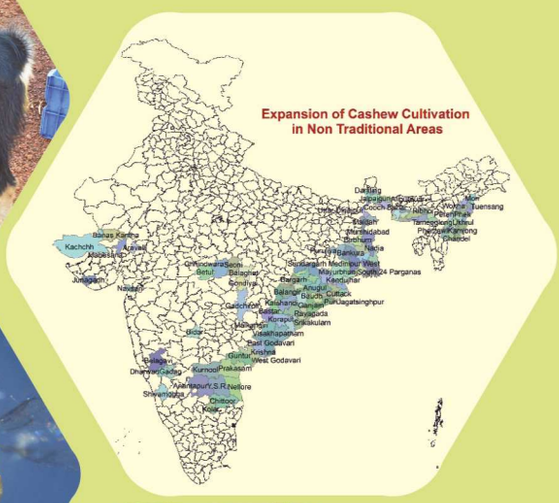
ISO 9001:2015

वार्षिक प्रतिवेदन
Annual Report
2020



ICAR-Central Coastal Agricultural Research Institute

भाकृअनुप-केन्द्रीय तटीय कृषि अनुसंधान संस्थान

Old Goa, Goa, India - 403 402

https://ccari.icar.gov.in

FOLLOW US ON twitter

Find us on Facebook

Training on Turmeric production, processing and marketing

Inputs distribution under SCSP Programme

वार्षिक प्रतिवेदन
Annual Report
2020

भाकृअनुप
ICAR

भाकृअनुप-केन्द्रीय तटीय कृषि अनुसंधान संस्थान

ओल्ड गोवा, गोवा, भारत - ४०३ ४०२

ICAR-CENTRAL COASTAL AGRICULTURAL RESEARCH INSTITUTE

Old Goa, Goa, India - 403 402

https://ccari.icar.gov.in

ICAR-CCARI, Goa
Annual Report
2020

Publisher : **Dr Parveen Kumar**
Director
ICAR - Central Coastal Agricultural Research Institute
Old Goa, Goa, India - 403 402
Tel : 0832-2285381, 2284677/678/679
Fax : 0832-2285649
E-mail : director.ccari@icar.gov.in
Website : ccari.icar.gov.in

Correct Citation : **ICAR-CCARI Annual Report 2020**
ICAR - Central Coastal Agricultural Research Institute
Old Goa, Goa, India - 403 402

Editors : Dr. Parveen Kumar
Dr. Mathala Juliet Gupta
Dr. Maruthadurai R
Dr. Susitha Rajkumar
Shri Trivesh Mayekar
Dr. Maneesha S R
Dr. Parmesha V
Dr. Sujeet Desai

Compilation & Technical Assistance : Mr. Sidharth K. Marathe

Cover page photos

1. Potential non-traditional areas for cashew cultivation
2. Konkan Kanyal goat
3. Brooding of chicks
4. Egg parasitoids of Fall armyworm
5. Dehydrated jackfruit bulbs
6. Seabass fish
7. Vertical nursery of lemongrass
8. Water harvesting pond
9. Hilario mango

Preface

Catering to the agricultural research needs of one of the world's most sensitive and vital ecosystems, "The Coastal Ecosystem", where almost 50-70% of the population thrives on a mere 4% of the earth's total area, places a significant burden on the shoulders of ICAR-CCARI. But very graciously, the tiny scientific fraternity of the institute has set about on the task assigned to it. I feel proud looking back on the achievements of the previous year and the positive partnerships forged with stakeholders, including educational and research institutions, line departments in the coastal departments and farmers.

The institute focuses on nine coastal states with 75 coastal districts along a total coastline of India measuring 7516.6 km, of which 5422.6 km is in the mainland, and 2094 km is in island territories. Coastal agriculture faces a diverse set of problems *vis-a-vis* climate change, natural calamities, rising sea level, soil and groundwater salinity, falling water table, lack of irrigation infrastructure, low productivity in crops and livestock, over-exploitation of fishery resources, biotic stress, biodiversity degradation, unplanned urbanization, non-availability and high cost of the workforce for agriculture, non-availability of quality seed and planting materials in time, wild animal menace in agriculture, high postharvest losses, lack of processing facility, cold storage and warehouses, non-availability of quality feed and fodder for livestock, lack of capacity building of farmers and youth, non-existent coordination among different government departments/various agencies etc. And hence, we work on a diverse set of research themes *viz.* conservation, utilization and management of natural resources, crop, livestock and fisheries, development of production technologies, postharvest management and agri-entrepreneurship.

The year 2020 has been a rewarding year for the institute, with very promising initiatives with stakeholders and outstanding achievements. The institute pioneers in the conservation of field and horticultural crops, important microbial, fish, birds and animals of the coastal ecosystem. A total of 133 landraces and 20 wild rice species have been collected and maintained at the institute. They are being purified and screened for valuable traits such as climate resilience, hardiness to biotic and abiotic stress *vis-a-vis* tolerance to salinity and submergence. Fish community structures from fourteen estuaries from the west coast of India have been analyzed, and a total of 302 species were recorded. A Survey of 150 backyard poultry farmers of Goa and North Karnataka to study the current scenario of backyard poultry farming has shown the way forward in coastal poultry research. The institute has also maintained 165 mango accesions, 97 cashew accesions and 47 nutmeg accesions. Two more new variety release proposals for Goa brinjal-5 and Goa brinjal-6 were submitted to the Director, Directorate of Agriculture, Government of Goa. A patent for Extender for the preservation of boar semen (application no. INBA3202001964 | Patent application No. 3037/MUM/2015) was filed to Patent Attorney in September 2020.

The institute has many projects funded through national agencies like DST-2, DBT-1, NABARD-2, ICAR network and Seed Projects-6. The institute's research output in peer-reviewed journals has been 38 for this year, and most of them have been published in journals of high impact. The number of other publications has been five popular articles, five book chapters, two technical bulletins, folders 2, leaflets five. The scientists have participated and presented their research achievements in 15 symposia.

ICAR-CCARI works for the needs of its stakeholders and in close association with the farmers. It has distributed inputs, mainly the technologies of ICAR-CCARI and ICAR, worth 48.52 lakhs to the SCSP Farmers and 9.68 lakhs to STC farmers.

I proudly present the achievements of ICAR-CCARI in the form of Annual Report 2020, which is just a window to our vast and diverse work. I humbly invite suggestions to modify and improve our future work plan.

I sincerely acknowledge the support of our stakeholders-line departments, NABARD and farmers and hope for the same in the future years to come across all the nine states and 2 Union Territories, comprising a total of 75 districts. I thank Dr Trilochan Mohapatra, Director General, ICAR and Secretary, DARE, for his patronage, support and avid interest in our institute's research and other activities. I gratefully acknowledge the support of Dr Suresh Kumar Chaudhari, Deputy Director General, NRM Division, ICAR, for his continuous encouragement and guidance.

Place : Old Goa
Date : 09-12-2021

(Parveen Kumar)
Director

CONTENT

कार्यकारी सारांश

- भाकृअनुप – केन्द्रीय तटीय कृषि अनुसंधान संस्थान, गोवा द्वारा विभिन्न अनुसंधान विषयों यथा प्राकृतिक एवं आनुवंशिक संसाधनों का संरक्षण, प्रबंधन एवं उपयोगिता; फसलों, पशुओं व मात्स्यिकी के लिए उत्पादन प्रौद्योगिकियों का विकास; फ़सलोत्तर प्रौद्योगिकियों का विकास एवं कृषि इको-टूरिज्म के अंतर्गत रणनीतिपरक एवं प्रायोगिक अनुसंधान किया जाता है। अनुसंधान परियोजनाओं को पांच मेगा विषयों में सुचारूबद्ध किया गया है। वर्ष 2020 के लिए संस्थान की प्रमुख अनुसंधान उपलब्धियों को नीचे प्रस्तुत किया गया है :

