18 | 2021-22 |
| 2 | Maize DMRH 1301 (kg) | 200 | 47 | 40 | 7 | 2021-22 |
| 3 | Mustard RH 749 (kg) | 200 | 97 | 54 | 43 | 2021-22 |
| 4 | Moong bean IPM 205:7 (kg) | 400 | 84 | 74 | 10 | 2021-22 |
| 5 | Neem coated urea (No. of bags) | 1250 | 625 | 500 | 125 | 2021-22 |
| 6 | DAP Paradeep (No. of bags) | 125 | 125 | 112 | 13 | 2021-22 |
| 7 | Plant saplings (guava, lime, coconut etc), (No.) | 500 | 150 | 125 | 25 | 2021-22 |
| | **Total** | | **1280** | **1039** | **241** | |

Ditribution of vegetable seed

Distribution of moong bean seed

Distribution of wheat seed

Distribution of mustard seed

**Fig. 33: Few glimpses of distribution of fertilizers/ seeds/ feed/ saplings**

## 5. *Infrastructure development*

The infrastructures have developed for the benefit of Scheduled Caste communities at various SC dominated villages in east Champaran district of Bihar. These infrastructures includes rehabilitation shelters (during flood) cum farm produce shelter, rain shelter, cattle & goat shelters, threshing floor; and bore wells with hand pumps for the supply of drinking water etc. A total of 865 SC persons have been benefitted from the infrastructures developed under SCSP scheme by ICAR-MGIFRI, Piprakothi, East Champaran, Bihar (Fig. 34). The details of the developed infrastructures are mentioned in the table below (Table 15).

**Table 15: Details of the locations of infrastructure developed in SCSP**

| SN | Infrastructure development | Address detail | No. of SC persons benefitted | Year |
|---|---|---|---|---|
| 1 | Open pucca shelter | Naraha, Tetariya | 115 | 2021-22 |
| 2 | Open pucca shelter | Narayanpur, Tetariya | 100 | 2021-22 |
| 3 | Open pucca shelter | Hasanpur, Tetariya | 100 | 2021-22 |
| 4 | Open pucca shelter | Hanuman Nagar, Tetariya | 100 | 2021-22 |
| 5 | Open pucca shelter | Cheni Chhapra, Tetariya | 100 | 2021-22 |
| 6 | Open pucca shelter | Maniyarpur, Tetariya | 115 | 2021-22 |
| 7 | Open pucca shelter | Ujheelpur, Tetariya | 110 | 2021-22 |
| 8 | Open pucca shelter | Bahuara, Tetariya | 125 | 2021-22 |
| | | Total | 865 | |

Farm produce shelter at Bishunpura

Cattle shed at Chandrahiya

Goat shed at Areraj

Borewell & handpump at Mahuawa

Open pucca shed at Chheni Chhapara

Open pucca shed at Narayanpur Bazar

**Fig. 34: Few glimpses of developed infrastructure in SCSP villages**

# Events/Training Organized for Women Empowerment

## *Rashtriya Mahila Kisan Diwas/* National Women Farmer's Day

An event celebrated by ICAR-Mahatma Gandhi Integrated Farming Research Institute, Piprakothi, East Champaran-845429 by organizing one *Kishan Gosthi* at vill: Khairimal-Jamunia, Block: Chakia, East Champaran. A total of 40 participants attended the programme. In this programme awareness was created to increase the active participation of women in agriculture. They were apprised about the technologies like composting /vermicomposting, mushroom cultivation and backyard poultry rearing, which requires virtually no land. The scientist of the institute (Fig. 35) organized the programme.

**Fig.**35: **Interaction with farm women during Mahila Kissan Divas**

# Weather Variability of the Location

Variation of different weather parameters (like rainfall, maximum and minimum air temperatures for 2021) in the standard meteorological week-(SMD) for the location (26.5486° N, 84.9341° E) is shown in Fig. 36. During the winter season in 2021 (Nov, Dec, Jan, Feb), the average air temperature was found 18.70oC with Tmin ranged from 5.23-10.66 oC. During summer (March, April, May), an average temperature of 29.96 oC was recorded with T-max ranging from 36.21-40.32 oC. The normal date of monsoon onset in Bihar is around 10-15th June. The location is blessed with receiving abundant of rainfall throughout the year. During 2021, the location received 1734.83 mm of total rainfall (Table 16). Among the three seasons, average rainfall received during monsoon (June, July, August, and September), summer and winter were 1246.76 mm (71.86%), 469.83 mm and 18.24 mm respectively (Table 11). The station received 121 rainy days (rainfall >2.5 mm) during 2021 (Table 16). Maximum number of rainy days was recorded in August (28 days).

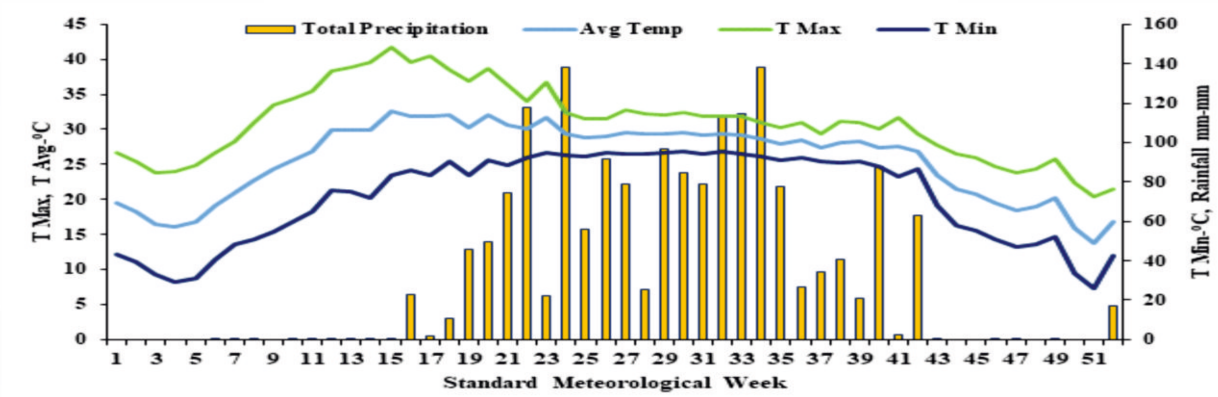



**Fig. 36**: Average values of different weather parameters of Piprakothi, Motihari, Bihar during 2021

### Table 16: Monthly average weather data of ICAR-MGIFRI, Piprakothi

| | Temperature | | | | | Precipitation | |
|---|---|---|---|---|---|---|---|
| Months | $T_{Avg}$ | Avg-$T_{Max}$ | Avg-$T_{Min}$ | Max-$T_{Max}$ | Min-$T_{Min}$ | Total | No. of Rainy days |
| January | 17.35 | 24.85 | 9.85 | 30.01 | 5.40 | 0.00 | 0 |
| February | 20.92 | 28.85 | 12.98 | 35.21 | 8.50 | 0.79 | 0 |
| March | 27.52 | 36.21 | 18.84 | 40.74 | 13.81 | 1.22 | 0 |
| April | 31.53 | 40.33 | 22.74 | 42.48 | 17.25 | 25.35 | 2 |
| May | 30.93 | 36.92 | 24.95 | 41.97 | 22.05 | 289.54 | 16 |
| June | 29.86 | 33.32 | 26.40 | 38.26 | 25.41 | 294.92 | 24 |
| July | 29.45 | 32.25 | 26.64 | 33.67 | 25.37 | 323.42 | 26 |
| August | 28.85 | 31.35 | 26.35 | 33.32 | 25.26 | 497.95 | 28 |
| September | 28.12 | 30.73 | 25.52 | 32.73 | 24.31 | 130.47 | 15 |
| October | 25.85 | 29.45 | 22.26 | 33.00 | 15.80 | 153.72 | 8 |
| November | 19.61 | 24.82 | 14.41 | 27.41 | 10.66 | 0.09 | 0 |
| December | 16.93 | 22.69 | 11.16 | 26.81 | 5.23 | 17.36 | 2 |

# List of Publications

## Peer Reviewed Research Papers


Ghosh, D., Roy, D., Choudhary, V.K., Mandal, K.G. and Mishra, J.S. 2021. Increasing Water and Nutrient-Use Efficiency in Crops by Innovative and Low-Cost Weed Management. *Indian Journal of Fertilisers*, 17(11), pp.1182-1193.

Kumar, R., Mishra, J.S., Mondal, S., Meena, R.S., Sundaram, P.K., Bhatt, B.P., Pan, R.S., Lal, R., Saurabh, K., Chandra, N. and Samal, S.K. 2021. Designing an ecofriendly and carbon-cum-energy efficient production system for the diverse agroecosystem of South Asia. *Energy*, 214, pp.118860.

Mandal, K.G., Purbey, S.K., Singh A. K., Bharti, P.K., Kumar R., Samal, S.K. and Banerjee, K. 2021. Perspectives on integrated farming in waterlogged ecosystems for ensuring food and nutrition security to farmer. *Indian Journal of Agronomy*, 66 (*5th IAC Special issue*): pp.32-43.

Mandal, K.G., Thakur, A.K. and Mohanty, R.K. 2021. Self-Reliant Farming and Employment Opportunities for Migrant Workers Relating COVID-19 Post-Pandemic. *Economic Affairs*, 66(1), pp.41-52.

Paradkar, V., Raheman, H. and Rahul, K., 2021. Development of a metering mechanism with serial robotic arm for handling paper pot seedlings in a vegetable transplanter. *Artificial Intelligence in Agriculture*, *5*, pp.52-63.

Pongener, A., Purbey, S. K. Singh, S. K. and Kumar, A. 2021. Development of a "Litchi Maturity Kit" for judging optimum time of harvest. Crop management, *ICAR Annual report*, pp-81.

Rao, K.K., Samal, S.K., Kumar, M., Naik, S.K., Bhatt, B.P., Prakash, V., Mondal, S., Choubey, A.K., Dalal, R.C., Mishra, J.S. and Kumar, U. 2021. Carbon sequestration potential of rice-based cropping systems under different tillage practices. *Agrochimica*, 65(3), pp.229-246.

Rao, K.K., Samal, S.K., Poonia, S.P., Kumar, R., Mishra, J.S., Bhatt, B.P., Dwivedi, S.K., Mondal, S., Choubey, A.K., Kumar, S. and Kumar, M. 2021. Conservation agriculture improves soil physical properties and crop productivity: A long-term study in middle indo-gangetic plains of India. *Soil Research*, 60(6), pp.442-454.

Saurabh, K., Rao, K.K., Mishra, J.S., Kumar, R., Poonia, S.P., Samal, S.K., Roy, H.S., Dubey, A.K., Choubey, A.K., Mondal, S. and Bhatt, B.P. 2021. Influence of tillage based crop establishment and residue management practices on soil quality indices and yield sustainability in rice-wheat cropping system of eastern Indo-Gangetic Plains. *Soil and Tillage Research*, 206, pp.104841.

Singh, A. K., Ghosal, S. and Monobrullah, M., 2021. Evaluation of lac factory waste on flower production: Lac factory waste-A value for floriculture. *Journal of AgriSearch*, *8*(1), pp.45-49.

Upadhyay, D., Singh, M., Gaur, G.K., Bharti, P.K. and VERMA, M., 2021. Effect of flooring system on maintenance behaviours of cows. *The Indian Journal of Animal Sciences*, 91(8).


## Extended Summary


Singh, A. K., Saurabh, K. and Samal S. K. 2021. Enhancing sugarcane (Saccharum hybrid complex) productivity through zinc application schedule in calcareous soil. Extended Summaries (Vol. 1) of 5th

International Agronomy Congress on Agri Innovations to Combat Food and Nutrition Challenges, Organized by The Indian Society of Agronomy at Hyderabad during 23-27 Nov. 2021. pp. 633-634.

Samal., S.K., Datta, S.P., Dwivedi, B.S., Meena, M.C., Singh, A.K. 2021. Phytoextraction efficiency of sunflower, marigold and spinach plant grown in Zn contaminated soil. Extended Summaries: 5th International Agronomy Congress, November 23-27, 2021, India.

## Book chapter

Banerjee, K., Bal, S.K., Chakraborty, D., Malleswari, S., Banerjee, A., Sadhukhan, R. 2021. Crop Calendars and Advances in Agriculture Insurance Products in India. In: Ch. Srinivasarao et al., (Eds). Agricultural Research, Technology and Policy: Innovations and Advances, ICAR *National Academy of Agricultural Research Management* (NAARM), Hyderabad, Telangana, India, pp 307-332.

Purbey, S. K. and Pongener, A. 2021. Litchi. In: Chadha, K. L. and Pal, R. K. (eds). Managing Postharvest Quality and Losses in Horticultural Crops. Revised edition.

Jagadle, M., Shrivastava, P., Paradkar, V., Bijarniya, H. and Murthhy, G., R., K. 2021. Farm Mechanization to Improve Energy Efficiency and Drudgery Reduction. Ch. Srinivasarao et al., (Eds): Agricultural Research, Technology and Policy: Innovations and Advances. ICAR-National Academy of Agricultural Research Management (NAARM), Hyderabad, Telangana, India, pp 307-332.

Raizada, H. Biswas and S. Eslamian (2021) Groundwater recharge by water harvesting structures in the semiarid zones. In: Handbook of Water Harvesting and Conservation: Case studies and Application Examples. (Ed. S. Eslamian and F. Eslamian). *John Wiley & Sons Limited*. pp.313 - 323.

Sadhukhan, R., Sharma, L.D., Sen, S., Karmakar, S., Banerjee, K. and Baral, K., 2021. Enhancing the Productivity of Field Crops through Nano-Fertilizer. *Agricultural Development in Asia: Potential Use of Nano-Materials and Nano-Technology*.

Saran, B., Kumar, A. and Nivesh, S. (2021). Objective Questions In Land And Water ManagementEngineeringFor:ARS/NET/SRF/JRF/GATE/AE/JE/ADA/SCO/SMS/BHU/GBPUAT And Other Competitive Exams, New Delhi Publishers.

नंदलाल कुशवाहा, जितेंद्र राजपूत, श्रेया निवेश, प्रदोष कुमार परमगुरु एवं ब्लेसी वी. ए. (2021). जलवायु परिवर्तन के परिवेश में जलग्रहण क्षेत्र (वाटरशेड) प्रबंधन का महत्त्व इन: जलवायु परिवर्तन और भारतीय कृषि : चुनौतियां अनुकू लन और शमन रणनीतियाँ, भाकृअनुप - राष्ट्रीय कृषि अनुसंधान प्रबंध अकादमी हैदराबाद-500 030, तेलंगाना, भारत, पृष्ठ: 69-74.