तटीय क्षेत्र के प्राकृतिक संसाधनों का संरक्षण एवं प्रबंधन

- भारत के पश्चिमी एवं पूर्वी तटों के क्षेत्रों में मौसमी (मानसून), मानसून उपरांत खरीफ (POMKH), मानसून उपरान्त रबी (POMRB) तथा मानसून पूर्व (PREMON) भूजल स्तर की गहराई में रूझानों का मूल्यांकन किया गया और इस कार्य में मैन केंडल जांच एवं सेन स्लोप का इस्तेमाल किया गया।
- पश्चिमी और पूर्वी तटों के लिए विभिन्न मौसमों हेतु भूजल स्तर की गहराई में बढ़ोत्तरी क्रमश: 0.56 से 0.65 मीटर प्रति वर्ष और 0.31 से 0.41 मीटर प्रति वर्ष थी।
- इसी प्रकार पश्चिमी एवं पूर्वी तटों में विभिन्न मौसमों के लिए भूजल स्तर गहराई में कमी क्रमश: -0.19 से -0.32 मीटर प्रति वर्ष एवं -0.54 से 0.86 मीटर प्रति वर्ष पाई गई।
- भारत के पश्चिमी तटवर्ती क्षेत्रों की लवण प्रभावित मृदाओं में, मृदा संतृप्त घोल (1:1, 1:2, 1:2.5 तथा 1:5 के अनुपात में) में मापा पी.एच. एवं विद्युत चालकता का जल निष्कर्षण के संबंध मजबूत, रेखीय तथा उल्लेखनीय (पी.एच. के लिए $R^2 \geq 0.72$ तथा विद्युत चालतकता के लिए ≥ 0.84) पाया गया।
- जल अनुपात (EC 1: 2) में मृदा संतृप्त घोल के निष्कर्षण (ECe) तथा 1 : 2 मृदा में मापी गई विद्युत चालकता के मध्य समाश्रयण संबंध इस प्रकार पाया गया : $ECe = 2.5272 \times (EC\ 1:2) + 2.77$ ($R^2 = 0.84$, $p<0.05$) । यह भारत के पश्चिमी तटवर्ती क्षेत्रों की लवण प्रभावित मृदा जहां मृदा की लवणीयता का संबंध अम्लता से जुड़ा हुआ है, की लवणता का अध्ययन करने में उपयोगी हो सकता है।
- आम और काजू की पत्तियों में पोषणिक स्तर का पूर्वानुमान लगाने के लिए विजीबल नियर इन्फ्रारेड़ हायपरस्पेक्ट्रेल रिमोट सेन्सिंग का उपयोग किया जा सकता है। आम के लिए $R^2 \geq 0.88$ तथा काजू के लिए $R^2 \geq 0.48$ की सटीकता के साथ वृहद एवं सूक्ष्म पोषक तत्वों का सर्वश्रेष्ठ तरीके से पूर्वानुमान लगाने के लिए आंशिक न्यूनतम वर्गाकार समाश्रयण सम्मिलित मशीन लर्निंग मॉडल्स के एक स्पेक्ट्रेल एल्गोरिदम की पहचान की गई। यह सुझाव है कि परिशुद्ध प्रबंधन हेतु काजू पत्ती में पोषणिक स्तर को पुन: प्राप्त करने में स्पेक्ट्रेल एल्गोरिदम का उपयोग किया जाए।
- गोवा की विशिष्ट निचली भूमि वाली परिस्थितियों के लिए 0.5 हेक्टेयर पर एक चावल आधारित कृषि प्रणाली मॉडल (फसल-डेयरी) का मानकीकरण किया गया। इस मॉडल में शामिल विभिन्न उद्यम हैं : क्षेत्र फसलें (चावल एवं तदुपरान्त लोबिया/मूंग/सब्जियां/बेबी कॉर्न/स्वीट कॉर्न – 0.4 हेक्टेयर), चारा उगाये गए बंध (संकर नेपियर – 0.032 हेक्टेयर), डेयरी (24 m^2 – संकर नस्ल की दो गायें), मत्स्य तालाब एवं बत्तख पालन तथा गोबर की खाद वाली इकाई (10 m^2)। इस प्रणाली के अंतर्गत 18.2 क्विंटल चावल, 316 किलोग्राम बेबी

कॉर्न, 184 किलोग्राम स्वीट कॉर्न, 132 किलोग्राम मूंग (दो फसलें), 73 किलोग्राम लोबिया, तथा 2.9 टन चारा मक्का एवं 1060 लिटर दूध का उत्पादन हुआ। सकल लाभ में सबसे अधिक योगदान (रूपये 2.71 लाख) फसलों का (61 प्रतिशत) एवं तदुपरान्त डेयरी उद्यम (22 प्रतिशत) का था। कम्पोस्टिंग के माध्यम से फॉर्म अपशिष्ट और फसल अपशिष्ट की रिसाइक्लिंग का कार्य किया गया।

- विभिन्न बागवानी आधारित फसलचक्र प्रणालियों में, आई.एफ.एस. मॉडल के छः वर्ष उपरान्त प्रणाली का सकल लाभ लगभग रूपये 1,92,700/- और शुद्ध लाभ रूपये 1,30,250/- था। शुद्ध लाभ में सबसे अधिक हिस्सेदारी शूकर पालन इकाई (37 प्रतिशत) से एवं तदुपरान्त काजू – अनानास फसलचक्र प्रणाली (33 प्रतिशत) से थी।
- धान की पंकिल अथवा गीली पौध रोपण प्रणाली (PTR), धान की सीधी बीजाई (DSR), चावल-मूंग, चावल - लोबिया तथा चावल - बेबी कॉर्न सहित चावल आधारित फसलचक्र प्रणालियों में विभिन्न प्रकार की जुताई प्रबंधन रीतियों को परखा गया। फसल के उपज संबंधी आंकड़ों से विभिन्न जुताई प्रबंधन रीतियों के मध्य उल्लेखनीय भिन्नता देखने को मिली। धान की सीधी बीजाई - बेबी कॉर्न में शून्य जुताई - मूंग में शून्य जुताई (तिहरा फसलचक्र) को अपनाकर किसान अपने फसल उत्पादन (REY - 12.1 टन/हेक्टेयर) एवं लाभप्रदता (शुद्ध लाभ : प्रति हेक्टेयर 1.1 लाख रूपये) को बढ़ा सकते हैं। चावल परती भूमि के उपरान्त बेबी कॉर्न की खेती करने से पशुधन संघटक में अतिरिक्त हरा चारा(6 टन/हेक्टेयर)मिलता है। वातावरणीय नाइट्रोजन को नियत करने की अपनी स्वाभाविक क्षमता के कारण ग्रीष्म मूंग की खेती करने पर मृदा उर्वरता बढ़ी और मृदा कार्बन पृथक्करण (प्रति हेक्टेयर 31 मिग्रा. कार्बन) में सुधार आया।
- भारत के पश्चिमी तटवर्ती जिलों की जलवायु परिवर्तन के प्रति संवेदनशीलता का मूल्यांकन उनकी संवेदनशीलता, प्रकटन एवं अनुकूलनीय क्षमता संकेतकों पर संकलित डाटा के आधार पर किया गया।

तटवर्ती क्षेत्र में आनुवंशिक संसाधनों का संरक्षण एवं उपयोगिता

- खरीफ मौसम के दौरान प्रति वर्ष संस्थान के फार्म पर अप्रसंस्कृत अथवा लैण्डरेसिस किस्मों (133) तथा वन्य चावल किस्मों (20) सहित चावल जननद्रव्य संकलन का रखरखाव किया जा रहा है । इनमें उपज एवं योगदान करने वाले लक्षणों पर आंकड़ों को दर्ज किया गया ताकि भावी उपयोग के लिए वंशक्रमों का विकास करने हेतु प्रजनन–पूर्व कार्यक्रमों में प्रयोजन से आशाजनक वंशक्रमों की पहचान की जा सके। संकलन में शामिल हैं: लवणता एवं जल–मग्नता वाली अप्रसंस्कृत किस्में अथवा लैण्डरेसिस, सुगन्धित चावल किस्में, तथा पश्चिमी तटवर्ती क्षेत्र में प्रचलित कीटों व रोगों की प्रतिरोधिता वाली किस्में।
- खरीफ मौसम के दौरान प्रति वर्ष गुणनीकरण करते हुए संस्थान के फार्म पर अप्रसंस्कृत अथवा लैण्डरेसिस किस्मों (133) तथा वन्य चावल किस्मों (20) सहित चावल जननद्रव्य संकलन का रखरखाव किया जा रहा है । सूक्ष्म प्लॉटों के अंतर्गत पौद अवस्था में लवणीय दबाव उत्पन्न करने के लिए 163 चावल जननद्रव्यों की फिनोटाइपिंग की गई। छांटे गए जीनप्ररूपों में, आठ जीनप्ररूपों में लवणीय दबाव की सहिष्णु (T) प्रतिक्रिया, बीस जीनप्ररूपों में संतुलित प्रतिक्रिया (MT) प्रदर्शित हुई जबकि शेष 132 जीनप्ररूपों में लवणीय दबाव के प्रति संवेदनशील (S) से लेकर अत्यधिक संवेदनशील (HS) प्रतिक्रिया देखने को मिली। अध्ययन के अंतर्गत पाए गए सहिष्णु जीनप्ररूप हैं: गोवा धान 2, गोवा धान – 4, CST - 1, कोरगट, कावेरी गिद्दा, GWR 016, डोडगी, तथा KS 04.
- निचले तटवर्ती लवणीय क्षेत्रों के लिए दोहरी दबाव सहिष्णु चावल किस्मों का विकास करने हेतु रिकॉम्बीनेन्ट अंत: प्रजात वंशक्रमों (RILs) का विकास करने के लिए उच्च उपजशील, लवणता तथा जल–मग्नता के प्रति सहिष्णु किस्मों/अप्रसंस्कृत किस्मों के साथ वर्ष 2020 की खरीफ मौसम में क्रास का एक नया सेट प्रारंभ किया गया था। कुल मिलाकर, ग्यारह द्विमार्गी क्रास, पांच त्रिमार्गी क्रास और

एक डबल क्रास विकसित किए गए। Karjat 3 X KS 19-2 क्रास से उत्पन्न लगभग 112 F8 रिकॉम्बीनेन्ट अंत: प्रजात वंशक्रमों (RILs) की फिनोटाइपिंग का कार्य शोराव द्वीप, उत्तरी गोवा में प्रयोगात्मक खेतों में तटवर्ती लवणीय परिस्थितियों के अंतर्गत किया गया। पचास प्रतिशत पुष्पन में लगने वाला समय (दिन), प्रति शीर्ष उपजाऊ दोजियों की संख्या, प्रति पुष्पगुच्छ दानों की संख्या तथा दाना उपज आदि लक्षणों को मापा गया ताकि स्टेशन परीक्षणों के लिए छांटे जाने हेतु उपयुक्त आशाजनक वंशक्रमों की पहचान की जा सके।

- बीज उत्पादन कार्यक्रम के अंतर्गत, संस्थान के फार्म पर उच्च उपजशील एवं लवणीय सहिष्णुता वाली चावल किस्मों के प्रजनक बीजों तथा विश्वसनीय लेबल्ड बीजों को लिया गया। संस्थान के फार्म पर लगभग 7.5 क्विंटल प्रजनक बीज और 2.65 क्विंटल विश्वसनीय लेबल्ड बीज का उत्पादन किया गया। इसके अलावा, संस्थान की चार लवणता सहिष्णु चावल किस्मों में 25 किलोग्राम केन्द्रक बीज उत्पादन किया गया। भारतीय कृषि अनुसंधान परिषद बीज परियोजना के क्षमता निम र्ाण घटक के तहत गावडोनग्रिम तथा कोतिगाव गांवों के किसानों को प्रशिक्षण प्रदान किया गया। किसानों को उच्चतर उत्पादन हासिल करने में गुणवत्ता बीजों का उपयोग करने के महत्व के बारे में जानकारी प्रदान की गई। किसानों को बीज उपचार करने और खेत में समुचित नियंत्रण उपायों को अपनाने हेतु प्रमुख कीट नाशीजीवों व रोग लक्षणों की पहचान करने पर प्रशिक्षण प्रदान किया गया।
- निचली भूमि वाली तटीय लवणीय मृदाओं में किसानों के खेतों में नवीन उच्च उपजशील लवणता सहिष्णु धान किस्में गोवा धान 3 एवं गोवा धान 4 पर अग्रिम पंक्ति प्रदर्शन लगाए गए। उत्तरी गोवा तथा दक्षिणी गोवा जिलों में 14 हेक्टेयर कृषि रकबे को शामिल करते हुए 22 अग्रिम पंक्ति प्रदर्शन लगाए गए। नवीन लवणता सहिष्णु चावल किस्मों में स्थानीय किस्म (1.8 टन/हेक्टेयर) की तुलना में कहीं अधिक दाना उपज (3.0 टन/हेक्टेयर) दर्ज की गई।
- उच्चभूमि परिस्थितियों में, कुल 28 हेक्टेयर कृषि रकबे को शामिल करते हुए चावल किस्म सहभागी धान पर कुल 42 अग्रिम पंक्ति प्रदर्शन आयोजित किए गए। प्रदर्शन (उन्नत प्रौद्योगिकी) तथा किसानों द्वारा अपनाई गई रीति में यादृच्छिक रूप से फसल की कटाई करके उपज आंकड़ों को संकलित किया गया। परिणामों से पता चला कि सहभागी धान किस्म में 44.0 से 49.42 क्विंटल/हेक्टेयर की दाना उपज हासिल की गई जबकि इसकी तुलना में किसानों द्वारा अपनाई गई रीति के तहत 34.12 से 39.45 क्विंटल/हेक्टेयर की दाना उपज हासिल की जा सकी। कुल मिलाकर किसानों द्वारा अपनाई गई रीति के मुकाबले में सहभागी धान किस्म में 29.62 प्रतिशत कहीं अधिक दाना उपज दर्ज की गई।
- भारत के पश्चिमी तट से चौदह नदीमुख से मत्स्य समुदाय संरचना का विश्लेषण किया गया और सभी नदीमुख से कुल 302 प्रजातियां दर्ज की गई। अधिकतम गणना जहां जुआरी से की गई वहीं सबसे कम गणना उल्हास से की गई। सभी नदीमुख में आवासीय नदीमुख मत्स्य जीव जंतु की तुलना में समुद्री प्रवासी प्रजातियों की बहुलता देखने को मिली। नदीमुख की पारितंत्र मॉडलिंग से मन्डोवी और जुआरी टेरेखोल नदीमुख के लिए अपेक्षाकृत रूप से कहीं उच्चतर संगठन एवं पारितंत्रिक अखण्डता का पता चला। नदीमुख मत्स्य समुदाय सूचकांक में भी जुआरी में अधिकतम मान और उल्हास में न्यूनतम स्तरों का पता चला।

तटवर्ती क्षेत्र की उल्लेखनीय फसलों की उत्पादन प्रौद्योगिकियों का विकास एवं प्रमाणन

- चार सालों के शोध आंकड़ों ने दर्शाया कि जीवाण्विक मुरझान प्रतिरोधी वंशक्रमों में जीवाण्विक मुरझान प्रकोप 3.0 प्रतिशत से भी कम है जबकि इनके मुकाबले में संवेदनशील वंशक्रमों में यह 87-95 प्रतिशत था।
- रोग संक्रमित मिर्च के पौध नमूनों के पी.सी.आर. एवं क्यू.पी.सी.आर. जाँचों से एक नमूने जिसमें CVMV पॉली-प्रोटीन पाया गया, अन्य सभी पौधों में केवल ChiL>CV ही पाया गया। मिर्च के क्षेत्र फसलों में

पर्यावरण–अनुकूल जीवाण्विक पदार्थों के उपचार से उच्चतर बढ़वार दर्ज किया गया । रोपण के 130 दिनों तक वॉइरेस संक्रमण का रोग संक्रमण पतिशत सूचकांक स्पिनोसड़, R>ch-2b आई. टेमिपेस में कम पाया गया। कुल उपज स्पिनोसड़ के उपचार वाले पौधों में (37.5 टन/हेक्टेयर), R>ch-2b के उपचार वाले पौधों में (33.5 टन/हेक्टेयर), आई. टेमिपेस में (33.3 टन/हेक्टेयर) पाया गया।