## Popular article/Technical Bulletin

Biswal P, Dutt T and Bharti P K. 2021. Care of livestock and handling of livestock products, *Indian Farming*. 71 (07): 44-45.

Biswal,P, Bharti P K, Somagond A, Panda S, Yadav S, Harini K R and Sriranga K R. 2021. African Swine fever How it occurs and how to control? *Indian Farming*. 71 (07): 16-18.

Chandel, N.S., Jat, D., Paradkar, V., Kumar, S.P. and Kumar, V. 2021. Mobile App for Mechanised Farming. *Krishi Abhiyantriki Darpan*. Jan-July 2021. (In Hindi).

Nogiya, M., Moharana, P.C., Meena, R.L., Meena, R.S., Yadav, R.K., Samal, S.K., Kumar, S. 2021. Aerobic rice cultivation: Management strategies to prevent the iron chlorosis. *Vigyan Varta*. 2(6), 38-41

Patil, S.L., Adhikari, R. N., Raizada, A., Ramajayam, D., Ramesha, M. N., Reddy, K. K., Prabhavathi, M., Loganandhan, N., Matth, S.K.N., and Channabasappa. K. 2021. Conservation and Management of Natural Resources in Ramsagara watershed, Molakalmuru Taluk, Chitradurga District, Karnataka. Indian Institute of Soil and Water Conservation Research and Training Institute, Research Centre, Bellary.p.100.

# Research Projects

## Completed research projects

| Sl. No. | Project Title | PI Name |
|---|---|---|
| 1 | Effect of method of Zn application in spring sugarcane under calcareous soil | Dr. A. K. Singh |

## Ongoing research projects

| Sl. No. | Project Title | PI Name |
|---|---|---|
| 1 | Development and assessment of fish-based integrated farming models under floodplain ecosystems | Dr. Ravi Kumar |
| 2 | Post harvest losses study of major fruits and vegetables in East Champaran district of Bihar | Dr. S. K. Purbey |
| 3 | Constraint analysis and performance evaluation of poultry birds reared under backyard system in East Chamaparan district of Bihar | Dr. P. K. Bharti |
| 4 | Enhancing sugarcane (Saccharum hybrid complex) productivity through zinc application with organic manures in calcareous soil | Dr. A. K. Singh |
| 5 | Development of horti-based farming system model for low lying areas of Bihar | Dr. S. K. Purbey |
| 6 | Development and assessment of goat based integrated farming models in wetland ecosystem | Dr. P. K. Bharti |
| 7 | Estimation of optimum residue retention in rice-wheat cropping system raised on calcareous soil of middle Indo-Gangetic Plains | Dr. S. K. Samal |
| 8 | Evaluation of irrigation water saving techniques in winter Maize under North Bihar conditions | Dr. Shreya Nivesh |

## New research projects

| Sl. No. | Project Title | PI Name |
|---|---|---|
| 1 | Development of organic rice-fish-duck IFS model in waterlogging situations of North Bihar | Dr. A. K. Singh |
| 2 | Design and development of low-cost equipment and machineries for waterlogged situations | Er. Vikas Paradkar |
| 3 | Delineation and characterization of flood-prone and water logged areas of Eastern India and development of IFS plans | Dr. Koushik Banerjee |

## Externally funded research projects

| Project Title | Budget (Rs in lakh) | Duration | PI Name | Funded by |
|---|---|---|---|---|
| Development of fish-based integrated farming system models for water congested ecologies of eastern India | 94.14 lakh | Feb 2019 to Mar 2022 | Mr. Ravi Kumar | MoFA&D, GoI, New Delhi) |
| Improving livelihood of small farmers through good practices in agriculture, fisheries and animal husbandry in the East Champaran region | 26.62 | 2021-22 | Dr. A. Raizada | Farmers FIRST Project |

# Awards, Honours, Recognitions

- Dr. K.G. Mandal, Director, has received the 'Certificate of Honour', conferred by the Indian Society of Agronomy (ISA), New Delhi during the Fifth International Agronomy Congress (IAC) held at PJTSAU, Hyderabad, 23-27 November 2021.
- Dr. A.K. Singh was conferred Best Oral Paper Presentation Award for the research work entitled "Intercropping of potato and winter maize in north Bihar for higher productivity" in 30th National Web Conference on 'Soil and Water Management Technologies for Climate Resilience, Agricultural and Environmental Sustainability', organized by SCSI, New Delhi, held at Bhubaneswar during 14-16 December 2021
- Dr. S.K. Purbey received 1st prize in Hindi essay writing and 2nd prize in Hindi quiz competition during Hindi Pakhawara at ICAR-MGIFRI, 14-28 September, 2021
- Dr. P. K. Bharti received 2nd Prize for kabya path during the Hindi Pakhwara wef 14-28 September 2021
- Dr. K.G. Mandal was invited to Chair a Technical Session in the National Conference (virtual mode) on Integrated Farming Systems: A Tool for Enhancing Income and Nutritional Security, ICAR-Research Complex for Eastern Region, Patna, Bihar on 6 October 2021.
- Dr. S.K. Purbey was Nominated as expert member (DG nominee) for DPC of a scientist at ICAR- RCER, Patna, 10.02.2022.
- Dr. S.K. Purbey was invited as an external expert member in selection committee for SMS, Horticulture, Fruit science at DRCAU, Pusa.
- Dr. S.K. Purbey was invited as external examiner for thesis evaluation and Viva-Voce examination of Mr. Gurpreet Singh, M.Sc.(Ag) student of Dept. of Horticulture, PG College of Ag, DRPCAU, Pusa, Bihar on 24.09.2021.

**Dr. K.G. Mandal receiving certificate of Honour by the Indian Society of Agronomy (ISA), New Delhi during the Fifth International Agronomy Congress (IAC) held at PJTSAU, Hyderabad, 23-27 November 2021**

# Research Management Meeting (RAC/IRC/IMC)

## Research Advisory Committee-RAC

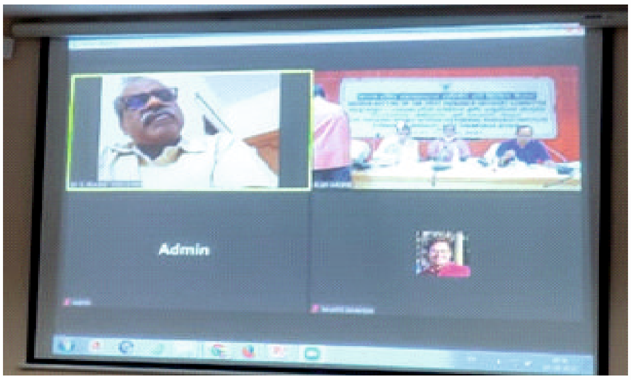
The second meeting of the first Research Advisory Committee of the ICAR-MGIFRI, Motihari was held with the following Chairman and Members and in presence of the Director of the institute and ADG (A, AF & CC), NRM, ICAR during 7-9 October 2021.