- जीवाणु आधारित फॉर्मूलेशन के भंडारण अवधि पर की अध्ययन में जीवाणु की आबादी 26 महीनों तक 9.0 Log CFU/g से अधिक पाया गया। अलजिनेट फॉर्मूलेशन में जीवाणुवों कि आबादी 24 महीनों तक 9.0 -10.0 Log CFU/g था ।
- चारा मक्का की फसल पर फॉल आर्मीवर्म (FAW), स्पोडोप्टेरा फ्रूजीपेर्डा के संक्रमण की सीमा 43 से 83 प्रतिशत के बीच दर्ज की गई। शाकीय अवस्था के दौरान प्रति पौधा अधिकतम 1.16 लार्वा संख्या के साथ प्रति पौधा औसतन 0.67 लार्वा पाए गए। गोवा से फॉल आर्मीवर्म की संख्या का mtCOI 5' आधारित अनुक्रम विश्लेषण करने पर पता चला कि चावल (R) स्ट्रेन तथा कॉर्न (C) स्ट्रेन चारा मक्का तथा स्वीट कॉर्न पर पलते हैं। सामान्य परभक्षी जैसे कि ईयरविग, मकड़ी, रेडुविड बग, रोव भौंरा अथवा भृंग, कॉक्सीनेलिड्स तथा ततैया फॉल आर्मीवर्म की विभिन्न अवस्थाओं में परभक्षण कर रहे हैं।
- अण्डा परजीव्याभ यथा टेलिनोमुस प्रजाति तथा ट्रॉइकोग्रामा प्रजाति अण्डों को परजीवी बनाते हुए पाए गए। रोव भृंग अथवा भौरों द्वारा अण्डों और द्वितीय इनस्टार लार्वा की तुलना में प्रथम इनस्टार फॉल आर्मीवर्म लार्वा को कहीं अधिक खाया गया। पीडेरस फुसाइप्स ने अण्डों और द्वितीय इनस्टार लार्वा की तुलना में प्रथम इनस्टार फॉल आर्मीवर्म लार्वा को कहीं अधिक खाया।
- मैक्सेन्ट मॉडल द्वारा 0.940 के प्रशिक्षण एयूसी मान और 0.936 के जांच एयूसी मान के साथ फॉल आर्मीवर्म के वर्तमान एवं भावी वितरण का पूर्वानुमान लगाया गया जिससे एस. फ्रूजीपेर्डा के लिए उपयुक्त एवं अनुपयुक्त मूलवास क्षेत्रों के बीच भेदभाव के लिए मॉडल की बेहतर क्षमता का पता चलता है। फॉल आर्मीवर्म की रोकथाम के लिए विभिन्न अंतर फसलों के प्रभाव का पता लगाने पर पता चला कि मक्का + लोबिया में 14.85 का कम प्रतिशत नुकसान और उच्चतर हरा चारा उपज दर्ज हुई जबकि इसके उपरान्त मक्का + मूंग में इसे दर्ज किया गया।
- नारियल की फसल में रूगोज़ स्पैरलिंग सफेद मक्खी एल्यूरो डाइकस रूगियोपर्कुलेटस मार्टिन तथा नेस्टिंग सफेद मक्खी पैरालेरोडेसमिनाई के गंभीर प्रकोप को दर्ज किया गया। नारियल के अलावा, केला, अमरूद, सुपारी, त्रियाण्ड्रा ताड़, आम, काली मिर्च, हेलिकोनिया, पपीता, सिट्रस, एवोकैडो, चाफा, इंडियन शॉट तथा मक्का पर सफेद मक्खी का संक्रमण और इसकी बसावट को दर्ज किया गया। मिर्च में पर्यावरण अनुकूल एकीकृत नाशीजीव एवं रोग प्रबंधन प्रौद्योगिकियों को प्रचलित किया गया। कंट्रोल की तुलना में आई. पी.डी.एम. प्रदर्शन प्लॉटों में सफेद मक्खी, एफ्ड़ तथा रोग का कहीं अधिक गंभीर प्रकोप दर्ज किया गया। एक एक्सीलोरोमीटर आधारित सेंसर की मदद से काजू में तना तथा जड़ वेधक प्लोसीडेरस प्रजाति संक्रमण की खाने वाली आवाजों का पता लगाया गया।
- पौध रोपण के तीन माह उपरान्त एक किलोग्राम एकीकृत पोषक तत्व मिश्रण (IN मिश्रण) का प्रयोग करने पर लाल लैटराइट मृदा में केला फसल की वृद्धि और उपज में सुधार आया। उर्वरकों की संस्तुत मात्रा के साथ एकीकृत पोषक तत्व मिश्रण से उपचारित ग्रैण्ड नैन किस्म में अधिकतम उपज (26.32 किग्रा.) दर्ज की गई । अगस्त – सितम्बर तथा नवम्बर – दिसम्बर के दौरान आम में नई बहार आई। अक्तूबर (215 मिमी.) और दिसम्बर (54.2 मिमी.) के दौरान आई वर्षा से पुष्पक्रम के स्थान पर नई बहार आई। वर्ष 2020 में चार वर्षीय KAS-11 कोक्म कलमबंधन में फूल आने प्रारंभ हुए और फलन हुआ जिसके परिणामस्वरूप 4.77 किग्रा. फल उत्पन्न हुए। केन्द्रीय तटीय कृषि अनुसंधान

संस्थान परिसर के भीतर कटहल प्राप्तियों की भिन्नता का मूल्यांकन किया गया और उच्च उपजशील (CT-10 : 10.81 किग्रा.) और उपयुक्त ताजा खपत तथा प्रसंस्करण टाइप की पहचान की गई।

पशुधन एवं मात्स्यिकी की उत्पादन प्रौद्योगिकियों का विकास एवं प्रमाणन

- डेयरी भैंस में पुनर्जनन परिवर्त के साथ पर्यावरणीय कारकों के सह–संबंध का मूल्यांकन करने के लिए ताप भार सूचकांक (HLI) का उपयोग करते हुए एक नवीन युक्ति को आजमाया गया। सर्दियों में कुल गर्भधारण दर के साथ HLI को नकारात्मक रूप से सम्बद्ध ($r = -0.97, p<0.05$) पाया गया और गर्मियों में पुनरावृति प्रजनन घटना के साथ सकारात्मक रूप से सम्बद्ध ($r = +0.90, p<0.05$) पाया गया। ग्रीष्म बांझपन अथवा निष्क्रियता से जुड़ी समस्याओं का समाधान करने हेतु ग्रीष्म में मदकाल के बिना वाली भैंस में मदकाल उत्पन्न होने और समकालिकता के लिए विभिन्न हार्मोनल तथा संयोजन उपचारों की प्रभावशीलता का मूल्यांकन किया गया।
- हर्बल तैयारी उपचार के साथ डबल पीजी एनालॉग का संयोजन ग्रीष्म में मदकाल रहित वाली भैंसों में मदकाल को उत्पन्न करने और मदकाल प्रकटन को बढ़ाने में कहीं अधिक प्रभावी पाया गया और इसमें संशोधित कोसिन्च प्रोटोकॉल (71.43 %) की तुलना में उल्लेखनीय ($p<0.05$) रूप से कहीं उच्चतर प्रारंभिक मदकाल उत्प्रेरण दर (83.33 %) पाई गई।
- स्मार्ट डेयरी पालन के लिए अवसरों को उत्पन्न करने की दिशा में एक वेब ऐप विकसित किया गया ताकि कटड़ों अथवा कटडियों के जन्म की तारीख की गणना करने और भैंस की विभिन्न नस्लों के लिए दूध छुड़ाने की आदर्श तारीखों का पता लगाने में किसानों की मदद की जा सके।
- अहाता कुक्कुट पालन की वर्तमान परिदृश्य का अध्ययन करने हेतु गोवा एवं उत्तरी कर्नाटक के कुल 150 अहाता कुक्कुट पालकों का सर्वे किया गया। परिणामों से दोहरे प्रयोजन वाले अहाता कुक्कुट पालन को अपनाने के बारे में पता चला और इस कार्य में भाकृअनुप – केन्द्रीय तटीय कृषि अनुसंधान संस्थान एक मुख्य स्रोत है तथा 84% किसानों ने चूजों के लिए सफाई के अलावा अनुपूरक आहार का उपयोग किया।

फसलोत्तर प्रौद्योगिकियों तथा अन्य कृषि उद्यमों के माध्यम से आजीविका सुरक्षा में सुधार करना