| | |
|---|---|
| Professor (Dr.) M.C. Varshneya<br>Former Vice-Chancellor, Kamdhenu University, Ahmedabad, Gujarat | Chairman |
| Dr. D.P. Sinhababu Former Principal Scientist (Fishery), ICAR-NRRI, Cuttack; Consultant Fisheries Development, West Bengal | Member |
| Dr. Bijoy Kumar Sahoo Former Professor, Agronomy & Dean, OUAT, Presently Dean, Institute of Agricultural Sciences, Siksha 'O' Anusandhan University, Bhubaneswar | Member |
| Dr. S. Bhaskar ADG (A, AF&CC), ICAR, KAB-II, Pusa, New Delhi | Member |
| Dr. A. Raizada<br>Pr. Scientist (Agroforestry), ICAR-MGIFRI, Motihari | Member-Secretary |

The meeting was held in a hybrid mode; the Chairman and the ADG participated in the virtual mode, while Dr. D.P. Sinhababu and Dr. B.K. Sahoo were present physically. The 3-days meeting comprised of deliberations, a visit to the Institute, research farm, farmers field at and near Motihari and interaction with Scientists and farmers, and the concluding session. A presentation on Action Taken Report (ATR) was given by Member Secretary covering details of infrastructure development, research, extension, and capacity building activities taken up by the Institute over the last two years. Subsequently, presentations on major research project was done by the scientist from the institute. With the permission of the Chairman, RAC members expressed their views and offered expert suggestions for research and training activities of the Institute.

Dr. D.P. Sinhababu emphasized goat farming with the IFS system, nutrient content of goat droppings, and potential use of it as fish feed; the need for raising fodder for goats; and the rice-fish-duck system which is being encouraged in waterlogged situations. He highlighted the need for investigation on the water depth available in the region for extending the rice-fish-duck system, and other suitable varieties of rice that may be tested under the system. Dr. B.K. Sahoo also urged upon a holistic investigation of the recurrence of floods, their historical cycle, and the feasibility of physical barriers at the village level along river banks for flood-prone areas. He also requested the house to take up small studies related to the quantification of goat droppings being added to fish ponds, shading effects of trees on ponds, the integration of makhana in fish ponds, use of local fruit species in IFS models for enhancing the income of farmers. Dr. S. Bhaskar expressed his gratitude in joining the RAC meeting virtually and desired that the RAC should give three broad recommendations covering the broad aspects of the crop, fish, animal production and sustainability, and their detailed study under IFS for waterlogged ecosystems for which the institute has been recently established.

The Chairman highlighted the need for elaborate studies on the close link between climate change and the occurrence of floods in the region. Collection of data may be required from IMD, SAU's, and ICAR institutes to analyze and prepare scenarios of floods, droughts, and unexpected climatic events.




**2nd RAC meeting of ICAR-MGIFRI and visit to farmer's filed of research site and insttute labrotary by thr RAC team**

There is also a need to document and map major waterlogged areas in Bihar. Regarding other activities which need to be taken up, he highlighted the need for undertaking a market survey for the value addition of fish-based products and also of value addition of products obtained from IFS and that of mushrooms before large-scale commercialization.

On the next day, RAC members along the scientists visited experimental farm of the institute and observed various laboratory facilities, research projects and infrastructure facilities developed/ developing at Motihari. Dr. Sahoo was happy to see the poultry birds ('Vanaraja') and of the opinion that the Institute should focus on local breeds due to their good growth and compatibility in farming situations. Dr. Sinhababu suggested a fish breeding unit at the farm, from which the sale of fingerlings can be made to farmers, who often find it difficult to get quality fingerlings at a reasonable price. the members visited the Institute and its laboratories, library, auditorium, hostel and guest house and expressed satisfaction with the way the farm and institute are being developed despite several constraints. Latter the members also visited at Pipra block, where an external-funded project is being taken up from the Ministry of Fisheries, Animal Husbandry and Dairying, Govt of India. The site is an abandoned area where soil had been excavated for numerous brick-kilns and is now permanently waterlogged. To use the waterlogged area efficiently, a small-scale fish-poultry unit is being established. The members also visited another experimental site in village Chandrahiya where the institute had established an IFS model. Dr. Sinhababu provided valuable suggestions for improving the fish yields further in the established unit and suggested the farmer install a biofloc unit where the farmer could increase fish production; and also suggested to establish a fish hatchery for a continuous supply of fingerlings to his pond and also for sale.

On the final day, Dr. D.P. Sinhababu and Dr. B.K. Sahoo gave concluding remarks on overall research work and the infrastructure development which has been done or being developed at the Institute and suggested to focus on rice as an essential component of IFS models since rice is a staple diet of the region. While IFS models involving goats, poultry and ducks are common, there is also a need to develop IFS models involving cattle. Dr. S. Bhaskar appreciated the development which has taken place at the Institute over the last two years and showed interest to establish various types of IFS models involving rice, fish, duck, poultry, livestock in various combinations, keeping in mind the size of landholding, market dynamics, capital, and labour availability. On the desire of Dr. S. Bhaskar, the RAC gave three broad recommendations that will provide a roadmap for the Institute which is at its establishment phase.

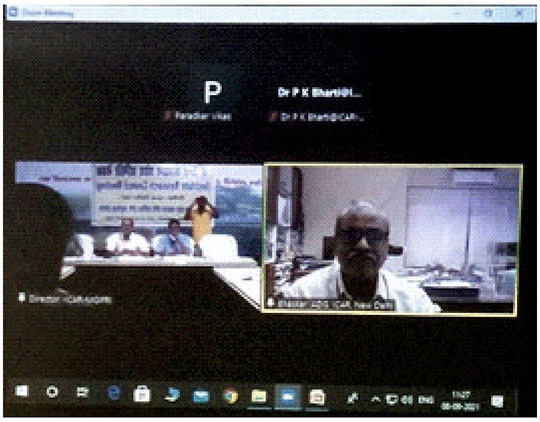
### *Three broad recommendations*

1. Establishment of the weather station at the research farm; delineation, situation analysis, and mapping of flood-prone, flood-affected and waterlogged areas in north Bihar; characterization and monitoring of waterlogged soils.
2. Design and development of IFS technology/ packages/ models with different components viz. crops, horticultural crops, fish, animal especially goat, poultry, cow and duck; post-flood crop management strategies and developing efficient irrigation technology for rabi and summer seasons; development of small farm tools and machinery required for IFS;
3. Capacity building of farmers and other stakeholders on different components of IFS through awareness programmes, training and demonstration of production technologies of field crops, horticultural crops, aquatic crops, fisheries, animal husbandry, mushroom, etc., the scope of increasing farmer's income and employment generation through IFS.

## Meeting of the Institute Research Council (IRC)

The 3$^{rd}$ IRC Meeting of the ICAR-Mahatma Gandhi Integrated Farming Research Institute (MGIFRI) was held on 8-9 September 2021 under the Chairmanship of the Director. All Scientists and invited experts attended the meeting. The meeting was started with the welcome address by Dr. S.K. Purbey, Member Secretary, IRC. In the opening remarks, Dr. K.G. Mandal, Director & Chairman emphasized the importance of integrated farming research for food and nutrition security, increasing income and employment generation by farmers, especially in the waterlogged ecosystems, and also the overall development of the institute. He has stressed carrying out on-farm adaptive research, evolving water management for excess and water scarcity situations, water-saving irrigation techniques condition, and also the capacity building of rural youth, women and farmers. The Chief Guest, Dr. S. Bhaskar, ADG (AAF & CC), who joined virtually, provided valuable guidelines to strengthen research activities at the Institute. He has encouraged Scientists to develop integrated farming system models particularly for waterlogged situations emphasizing fish-based systems, animal-based farming systems, and to organize capacity-building programmes for farmers and stakeholders. He further stressed the need for better collaboration and linkages to strengthen the research framework at the Institute. After opening remarks by the Chairman and the Chief Guest, Member Secretary presented the summary reports of research projects and apprised progress, in brief; followed by the presentation of the new research projects and progress of on-going projects by Scientists. Three new research projects along with eleven ongoing research project progress were presented on that day.

The invited expert was satisfied with the scientist's presentation; as an integrated farming system is location-specific, one should be careful with the selection of the components. He has suggested for generation of more scientific data from the projects and publishing research papers on IFS in good quality journals. The Chairman expressed his thankfulness to hon'ble ADG




**Glimpses of 3rd IRC of the institute**

for his valuable comments, and to the invited expert for his physical presence and suggestions. The Chairman has expressed that working in a waterlogged area is an opportunity for Scientists for carrying out research on IFS. He has motivated Scientists for bringing externally funded projects to this Institute. Farmer's participatory approach should be given importance for developing IFS models on-farm; selected on-station trials to be replicated on-farm i.e., at the farmers field. He has urged upon Scientists of the institute to emphasize the science and technology development from the on-going and new research projects, data generation and writing of good quality papers/ publications. He has assured his full support to the scientists in doing research and developing technology. The meeting was ended with a vote of thanks by Dr. A.K. Singh, Principal Scientist of the institute.

# Human Resource Development

### Training & capacity building undergone by the ICAR-employee

| Official designation | Subject | Organization | Period |
|---|---|---|---|
| Er. Vikas Paradkar | Orientation Training | ICAR-MGIFRI, Bihar | 12th January – 13th February 2021 |
| Dr. Koushik Banerjee | Orientation Training | ICAR-MGIFRI, Bihar | 12th January – 13th February 2021 |
| Er. Vikas Paradkar | Professional attachment training | ICAR-CIAE-Bhopal | 15th February - 15th May 2021 |
| Dr. Koushik Banerjee | Professional attachment training | ICAR-CRIDA-Hyderabad | 15th February - 15th May 2021 |
| Dr. A.K. Singh | Training Program on 'Enhancing Agricultural Resilience through Index -based Flood Insurance and Post-flood Management Interventions in India' | ICAR -IIWM and International Water Management Institute, Colombo | 29-30 June 2021 |

### Training & capacity building of stakeholders/ farmers

| Sl No | Duration | Title of the training | Organization | Total participants | Coordinators |
|---|---|---|---|---|---|
| 1 | 6-8 January, 2021 | Backyard murgi palan /utpadan me sudhar hetu unnat taknikiyan | ICAR-MGIFRI | 29 | Dr. P.K. Bharti |
| 2 | 15-17 January, 2021 | Fish Farming and Management | ICAR-MGIFRI | 25 | Mr. Ravi Kumar |
| 3 | 15-18 January, 2021 | Mushroom ki kheti ke madhyam se gramin yuvaon ki ajivika suraksha | ICAR-MGIFRI | 126 | Dr. S. K. Purbey |
| 4 | 15-17 March, 2021 | Integrated Fish Farming for Livelihood Improvement of Small and Marginal Farmers | ICAR-MGIFRI | 35 | Mr. Ravi Kumar |
| 5 | 18-20 March, 2021. | Improved management practices for goat husbandry | ICAR-MGIFRI | 34 | Dr. P.K. Bharti |
| 6 | 06 April, 2021 | On Farm training on orchard management for quality fruit production | Jhakra, madhuban, jasauli Patti | 50 | Dr. S. K. Purbey |

| | | | | | |
|---|---|---|---|---|---|
| 7 | 10 July, 2021 | Fish Seed Stocking and Management | ICAR-MGIFRI | 50 | Mr. Ravi Kumar |
| 8 | 14-16 August, 2021 | कृषक-वैज्ञानिक संगोष्ठी एवं कृषि उपकरणों/ सामग्रियों का वितरण” | ICAR-MGIFRI | 1500 | Mr. Ravi Kumar |
| 9 | 26 August, 2021 | KISAN GOSHTHI on 'Food and Nutritional Security through IFS | ICAR-MGIFRI | 73 | Mr. Ravi Kumar |
| 10 | 1 September, 2021 | System Diversification in Aquaculture' as a part of Bharat Ka Amrit Mahotsav | ICAR-MGIFRI | 33 | Mr. Ravi Kumar |
| 11 | 28-30 September, 2021 | *Bakri palan vyavsay dwara jal jamao kshetra ke krishakon ki ajivika me unnati* | ICAR-MGIFRI | 217 | Dr. P.K. Bharti |
| 12 | 12 October, 2021 | Production techniques of rabi vegetable crops and distribution of seed | Ujhilpur, Narha under FFP | 52 | Dr. S. K. Purbey |
| 13 | 17 November, 2021 | Hands-on Training on Button Mushroom | Hanuman Nagar, Ujhilpur | 45 | Dr. S.K. Purbey |
| 14 | 22-24 November, 2021 | Fish health management in integrated farming systems | ICAR-MGIFRI | 50 | Mr. Ravi Kumar |
| 15 | 16 December, 2021 | Farmers-scientists interaction meet program on Natural Farming | ICAR-MGIFRI | 51 | Mr. Ravi Kumar |
| 16 | 23 December, 2021 | National Farmers' Day program on. | ICAR-MGIFRI | 205 | Mr. Ravi Kumar |

**National Campaign/ Training & Capacity building organized at ICAR-MGIFRI**

**Capacity-Building Training to Farmers and Rural Youths on Livelihood Security under SCSP Scheme of the Institute, 18-20 February 2021**

**Capacity-Building Training to Farmers and Rural Women on Kitchen Gardening at the institute, 8 March 2021**

**Celebration of National Fish Farmers' Day 10 July 2021**

**One-Day Nutrition Camp at Village Belladheka, Piprakothi on -26 August 2021**

National Campaign on System Diversification
In Aquaculture 1st September 2021

Poshak Vatika Mahaavijan: Awarness Programme
on Millets on 17 September 2021

National Campaign on Agriculture & Envireonment:
The citizen Face 26 November 2021

Observing Mahila Kissan Divas at Chakia,
East Champaran on 15 October 2021

National Campaign on Fish Health
Management on 22-25 November 2021

Hands-on Training and Demonstration on Mushroom
cultivation at Farmers First Project (FFP) village ----
27 November 2021