- कृषि इकोटूरिज्म इकाई में पादप विविधता को दस्तावेजी रूप दिया गया और धन्वंतरि वाटिका के पौधों में अधिकतम प्रजातियों की संख्या पाई गई।
- एईटी के संघटक के तौर पर जीवामृत को तैयार करने एवं इसका उपयोग करने तथा एजोला के संवर्धन की विधि को प्रदर्शित किया गया।
- एईटी केन्द्र में वर्मी कम्पोस्ट तैयार करने वाले दो चक्रों में, छ: टन जैव अपघटनीय कूडा करकट अथवा अपशिष्ट को पांच टन वर्मी कम्पोस्ट में रूपांतरित किया जा सका और इसमें कुल 232 दिनों के समय में 0.67 की रूपांतरण दर पाई गई । इस कार्य में 1.76 के लाभ:लागत अनुपात के साथ रूपये 0.88 लाख की सकल आय और रूपये 0.56 लाख की शुद्ध आय हुई।
- जिला स्तरीय सेकेण्डरी डाटा का उपयोग करते हुए तटवर्ती भारत के किसानों की टिकाऊ आजीविका में सुधार लाने के लिए ताड़ का सदुपयोग किया गया। अध्ययन में प्रारंभिक जांच से पता चला कि केरल के तटवर्ती जिलों में नारियल का योगदान केरल राज्य की GDP में 1 प्रतिशत तक है। प्रत्येक ताड़ के तहत क्षेत्र की वार्षिक वृद्धि दर पर भी कार्य किया गया। गुजरात राज्य की समृद्धि की दिशा में नारियल और खजूर के अंतर्गत कृषि रकबे में वृद्धिशील रूझान प्रदर्शित हुआ। गोवा राज्य की नारियल पापुलेशन अथवा संख्या (रिवोना, कैलान्गुट, गावडोंगरी, क्नकोना) का लक्षणवर्णन पौद गुणों के लिए किया गया।
- केले की स्थानीय किस्मों के तने से जैव अपघटनीय कप तैयार करने की प्रक्रिया विकसित की गई। रसपली किस्म से बने कपों में तुलनात्मक रूप से कमतर कॉब मान था।

- संशोधित डबल स्पैन पॉलीहाउस के अन्दर टमाटर के लिए उत्पादन प्रौद्योगिकी का विकास किया गया; इसके तहत अध्ययन की गई किस्में थीं : GS 600, अभिरंग, नामधारी 4266, गुजरात के घेटो किसानों की कलमबंधन टमाटर पौद (कलम–अंशल तथा मूलवृंत–सोल्मे)। टमाटर पौद का प्रदर्शन सूत्रकृमियों तथा जीवाण्विक मुरझान (60 से 97 प्रतिशत मृत्युदर) से गंभीर रूप से प्रभावित था जबकि मृदा पर कलमबंधन द्वारा बेहतर प्रदर्शन (20 से 40 प्रतिशत मृत्युदर) किया गया और बढ़वार थैलों में कलम बंधन की गई पौद द्वारा सर्वश्रेष्ठ प्रदर्शन (शून्य प्रतिशत मृत्युदर) किया गया। बढ़वार थैलों का समग्र प्रदर्शन बढ़वार क्यारियों से बेहतर था। नत्रजन: फॉस्फोरस: पोटेसियम–106:171:266.7, कैल्सियम–51.3, मैग्नीशियम– 22, सल्फर – 28, बोरोन – 3.1 किग्रा./हेक्टेयर में अधिकतम औसत उत्पादन (585.83 ± 288.9 ग्राम/पौधा) था । संशोधित डबल स्पैन पॉलीहाउस में पाए गए मुख्य नाशीजीव थे मीलीबग (जिनकी बिना किसी छिड़काव के आसानी से रोकथाम की जा सकती है) लेकिन मार्च की समाप्ति पर जब दिन का तापमान बढ़ने लगता है तब सफ्फेद मक्खी का संक्रमण पाया गया और कमतर पुष्पन देखने को मिला।
- प्राकृतिक संवादित सिंगल स्पैन पॉलीहाउस के अन्दर खीरे के छ: F1 संकरों यथा कियान, फ्फाडिया, टम ैनिटर, गुरका (52-32), बेयाज, युक्सेल–225 को विभिन्न बढ़वार मीडिया और उर्वरीकरण उपचारों में पॉलीहाउस के भीतर उगाया गया। रात्रि के समय अधिक आर्द्रता बने रहने और तीसरे महीने के उपरान्त पत्ती धब्बा रोग संक्रमण एवं कुटकी तथा डाइफ्फैन्बेकिया के सेकेण्डरी संक्रमण के कारण बढ़वार को रोका गया । पलवार का प्रयोग करने वाली मृदा क्यारियों (1.20 ± 0.10 किग्रा./पौधा) तथा बढ़वार थैलों (1.25 ± 1.89 किग्रा./पौधा) में उपज को कहीं उच्चतर पाया गया और औसत उपज को नत्रजन: फॉस्फ्फोरस:पोटेसियम – 67.9 : 122 : 173, कैल्सियम – 27.6, मैग्नीसियम – 14.1, सल्फर – 17.6, बोरोन – 2.1 किग्रा./हेक्टेयर के साथ उर्वरीकरण करने पर अधिकतम दर्ज किया गया।
- टमाटर की फसल वाले डबल स्पैन पॉलीहाउस के अन्दर वायु संचरण और हवा के परिचालन को बढ़ाने हेतु पपीता की फसल लगाई गई। बौने पपीते की किस्म पूसा नन्हा पॉलीहाउस के अन्दर खेती के लिए उपयुक्त थी।
- एक संशोधित डबल स्पैन ग्रीनहाउस के बिना उपयोग किए गए क्षेत्रों में अनानास की रोपाई की गई। इथेफ्फॉन 25 पीपीएम + यूरिया (2%) सोडियम कार्बोनेट (0.04 %) का प्रयोग करने पर अनानास फसल में अगेती पुष्पन हुआ।
- एलोयवेरा, अश्वगंधा, सेण्टेला तथा ब्राह्मी जैसे औषधीय पौधों को पॉलीहाउस परिस्थितियों में सफलतापूर्वक उगाया जा सकता है।
- लेमनग्रास (सिम्बोपोगॉन सिट्रेटस) किस्म सुगन्धि (OPD- 19) के बीज अंकुरण को वर्षाकाल के दौरान डबल स्पैन वाले पॉलीहाउस के भीतर एक वर्टिकल नर्सरी संरचना (2 x 0.6 x 2.25 मीटर) में विभिन्न बढ़वार मीडिया में जांचा गया।

अनुसूचित जनजाति संघटक/अनुसूचित जाति उप - योजना

- अनुसूचित जनजाति वर्ग से सम्बद्ध किसानों को धान की लवण सहिष्णु तथा संवेदनशील किस्मों के गोवा बायो 1 (बैसिलस मिथाइलोट्रॉफिकस STC - 4 का पाउडर फार्मुलेशन) से उपचारित बीजों की बुवाई की एक उन्नत विधि दिखाई गई। 25 प्रतिशत उर्वरक आदानों में बचत के साथ दाना एवं पुआल उपज लाभ दर्ज किया गया।
- गोवा तथा महाराष्ट्र के अनुसूचित जनजाति संघटक और अनुसूचित जाति उप–योजना किसानों के बीच धान में फसलोत्तर नुकसान को कम करने हेतु लघु पारबॉयलिंग इकाइयों तथा हरमेटिक भण्डारण थैलों का प्रदर्शन एवं वितरण किया गया ।

EXECUTIVE SUMMARY

ICAR- Central Coastal Agricultural Research Institute conducts strategic and applied research under various research themes: conservation, management and utilization of natural and genetic resources, production technologies for crops, animals and fisheries, postharvest technologies, and agro eco-tourism. The research projects have been streamlined into five mega themes. The highlights of the research achievements for the year 2020 are presented below.