## Various input distribution to the farmers during 2021 at ICAR-MGIFRI

Distribution of vegetable seed to the farmers
8 March-2021

Distribution of Kapsack power sprayer
21 March-2021


Distribution of Chicks 11 May-2021


Storage grain bins (Drum) distribution on 23 August 2021


Har Med Par Ped programme: Saplings distribution of fruits on 16 September 2021


Distribution of winnowing fan & paddy thresher during 2021-2022

## Lectures delivered as resource person in training outside the institute

| Sl No | Scientist | Lecture given in | Total lecture | Location |
|---|---|---|---|---|
| 1 | Dr. K.G. Mandal | Training on integrated nutrient management to the farmers | 8 | KVK, Piprakothi, RPCAU, Pusa |
| 2 | Dr. S. K. Purbey | 15days Training on integrated nutrient management to the farmers | 1 | KVK, Piprakothi, RPCAU, Pusa |
| 3 | Dr. S. K. Purbey | Horticulture Based Integrated Farming System' | 4 | Sitamarhi at PDUCH&F, Piprakothi, East Champaran |
| 4 | Dr. S. K. Purbey | 15days Training on integrated nutrient management to the farmers | 1 | KVK, Piprakothi, RPCAU, Pusa |
| 5 | Dr. A. K. Singh | Training on integrated nutrient management to the farmers | 6 | KVK, Piprakothi, RPCAU, Pusa |
| 6 | Dr. S. K. Samal | Training on integrated nutrient management to the farmers | 4 | KVK, Piprakothi, RPCAU, Pusa |
| 7 | Dr. Shreya Nivesh | Training on integrated nutrient management to the farmers | 3 | KVK, Piprakothi, RPCAU, Pusa |
| 8 | Dr. Koushik Banerjee | Training on integrated nutrient management to the farmers | 2 | KVK, Piprakothi, RPCAU, Pusa |

## Participation in Seminar/ Symposium/ Conference/ Workshop/ Webinar

| Sl No | Scientist | Seminar/ Symposium/ Conference/ Workshop | Participation | Date | Location |
|---|---|---|---|---|---|
| 1 | Dr. P. K. Bharti | National webinar on eve of world milk day | Lecture delivered | 1 January 2021 | KVK, Saraiya, Muzzafafarpur |
| 2 | Dr. Koushik Banerjee | International Webinar on World Earth Day, 2021 Restore Our Earth | Online webinar | 22 April 2021 | ICAR-NAHEP, Sri Karan Narendra Agriculture University, Jobner (Raj.) |
| 3 | Dr. P. K. Bharti | National webinar on Blood transfusion in large animals under field conditions: An innovative approach | Webinar attended | 25 July 2021 | Alembic Pharmaceuticals Ltd, Mumbai |
| 4 | Dr. Koushik Banerjee | Ecosystem for Sustainable FPO" on, organized under Azadi Ka Amrut Mahotsav | Online webinar | 30 July 2021 | ICAR-Research Complex for Eastern Region, Patna |
| 5 | Dr. S. K. Purbey | "Horticulture for Next Generation in Eastern India | Lead lecture | 5-6 August 2021 | BAU, Sabour, Bhagalpur, Bihar |
| 6 | Dr. K.G. Mandal | National Seminar (virtual mode) on Rice-fallow management in Eastern India | Lead lecture | 26 August 2021 | ICAR-Research Complex for Eastern Region, Patna, Bihar |
| 7 | Dr. Koushik Banerjee | Rice -fallow management in Eastern India | Online webinar | 26 August 2021 | ICAR –Research Research Complex for Eastern Region, Region, Patna |
| 8 | Dr. K.G. Mandal | NABS-International Conference on "Life Sciences: Contemporary approaches in Biological Science for Food, Health, Nutrition Security and Conservation of Biodiversity (virtual mode) | Lead lecture | 27 August 2021 | NABS, Tamil Nadu, India |
| 9 | Dr. K.G. Mandal | National Stakeholders Consultation Workshop on 'Development of roadmap for institutional and policy mainstreaming of sustainable land and ecosystem management in India', under Green India Mission | Virtual Webinar | 27 August 2021 | Indian Council of Forestry Research & Education, Dehradun |
| 10 | Dr. K.G. Mandal | International Conference on "Reorienting Agronomic Research and Education to Combat Current and Future Challenges in Agriculture (virtual mode) | Lead lecture | 20–22 September 2021 | Department of Agronomy, PG College of Agriculture, Dr. RPCAU, Pusa, Samastipur, Bihar |
| 11 | Dr. P. K. Bharti | National webinar on Important animal diseases and their control program in India | Webinar attended | 23 October 2021 | ICAR RCER Patna |

| | | | | | |
|---|---|---|---|---|---|
| 12 | Dr. K.G. Mandal | Fifth International Agronomy Congress (IAC) on Agri-Innovations to Combat Food and Nutrition Challenges, organized by the Indian Soc of Agronomy, New Delhi | Attended | 23-27 November 2021 | PJTSAU, Hyderabad, Telangana, India |
| 13 | Dr. A. K. Singh | 5th International Agronomy Congress on Agri Innovations to Combat Food and Nutrition Challenges | Poster presentation | 23-27 November 2021 | CRIDA Hyderabad |
| 14 | Dr. Koushik Banerjee | 5th International Agronomy Congress on Agri Innovations to Combat Food and Nutrition Challenges | Poster presentation | 23-27 November 2021 | CRIDA Hyderabad |
| 15 | Dr. S. K. Samal | 5th International Agronomy Congress on Agri Innovations to Combat Food and Nutrition Challenges | Poster presentation | 23-27 November 2021 | CRIDA Hyderabad |
| 16 | Dr. Koushik Banerjee | Management of Water Surplus - Deficit Dichotomy in North Eastern Agriculture to enhance the Productivity | Online webinar | 30 November 2021 | NIRDPR-NERC, Guwahati & ICAR - Research Complex - North Eastern Hill Region, Meghalaya |
| 17 | Dr. Koushik Banerjee | Modelling soil physical processes for improving resource use efficiency in Agriculture on | Online webinar | 8 December 2021 | Indian society of Agrophysics and division of Agricultural physics ICAR-IARI |
| 18 | Dr. K.G. Mandal | National Web Conference of Soil Conservation Society India (SCSI) | Virtually attended | 14 December 2021 | SCSI, New Delhi & OUAT, Bhubaneswar |
| 19 | Dr. A. K. Singh | 30th National Web Conference on Soil and Water Management Technologies for Climate Resilience, Agricultural and Environmental Sustainability | Oral Presentation | 14-16, December 2021 | SCSI, New Delhi & OUAT, Bhubaneswar Soil Conservation Society of India at Bhubaneswar, Odisha |
| 20 | Dr. Koushik Banerjee | 30th National Web Conference on Soil and Water Management Technologies for Climate Resilience, Agricultural and Environmental Sustainability | Oral Presentation | 14-16, December 2021 | Soil Conservation Society of India at Bhubaneswar, Odisha |