Conservation and management of natural resources of the coastal region

- Trends in seasonal (monsoon, post-monsoon *kharif* (POMKH), post-monsoon *rabi* (POMRB) and pre-monsoon (PREMON) groundwater table depth in India's west and east coast regions were assessed using the Mann-Kendall test and Sen's slope. The increase in groundwater table depth for different seasons ranged from 0.56 to 0.65 m/yr and 0.31 to 0.41 m/yr for the west and east coast. The decrease in groundwater table depth for different seasons in the west and east coast ranged from -0.19 to -0.32 m/yr and -0.54 to -0.86 m/yr, respectively.
- In the salt-affected soils of the west coast region of India, the soil pH and electrical conductivity (EC) measured in the soil saturation paste extract strongly, linearly and significantly correlated (R^2 ≥0.72 for pH and ≥ 0.84 for EC) to their respective measurement in the 1:1, 1:2, 1:2.5 and 1:5 soil to water extraction ratios.
- A regression relation between electrical conductivity measured in soil saturation paste extract (ECe) and 1:2 soil to water ratio (EC1:2) was found as ECe = 2.5272 × (EC1:2) + 2.77 (R^2=0.84, $p<0.05$). It could be useful for studies related to the salinity of salt-affected soil of the west coast region of India, where soil salinity is typically associated with acidity.
- The visible near-infrared hyperspectral remote sensing can be employed for predicting the mango and cashew leaf nutritional status. A spectral algorithm of partial least square regression combined machine learning models was identified best to predict the macro and micronutrient with an accuracy of R^2 ≥ 0.88 for mango and R^2 ≥ 0.48. The spectral algorithms are suggested to be employed to retrieve cashew leaf nutritional status for precision management.
- A rice-based farming system model (crop-dairy) has been standardized on a 0.5 ha area for typical lowland situations of Goa. Different enterprises of the model are crops (rice followed by cowpea/ moong/vegetables/baby corn/sweet corn – 0.4 ha), forage grown bunds (Hybrid Napier - 0.032 ha), dairy (24 m^2- 2 cross breed cows), fish pond and duckery, and FYM unit (10 m^2). The system produced 18.2 q of rice, 316 kg of baby corn, 184 kg of sweet corn, 132 kg of moong (2 crops), 73 kg of cowpea, and 2.9 tons of fodder maize with 1060 litre of milk. In terms of gross return (Rs. 2.71 lakh), the highest % contribution was from crops (61%), followed by dairy (22%). Recycling of farm waste and crop residue were done through composting.
- Among different horticulture-based cropping systems, after the sixth year of the IFS model, the gross return of the system was around Rs. 1,92,700 and the net profit was Rs. 1,30,250. The highest contribution to net profit was from the piggery unit (37%), followed by the cashew-pineapple system (33%).
- Tested different tillage management practices in rice-based cropping systems, including puddled transplanted rice (PTR)-PTR, direct-seeded rice (DSR)-DSR, rice-moong, rice-cowpea, and rice-baby corn. The crop yield data revealed a significant difference between different tillage management practices. Adopting direct-seeded rice- zero tillage baby corn-zero tillage moong (triple cropping), the farmers can enhance the production (REY-12.1 t/ha) and profitability (net return- 1.1 lakh per hectare). Including baby corn after rice fallow offers additional green fodder (6 ton /ha) to the livestock component. Summer moong cultivation enhanced soil fertility due to its inherent capacity to fix the atmospheric N and improved soil carbon sequestration (31 Mg C/ha).
- Climate change vulnerability of west coastal districts of India was assessed based on the data collected on sensitivity, exposure and adaptive capacity indicators.

Conservation and utilization of genetic resources in the coastal region

- The rice germplasm collections of the Institute comprising of landraces (133) and wild rice (20) are being maintained at the Institute farm by growing every year during *kharif* season. The data on all the yield and its attributing characters are recorded for identifying promising liens for utilizing in pre-breeding programs to develop lines for future use. The collection includes salinity and submergence landraces, aromatic rice varieties, and resistance to essential insects and diseases prevailing in the west coast region.
- One hundred sixty-three rice germplasms were phenotyped for induced salt stress at the seedling stage under micro plots. Among the genotypes screened, eight genotypes showed tolerant (T) reaction to salt stress, 20 genotypes were moderately tolerant (MT), and the remaining 132 genotypes showed sensitive (S) to a highly sensitive (HS) reaction. Tolerant genotypes from the study are Goa Dhan 2, Goa Dhan 4, CST 7-1, Korgut, Kaveri Gidda, GWR 016, Dodgi, and KS 04.
- A new set of crosses were initiated in the *kharif* season of 2020 with high-yielding, salinity and submergence tolerant varieties/landraces to develop Recombinant Inbred Lines (RILs) for the development of dual stress-tolerant rice varieties for low lying coastal saline areas. Altogether, 11 two-way crosses, five three-way crosses, and one double-cross were developed. About 112 F8 RILs derived from Karjat 3 **X** KS 19-2 cross were phenotyped under coastal salinity conditions in experimental fields at Chorao Island, North Goa. Characters, namely, days to fifty per cent flowering, number of productive tillers per hill, number of grains per panicle, and grain yield, were measured to identify promising lines suitable for shortlisting for stations trials.
- In the seed production program, breeder seeds and truthfully labelled seeds of high-yielding salinity tolerant rice varieties were taken up at the Institute farm. About 7.5 q breeder seeds and 2.65 q TL seeds were produced at the Institute farm. Apart from that, 25 kg of nucleus seeds were produced in all the four salt-tolerant rice varieties of the Institute. As part of the ICAR seed project's capacity building, training was imparted to farmers in Gaodongrim and Cotigao villages. Farmers were apprised about the importance of using quality seeds in realizing higher production. Farmers were given training on seed treatment and identification of important insect pests and disease symptoms in the field to take the appropriate control measure.
- Front Line Demonstrations on new high-yielding salinity tolerant paddy varieties Goa Dhan 3 and Goa Dhan 4 were taken up in farmers' fields in the low-lying salt-affected coastal saline soils. Twenty two FLDs were conducted covering 14 ha areas both in North Goa and South Goa districts. The new salt-tolerant rice varieties recorded more than 3.0 t/ha grain yield than the local variety with 1.8 t/ha.
- In upland situations, 42 FLDs on upland rice variety Sahbhagi Dhan were conducted covering 28 ha area. The yield data were collected in a demonstration (improved technology) and farmers' practice by random crop cutting. Results indicated that Sahbhagi Dhan recorded grain yield ranging from 44.0 to 49.42 q/ha against the farmers' practice ranging from 34.12 to 39.45 q/ha. Overall, Sahbhagi Dhan recorded 29.62% more grain yield compared to the farmers' practice.
- Fish community structure from fourteen estuaries from the west coast of India was analyzed, and a total of 302 species were recorded from all estuaries. The highest count was from Zuari, and the lowest was from Ulhas. All the estuaries showed a dominance of marine migrant species over the resident estuarine fish fauna. The ecosystem modelling of estuaries revealed relatively higher organization and ecosystem integrity for Mandovi and Zuari than Terekhol estuary. The estuarine fish community index has also shownthe highest values in Zuari and lowest levels in Ulhas.

Development and validation of production technologies of significant crops of the coastal region

- Four years data indicated that bacterial wilt incidence was less than 3.0 % in all the 6 bacterial wilt resistant varieties as against 87-95% wilt in susceptible lines. The above varieties/lines recorded fruit yield ranged from 22.7 to 30.2 t/ha.
- PCR and qPCR results of infected chilli samples showed the presence of only ChiLCV in all the field samples and one sample was positive for CVMV poly protein. Field evaluation of eco-friendly compounds on chilli indicated higher growth parameters of chilli. Percent disease index (PDI) of virus infection was comparatively less in Spinosad, Rch6-2b, *I. tenuipes* treatments and insecticide treatments over the period of 130 days after planting. Total fruit yield was higher in Spinosad

(37.5 t/ha) and Rch6-2b (33.5 t/ha), *I. tenuipes* treatments (33.3 t/ha).

- Shelf life studies of different bio-formulations of *B. methylotrophicus* (RCh6-2b & STC-4) indicated that bacterial population in various value added formulations was above 9.0 Log CFU g^{-1} till 26 months. In alginate formulations, the bacterial population 9.0-10.0 Log CFU g^{-1} till 24 months.
- Fall armyworm (FAW), *Spodoptera frugiperda* infestation on fodder maize ranged from 43 to 83%. An average of 0.67 larvae was found per plant, with a maximum of 1.16 larvae/plant during the vegetative stage. The mtCOI 5' based sequence analysis of FAW populations from Goa revealed both Rice (R) strain and Corn (C) strain which feeds on fodder maize and sweet corn. General predators like earwig, spiders, reduviid bug, rove beetle, coccinellids, and wasps are found to predate on various stages of fall armyworm. Egg parasitoids, i.e., *Telenomus* spp. and *Trichogramma* spp. were found parasitizing the eggs. Rove beetle *Paederus fuscipes* fed more first instar FAW larvae compared to eggs and second instar larvae.
- The Maxent model predicted the current and future distribution of FAW with a training AUC value of 0.940 and a test AUC value of 0.936, indicating a better ability of the model for discrimination between suitable and unsuitable habitat areas for *S. frugiperda.* Effect of different intercrops for the management of fall armyworm revealed that maize + cowpea had registered less per cent damage of 14.85 and higher green fodder yield followed by maize + green gram.
- The severe incidence of rugose spiralling whitefly *Aleurodicus rugioperculatus* Martin and nesting whitefly *Paraleyrodes minei* were recorded in coconut. Besides coconut, the whiteflies infestation and its colonies were recorded on banana, guava, areca nut, triandra palm, mango, black pepper, heliconia, papaya, citrus, avocado, chafa, Indian shot and maize.
- Popularized eco-friendly integrated pest and disease management technologies in chilli. Lesser incidences of whiteflies, aphids and diseases were recorded in IPDM demonstration plots compared to control.
- Detected feeding sounds of stem and root borer *Plocaederus* spp infestation in cashew through an accelerometer-based sensor.
- Application of one kg Integrated Nutrient mixture (IN mixture) at three months after planting improved growth and yield of banana in red laterite soil. The highest yield (26.32 kg) was recorded in the Grand Naine variety treated with IN mixture along with a recommended dose of fertilizers.
- New flushes developed in mango during August-September and November-December. Rainfall induced a new flush instead of inflorescence during October (215 mm) and December (54.2 mm).
- Four-year-old KAS-11 kokum graft started flowering and fruiting and yielded 4.77 kg fruits in the year 2020. Variability of jackfruit accessions inside the CCARI campus was evaluated and identified high yielding (CT-10: 10. 81 kg) and suitable fresh consumption and processing types.