# Events organized (Meeting/Training/ Exhibition/ Workshop/Seminar)

| Sl. No. | Date | Name of the event | Place | No. of participant | Coordinators |
|---|---|---|---|---|---|
| 1 | 18 June 2021 | Farmers' Awareness Campaign on Balanced use of Fertilizers | ICAR-MGIFRI | 15 | Dr. S.K. Samal<br>Dr. A.K. Singh<br>Dr. S.K. Purbey |
| 2 | 10 July 2021 | National Fish Farmers Day | ICAR-MGIFRI | 45 | Mr. Ravi Kumar<br>Dr. S.K. samal<br>Dr. P.K. Bharti<br>Dr. Shreya Nivesh |
| 3 | 16 July 2021 | Har Med Par Ped | ICAR-MGIFRI | 150 | Dr. S.K. Purbey<br>Dr. A.K. Singh<br>Dr. S.K. samal |
| 4 | 30 July 2021 | 'Black Bengal' Goat Distribution To Scheduled Castes Farmers Under Sc-SP Scheme | ICAR-MGIFRI | 150 | Mr. Ravi Kumar |
| 5 | 14-15 August 2021 | कृषक-वैज्ञानिक विचार मंथन सह प्रक्षेत्र भ्रमण एवं तकनीकी अवलोकन (कार्यशाला एवं जागरूकता कार्यक्रम) | ICAR-MGIFRI | 1000 | Dr. K.G. Mandal<br>Dr. A. Raizada<br>Mr. Ravi Kumar<br>Other scientists of the institute |
| 6 | 16 August 2021 | कृषक-वैज्ञानिक संगोष्ठी एवं कृषि उपकरणों/सामग्रियों का वितरण (एस.सी.एस.पी. परियोजना के अतर्गत) | ICAR-MGIFRI | 700 | Dr. K.G. Mandal<br>Dr. A. Raizada<br>Mr. Ravi Kumar<br>Other scientists of the institute |
| 7 | 21 August 2021 | Seventh Foundation Day Celebration Of The Institute On 21st August 2021 | ICAR-MGIFRI | 12 | All scientists of the institute |
| 8 | 26 August 2021 | समेकित कृषि प्रणाली के माध्यम से खाद्य एवं पोषण सुरक्षा विषय पर एक दिवसीय किसान गोष्ठी | Bela Dhekaha, Piprakothi, East champaran, Bihar | 70 | Mr. Ravi Kumar |
| 9 | 01 September 2021 | System Diversification In Aquaculture | ICAR-MGIFRI | 30 | Mr. Ravi Kumar |
| 10 | 17 September 2021 | Poshan Vatika Maha Abhiyan & Tree Plantation | ICAR-MGIFRI | 125 | Dr. S.K. Samal<br>Dr. Koushik Banerjee |
| 11 | 12 October 2021 | Special National Swachchhata Campaign | Chintamanpur, Chakia, East Champaran, Bihar | 150 | Dr. S.K. Samal |
| 12 | 15 October 2021 | Mahila Kishan Divas | Khairimal-Jumunia, Chakia, East Champaran, Bihar | 32 | Dr. Shreya Nivesh<br>Dr. S.K. Samal<br>Dr. A.K. Singh |
| 13 | 16 October 2021 | World Food day | Khairimal-Jumunia, Chakia, East Champaran, Bihar | 40 | Dr. S.K. Samal<br>Dr. Shreya Nivesh<br>Dr. A.K. Singh |
| 14 | 22-24 November 2021 | National Campaign On "Antimicrobial Resistance In Fish"-A training programme | ICAR-MGIFRI | 47 | Mr. Ravi Kumar<br>Dr. P.K. Bharti |

| | | | | | |
|---|---|---|---|---|---|
| **15** | 26 November 2021 | National Campaign- Agriculture and Environment: The Citizen Face | ICAR-MGIFRI | 30 | Dr. S.K. Samal<br>Dr. Shreya Nivesh |
| **16** | 05 December 2021 | World Soil Day<br>5 December 2021 | Jasaulipatti, Kotwa, East Champaran, Bihar | 37 | Dr. S.K. samal<br>Dr. Shreya Nivesh<br>Dr. Koushik Banerjee |
| **17** | 16 December 2021 | Farmers-Scientists Interaction Program | ICAR-MGIFRI | 51 | Mr. Ravi Kumar |
| **18** | 23 December 2021 | Farmers-Scientists Interaction & Exposure Visit | ICAR-MGIFRI | 200 | Mr. Ravi Kumar<br>Dr. A.K. Singh |
| | | **Total no. of participants** | | **2884** | |

## Various events conducted at ICAR-MGIFRI, 2021

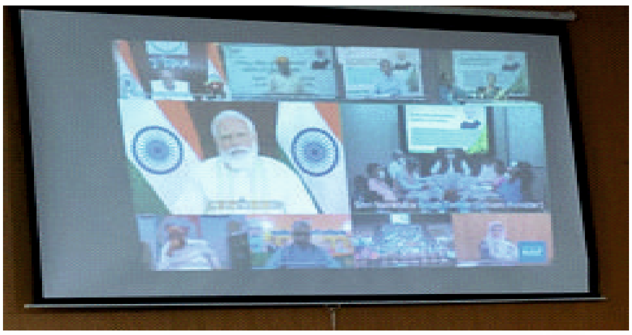
**Celebration of International Yoga Day, 21 June 2021**

**Celebration of Republic Day of India: 26 January 2021 at ICAR-MGIFRI**

**Joining of First Director of the Institute on 5 July 2021**

**Celebration of 7th Foundation Day of ICAR-MGIFRI, Motihari on 21st August 2021**

**Celebration of 75th Independence Day: 15 August 2021 at ICAR-MGIFRI**



**Farmer-Scientist Interface on Climate Resilient Programme: Hon'ble Prime Minister of India addressed on 28 September 2021**

Celebration of Hindi Pakhwada 14-28 September 2021


ICAR-MGIFRI observed World Food Day 15th October 2021


Celebration of Gandhi Jayanti-Mahatma Gandhi Birthday on 2 October 2021


Celebration of Constitution Day 26 November 2021


Dr. Trilochan Mahapatra, Hon'ble Secretary (DARE) & DG (ICAR) and Dr. S.K. Chaudhari, Hon'ble DDG (NRM) visited at ICAR-MGIFRI during 6-7 November 2021



Celebration of Rastriya Kisan Diwas on 23 December 2021

# Swachha Bharat Abhiyan

The Director and staff of ICAR-MGIFRI, Motihari participated actively in *Swachha Bharat bhiyan*. Cleanliness programmes were conducted monthly to keep the institute campus clean. *Swachhta* awareness programmes were also conducted time to time in institute and village levels to create an awareness about the swachhta among the local people. As per the directive received from the council and under the guidance of the Director of the institute, *Swachhata Pakhwada* was celebrated during 16.12.2021 to 31.12.2021. During the period composting and on-farm residue management technology was demonstrated to the farmers. They were made aware about the farm waste to wealth conversion. Swachhta activities were also conducted at village level and nearby area of the institute.

**A brief account on *Swachha Bharat Abhiyan* at ICAR-MGIFRI, Motihari in the year 2021**

| Sl. No. | Nature of event | No. of event | No. of staff/farmer participated |
|---|---|---|---|
| 1 | Basic maintenance | 28 | 50 |
| 2 | Cleaning and beautification of the surrounding area | 40 | 10 |
| 3 | Composting/vermicomposting/residue management and other activities on generation of wealth from waste | 02 | 10 |
| 4 | *Swachhata* awareness at local level | 05 | 50 |
| 5 | Involvement of print and electronic media | 04 | - |
| 6 | No. of VIP/VVIPs involved in the activities | 02 | 05 |
| 7 | Sanitization of office and campus of ICAR-MGIFRI | Daily | 05 |
| 8 | Swachhta pledge | 01 | 50 |

**Cleaning of institute campus**

**Cleaning of institute campus**

Beautification of institute campus


Swachhata pledge

Demonstration of residue management technology

Demonstration of composting technology

Swachhta activity at nearby of the institute


Swachhta activity at Jhakhra village

# Joining, Promotion, Superannuation & Transfer

| Name | ARS Discipline | |
|---|---|---|
| Dr. K.G. Mandal joined as a Director of ICAR-MGIFRI on 5th July 2021 | Former Principal Scientist, Agronomy, ICAR-IIWM, Bhubaneswar |  |
| Dr. Koushik Banerjee joined as a scientist on 12th January 2021 | Agricultural Meteorology |  |
| Er. Vikas Paradkar joined as a scientist on 12th January 2021 | Farm Machinery & Power Engineering |  |