Development and validation of production technologies of livestock and fisheries

- A novel approach using Heat Load Index (HLI) was applied for assessing the correlation of environmental factors with reproductive variables in dairy buffaloes. HLI was found to be negatively correlated ($r = -0.97$, $p<0.05$) with the overall conception rate in winter and positively correlated ($r = +0.90$, $p<0.05$) with repeat breeding incidence in summer. The efficacy of different hormonal and combination regimens was evaluated for estrus induction and synchronization in summer anestrous buffaloes to address the problems related to summer infertility.
- Combination of double PG analogue with herbal preparation regimen was found to be more effective in inducing estrus and enhancing estrus expression in summer anestrous buffaloes with significantly ($p<0.05$) higher initial estrus induction rate (83.33%) as compared to modified Cosynch protocol (71.43%).
- Towards creating opportunities for smart dairy farming, a web application was developed that can assist farmers in calculating calving dates and ideal weaning dates for different breeds of buffalo.
- Survey of 150 backyard poultry farmers of Goa and North Karnataka to study the current scenario of backyard poultry farming. Results indicated the adoption of dual-purpose backyard poultry, with ICAR-CCARI as the primary source of and 84% used supplementary feed in addition to scavenging for the chicks.
- Development of energy efficient aquaculture technology with utilization of indigenous fishes by reducing the cost of production for culture of highly commercial Asian seabass for increasing

fish productivity per ha in inland aquaculture and for utilization of inland resources for aquaculture production. The Asian seabass growth obtained in nine months culture period varied from 210 g – 2.4 kg (mean growth: 521.57 ± 88.34 gm), along with, Tilapia (287.42 ± 11.75 g), Catla (4.1 ± 0.34 kg), Rohu (2.27 ± 0.08 kg) and Common carp (1.05 ± 0.20 kg). Small Indigenous Fish (SIF) stocking gave best growth in initial months of culture.

Improving livelihood security through postharvest technologies and other agri- enterprises

- Agro eco tourism unit plant diversity was documented, and the highest number of species of plants was in *Dhanvantari Vatika*.
- The method of preparations and use of Jeevamrut and culturing of Azolla as a component of AET were demonstrated.
- In two vermicomposting cycles, 6 tonnes of biodegradable waste could be converted into 5 tonnes of vermicompost with a conversion ratio of 0.67 in 232 days was produced at AET centre. The gross and net income was Rs. 0.88 Lakhs and Rs. 0.56 Lakhs with a benefit-cost ratio of 1.76.
- Harnessing palms for improving the sustainable livelihoods of coastal India using district-level secondary data was employed. Preliminary investigations in the study reveal that the coconut in the coastal districts of Kerala contributes to 1 % of the state GDP of Kerala. The annual growth rate of the area under each palm is also worked out. Gujarat state has shown an increasing trend in the area under coconut and date palm towards prosperity. Coconut populations of Goa state (Rivona, Calangute, Gaodongri, Canacona) were characterized for seedling traits.
- The process to develop biodegradable cups from local varieties of banana pseudostem was developed. The cups made of Raspali variety had the comparatively lesser Cobb value.
- The production technology for tomato was developed; varieties studied were GS 600, Abhirang, grafted tomato seedlings of Ghetto Farmers, Gujarat (Scion- Anshal and Rootstock –Solme). The performance of tomato seedlings was severely affected by nematodes and bacterial wilt (60-97% mortality), while grafts on soil performed better (20-40% mortality), and grafted seedlings in growbags performed the best (0% mortality). The overall performance in growbags were better than growbeds. Fertigation with N: P: K -106:171:266.7, Ca- 51.3, Mg- 22, S-28, B-3.1 had the highest average production (585.83±288.9g/ plant). The main pests faced in the modified DSGH were mealybugs (which could be easily managed without any sprays, but towards the end of March, when the daytime temperatures started to increase, there was an infestation of whiteflies, and lesser flowering observed.
- Six F1 hybrids of cucumber *viz.*, Kian, Fadia, Terminator, Gurka (52-32), Beyaz, Y-225 were grown inside the polyhouse in different growing media and fertigation treatments. The growth was inhibited by leaf spot disease infestation after the third month due to high night humidity and secondary infestation of mites and caterpillar. The yield was higher in mulched soil beds (1.20±0.10 kg/plant) and grow bags (1.25±1.89 kg/plant), and the average yield was the highest in fertigation with N: P: K -67.9:122:173, Ca-27.6, Mg-14.1, S-17.6 B -2.1, kg/ha).
- Papaya and pineapple crops were introduced to enhance ventilation and air movement inside the double-span polyhouse cultivated with tomatoes. Dwarf papaya variety Pusa Nanha was suitable for cultivation inside polyhouse.
- Pineapple was planted in the unused areas of a modified double-span greenhouse. Application of ethephon 25 ppm+ urea (2 %) + sodium carbonate (0.04%) could induce early flowering in pineapple.
- Medicinal plants such as Aloe vera, Aswagandha, Centella and Brahmi can be successfully cultivated under polyhouse conditions.
- Seed germination of lemongrass (*Cymbopogon citratus*) variety 'Sugandhi' (OPD-19) was tested in different growing media in a vertical nursery structure (2 x 0.6 x 2.25 m) inside a double span polyhouse during the rainy season.

Scheduled Tribe Component/Scheduled Caste Sub Plan

- An improved method of sowing Goa Bio 1 (talc formulation of *Bacillus methylotrophicus* STC-4) treated seeds of salt-tolerant and susceptible paddy varieties by broadcasting was demonstrated to the scheduled tribe farmers. A grain and straw yield advantage was recorded with a saving of 25% of the fertilizer inputs.
- Mini Parboiling units and hermetic storage bags were demonstrated and introduced to reduce paddy postharvest losses among STC and SCSP farmers of Goa and Maharashtra.

INTRODUCTION

ICAR- Central Coastal Agricultural Research Institute (ICAR-CCARI) is a premium multi-disciplinary institute working to address the sustainable agricultural and allied activities in the fragile coastal ecosystem of the country. The institute is poised to carry out the research and extension work on the field and horticultural crops, livestock, and fisheries relevant to the natural resource base for sustainable productivity, to develop climate-resilient land use and farming systems and agro-ecotourism in the coastal region.

The institute was established as the ICAR Research Complex for Goa in April 1976. After a short spell working as a part of the ICAR Research Complex for North East Hill Region, the Complex was brought under the administrative and technical control of the Central Plantation Crops Research Institute, Kasaragod, Kerala. After functioning at different Government agricultural farm sites in Goa, the location was finally shifted to Ela, Old Goa, in 1982. The institute was upgraded to a full-fledged Institute in April 1989 to cater to the growing needs of agricultural research, education and extension in Goa. The institute's research activities were earlier confined to the agriculture needs of Goa. After renaming as ICAR-CCARI in April 2014, it is serving agricultural research needs of 68 coastal districts in 9 states and seven union territories.

ICAR-CCARI is under Natural Resources Management (NRM) Subject Matter Division and is situated at Ela, Old Goa. The vision of the institute is 'Global Excellence in Sustainable and Sustaining Coastal Agricultural Research'. The institute has the following mandates:

- Researches on the field and horticultural crops, livestock, and fisheries relevant to the natural resource base of coastal India for sustainable productivity.
- Develop climate-resilient land use and farming systems for improved and sustainable livelihood through coastal agriculture.
- Act as a centre of agro-eco-tourism.

The institute has four major divisions: Natural Resource Management, Crop Science, Horticultural Science, and Animal & Fishery Science.