# Personnel

As on 31.12.2021

**Scientific**

| SN | Name | Designation | ARS Discipline |
|---|---|---|---|
| 1 | Dr. K.G. Mandal | Director | Agronomy |
| 2 | Dr. Anurag Raizada | Principal Scientist | Agroforestry |
| 3 | Dr. S. K. Purbey | Principal Scientist | Fruit Science |
| 4 | Dr. A. K. Singh | Principal Scientist | Agronomy |
| 5 | Dr. P. K. Bharti | Senior Scientist | Livestock Production & Management |
| 6 | Dr. S. K. Samal | Scientist | Soil Science |
| 7 | Dr. Ravi Kumar | Scientist | Fisheries Resource Management |
| 8 | Dr. Shreya Nivesh | Scientist | Land and Water Management Engineering |
| 9 | Dr. Koushik Banerjee | Scientist | Agricultural Meteorology |
| 10 | Er. Vikas Paradkar | Scientist | Farm Machinery and Power engineering |

**Administration**

| SN | Name | Designation |
|---|---|---|
| 1 | Sh. Vipul Raj | Administrative Officer |
| 2 | Sh. Sajid Mustaq | Assistant Administrative Officer |

# Budget & Expenditure

### Table 1a – Research

| Research Component; Sub Scheme 4h: ICAR-Mahatma Gandhi Integrated Farming Research Institute, Motihari | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | (Rupees in lakhs) |
| **S. No.** | **Major Heads of Account** | **2021-22 (RE)** | **2022-23 (BE)** | **2023-2024** | **2024-2025** | **2025-2026** | **Total** |
| (A) | **Capital#** | | | | | | |
| 1 | **Building &Orignal works** | 168.11 | 130.00 | 278.00 | 270.00 | 235.00 | **1081.11** |
| 2 | **Equipment** (Laboratory & Farm Equipent including plant & machinery) | 52.69 | 30.00 | 65.00 | 68.00 | 58.50 | **274.19** |
| 3 | **Vehicles & Vessels** | 0.00 | 9.00 | 0.00 | 0.00 | 30.00 | **39.00** |
| 4 | **Information Technology & ICT** | 9.00 | 20.00 | 50.00 | 45.00 | 44.50 | **168.50** |
| 5 | **Livestock** | 8.00 | 6.72 | 15.00 | 10.00 | 10.00 | **49.72** |
| 6 | **Library** | 0.00 | 1.50 | 2.00 | 2.00 | 2.00 | **7.50** |
| | **SUB-TOTAL (A)** | **237.80** | **197.22** | **410.00** | **395.00** | **380.00** | **1620.02** |
| (B) | **REVENUE** | | | | | | |
| 1 | **Research and operational Expenses*** | 81.50 | 87.00 | 120.00 | 130.00 | 123.00 | **541.50** |
| 2 | **Administrative Expenses**** | 104.55 | 72.44 | 80.00 | 89.00 | 80.22 | **426.21** |
| I). | Travelling Expenses | | | | | | |
| a. | Domestic (TA/TTA) | 4.70 | 5.00 | 10.00 | 11.00 | 10.13 | **40.83** |
| b. | Abroad | 0.00 | 0.00 | 5.00 | 0.00 | 5.00 | **10.00** |
| 3 | **Miscellaneous Expenses** | 2.45 | 5.50 | 6.50 | 7.50 | 8.05 | **30.00** |
| | **SUB-TOTAL (B)** | **193.20** | **169.94** | **221.50** | **237.50** | **226.40** | **1048.54** |
| | **GRAND TOTAL (A+B)** | **431.00** | **367.16** | **631.50** | **632.50** | **606.40** | **2668.56** |

### Table 2b - Research Establishment

| Research Establishment; Sub Scheme 4h: ICAR-Mahatma Gandhi Integrated Farming Research Institute, Motihari | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | (Rupees in lakhs) |
| **S.no.** | **Particular** | **2021-2022 (RE)** | **2022-2023 (BE)** | **2023-2024** | **2024-2025** | **2025-2026** | **Total** |
| **1** | Grant in Aid Capital | 237.80 | 197.22 | 410.00 | 395.00 | 380.00 | **1620.02** |
| **2** | Grant in Aid General | 193.20 | 169.94 | 221.50 | 237.50 | 226.40 | **1048.54** |
| | **Total** | **431.00** | **367.16** | **631.50** | **632.50** | **606.40** | **2668.56** |

## Table 2a – Research Establishment

| S.No. | Major Heads of Account | 2021-22 | 2022-23 | 2023-2024 | 2024-2025 | 2025-2026 | Total |
|---|---|---|---|---|---|---|---|
| Sub Scheme 4h: ICAR-Mahatma Gandhi Integrated Farming Research Institute, Motihari | | | | | | | |
| | | | | | | | (Rupees in lakhs) |
| **(A)** | **Capital#** | | | | | | |
| **1.** | **Land** | | | | | | |
| **a.** | Freehold | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** |
| **b.** | Leasehold | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** |
| **2.** | **Equipment**<br>Office Equipment | 0.00 | 5.00 | 6.00 | 5.00 | 5.00 | **21.00** |
| **3.** | **Furniture & Fixtures** | 10.00 | 5.00 | 10.00 | 8.00 | 7.73 | **40.73** |
| | **SUB-TOTAL (A)** | **10.00** | **10.00** | **16.00** | **13.00** | **12.73** | **61.73** |
| (B) | **REVENUE** | | | | | | |
| 1 | **Administrative Expenses and other Expenses**** | | | | | | |
| I. | Repairs & Maintenance of Building and other Assets | 0.58 | 11.50 | 12.00 | 14.50 | 9.58 | **48.16** |
| II. | Office/Farm/Laboratary Upkeep & other Maintenance Expenses | 0.00 | 27.50 | 106.15 | 108.00 | 97.24 | **338.89** |
| | **SUB-TOTAL (B)** | **0.58** | **39.00** | **118.15** | **122.50** | **106.82** | **387.05** |
| | **GRAND TOTAL (A+B)** | **10.58** | **49.00** | **134.15** | **135.50** | **119.55** | **448.78** |

## Table 2b - Research Establishment

| S.no. | Particular | 2021-2022 (RE) | 2022-2023 (BE) | 2023-2024 | 2024-2025 | 2025-2026 | Total |
|---|---|---|---|---|---|---|---|
| Research Establishment; Sub Scheme 4h: ICAR-Mahatma Gandhi Integrated Farming Research Institute, Motihari | | | | | | | |
| | | | | | | | (Rupees in lakhs) |
| **1** | Grant in Aid Capital | 10.00 | 10.00 | 16.00 | 13.00 | 12.73 | **61.73** |
| **2** | Grant in Aid General | 0.58 | 39.00 | 118.15 | 122.50 | 106.82 | **387.05** |
| | **Total** | **10.58** | **49.00** | **134.15** | **135.50** | **119.55** | **448.78** |

**Dr. Trilochan Mahapatra**
**Hon'ble Secretary (DARE) & DG (ICAR)**
**&**
**Dr. S.K. Chaudhari**
**Hon'ble DDG (NRM)**
**visited the ICAR-MGIFRI, Motihari**
**6-7 November 2021**


भाकृअनुप-महात्मा गाँधी समेकित कृषि अनुसंधान संस्थान

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