The institute is headed by the Director, who is supported by 23 Scientists, 13 Technical, 15 Administrative and 19 Skilled Support staff, making the total staff strength of the institute 70.

The Research programmes of the institute are streamlined by the Research Advisory Committee of the institute. The significant areas of research are

i) Conservation and management of natural resources of the coastal region
ii) Conservation and utilization of genetic resources in the coastal region
iii) Development and validation of production technologies of significant crops of the coastal region
iv) Development and validation of production technologies of livestock and Fisheries
v) Improving livelihood security through post-harvest technologies and other Agri-enterprises.

The Institute has significant research contributions in identification of promising crop varieties/accessions of field and horticultural crops; development of suitable soil and water conservation measures in cashew, coconut and mango; development of integrated farming system models; development of eco-friendly management practices of major insect pests and diseases in plantation field crops and vegetable crops; development and standardization of production technologies for field and horticultural crops of Goa; standardization of low cost protected structures for vegetable and flower crop production; standardization of packages for rearing cattle, goat, buffalo, pig and poultry; standardization of hydroponics green fodder production and bypass fat production; disease diagnosis and animal health management; standardization of ornamental fish culture, carp culture and brackish water fish farming; standardization of mussel farming practices; dissemination of PFZ advisories and validation of advisories and exploration of fish diversity of Goa.

The institute is also engaged in transferring technology through FLDs training, workshops, etc. The research accomplishments made by the scientists, the technologies transferred to farmer's fields, the other events conducted by the institute and the awards and recognitions conferred upon the staff are presented in the report.

WEATHER REPORT

Information on weather is of paramount importance for agricultural production. Observation of weather parameters is being continuously recorded by the Institute. Observations made during January to December 2020 are discussed here.

Air temperature

Mean monthly maximum temperature during January to December 2020 varied from 29.4 °C (July and August 2020) to 36.3 °C (May 2020), whereas mean minimum temperature varied from 18.1 °C (January 2020) to 26.7 °C (May 2020).

Rainfall and rainy days

The total rainfall received during January to December 2020 was 4627.5 mm. Total of 4351.9 mm was received during kharif (June to September 2020). The annual rainfall for this year was 156.9 mm higher than that of 2019 (4470.6 mm). Total number of rainy days observed was 118 and was higher compared to last year (117 days).

Evaporation and relative humidity

Daily evaporation was measured using USWB-Class A open pan evaporimeter. The total water evaporated from January to December 2020 was 1562.7 mm. The highest morning and afternoon relative humidity was observed during September and July 2020, respectively, whereas the corresponding lowest was recorded during December and February 2020.

Wind speed

Mean monthly wind speed ranged from 4.2 km/h (December 2020) to 6.7 km/h (May 2020). Mean monthly wind speed started decreasing from August 2020 to December 2020 and it increased thereon.

Sunshine hours

The mean monthly sunshine hour recorded ranged from 1.6 hours (July 2020) to 9.6 (February 2020). As expected, mean monthly sunshine hours were lower during rainy season compared to rest of the months of the year.

Soil temperature

The ranges of mean monthly soil temperature recorded in morning hours at 5, 10 and 20 cm depths were 25.6-34.0°C, 26.6-36.6°C and 28.3-43.4°C, respectively, whereas the corresponding ranges for afternoon observation were 26.5-35.1°C, 29.2-47.6°C and 27.1-37.9°C.

Mean monthly weather parameters recorded at ICAR-CCARI from January to December 2020

Month	Temperature (°C)		Relative Humidity (%)		Wind Speed (km/h)	Sunshine (h/day)	Evaporation (mm/day)	Rainfall (mm)	Rainy day	Cloudiness (h)	
	Maximum	Minimum	07.34 AM	2.34 PM						07.34 AM	2.34 PM
January	33.4	18.1	87.4	40.7	5.0	9.2	3.9	0.0	0	2.7	1.1
February	35.2	20.1	88.7	38.2	4.6	9.6	4.7	0.0	0	4.1	0.8
March	34.4	22.6	88.2	46.9	5.5	8.3	5.5	0.0	0	3.0	0.7
April	35.5	25.3	83.8	54.3	5.7	8.5	5.6	6.0	2	1.6	1.1
May	36.3	26.7	78.7	55.2	6.7	7.3	6.0	0.4	0	3.2	2.8
June	31.1	24.1	92.6	80.1	5.9	3.5	4.5	1215.2	26	5.0	4.8
July	29.4	24.1	94.2	85.6	5.0	1.6	4.6	1347.7	28	5.3	5.2
August	29.4	24.2	93.0	82.6	6.6	1.7	4.7	1060.0	31	5.1	4.8
September	30.3	24.0	94.8	80.9	4.7	3.3	3.6	729.0	20	4.9	4.7
October	31.7	24.0	93.4	70.7	4.3	4.6	3.2	215.0	10	4.4	3.8
November	34.8	22.9	78.7	45.1	4.3	8.8	4.2	0.0	0	1.7	2.0
December	34.1	21.7	75.6	39.8	4.2	8.7	3.6	54.2	1	1.7	1.3

Important dates of observations during January to December 2020 with the highest and lowest values of weather parameter

Particular of weather parameter	Value	Date
Highest maximum temperature	38.2°C	30/05/2020
Lowest minimum temperature	14°C	17/01/2020
Highest rainfall	189.7 mm	17/06/2020
Highest evaporation	9.4 mm	19/06/2020
Highest wind speed	14.1 km/h	03/06/2020
Maximum sunshine hours	11.1 h	28/04/2020

RESEARCH ACHIEVEMENTS

- Conservation and management of natural resources of coastal region
- Conservation and utilization of genetic resources of coastal region
- Development and validation of production technologies of crops
- Development and validation of production technologies of livestock and fisheries
- Improving livelihood security through post- harvest technologies and other agri- enterprises

A view of experientmental paddy field of ICAR-CCARI

Mega Project 1: Conservation and management of natural resources of coastal region

Project: Genesis of soils and associated evaporates in the coastal ecosystem for sustainable land use options and carbon management in India

SK Singh, GR Mahajan, Bappa Das, Sujeet Desai, Sreekanth GB

During the year, physiography, sub-physiography, and broad landforms for the east coast plains are extensively studied and compiled to understand soils and evaporates' genesis. The plain occurs between 8° 22' to 22° 30' north latitude and 77° to 87° 20' east longitude and occupied an area of 120882 km^2. It encompasses Tamilnadu coastal plain (TCP), Andhra coastal plain (ACP), and Utkal Coastal Plains (OCP). OCP lay between the Subarnarekha river and Mahanadi delta and was delineated by the contours of 75 meters. Chilka, Mahanadi, and Balasore regions of OCP were divisible into Utakal plains and Mahanadi delta, which involved 49 and 51% area OCP. The tables and delta were developed from recent, tertiary, and pleistocene alluvia of the Mahanadi river, originating from the hills of Maikal range and passing through the pat land, Mahanadi plains of Chhattisgarh and the eastern ghats of Odisha.

The ACP occurs between Pulicate lake and the Godavari delta and is unplugged by the contours of 100 meters. Marine, inland plains, Krishna and Godavari delta, laterites, and sandstone of ACP include Palar-Ponnaiyar plain region, Pennar (Nellore) region, Krishna-Godavari Delta, and Vishakhapatnam region. Coastal and inland plains covered 11.4 and 55.3 % area. Krishna and Godavari delta occupied another 8.9 and 14.8% area, respectively. Laterites and sandstone were the part of ACP holding 5 and 4% area, respectively. Krishna and Godavari rivers, originating from the Maharashtra plateau and passing through the basaltic trap of Karnataka, contributed massive sediments in ACP. TCP between the Capecomorin and Pulicate lake developed by the transgression (up wrapping) and regressive (down wrapping) action during the Mesozoic and tertiary period, respectively and was separated by the contours of 150 meters from the rest of Tamilnadu. It includes the southern plain, Tambrapani, and delta region. First, two occupied 35% area with dunes of 30-60 meters. Delta region covered another 65% area. Apart from Krishna and Godavari, the river Kaveri draining through the Mayur fault deposited TCP sediments. The lower deltaic region (LDR) of West Bengal is considered part of the east coast from an operational point of view. Coastal plains hardly covered 13% area, and deltaic tables were classified on another 87% area. These are extensive in 24 Parganas and East Medinipur districts and had the testimonies of peninsular India and the recent alluvia primarily from Ganga, Tista and Mahananda river systems.

Project: Assessment and mapping of trends in the hydro-climatic variables over the west and east coast regions of India

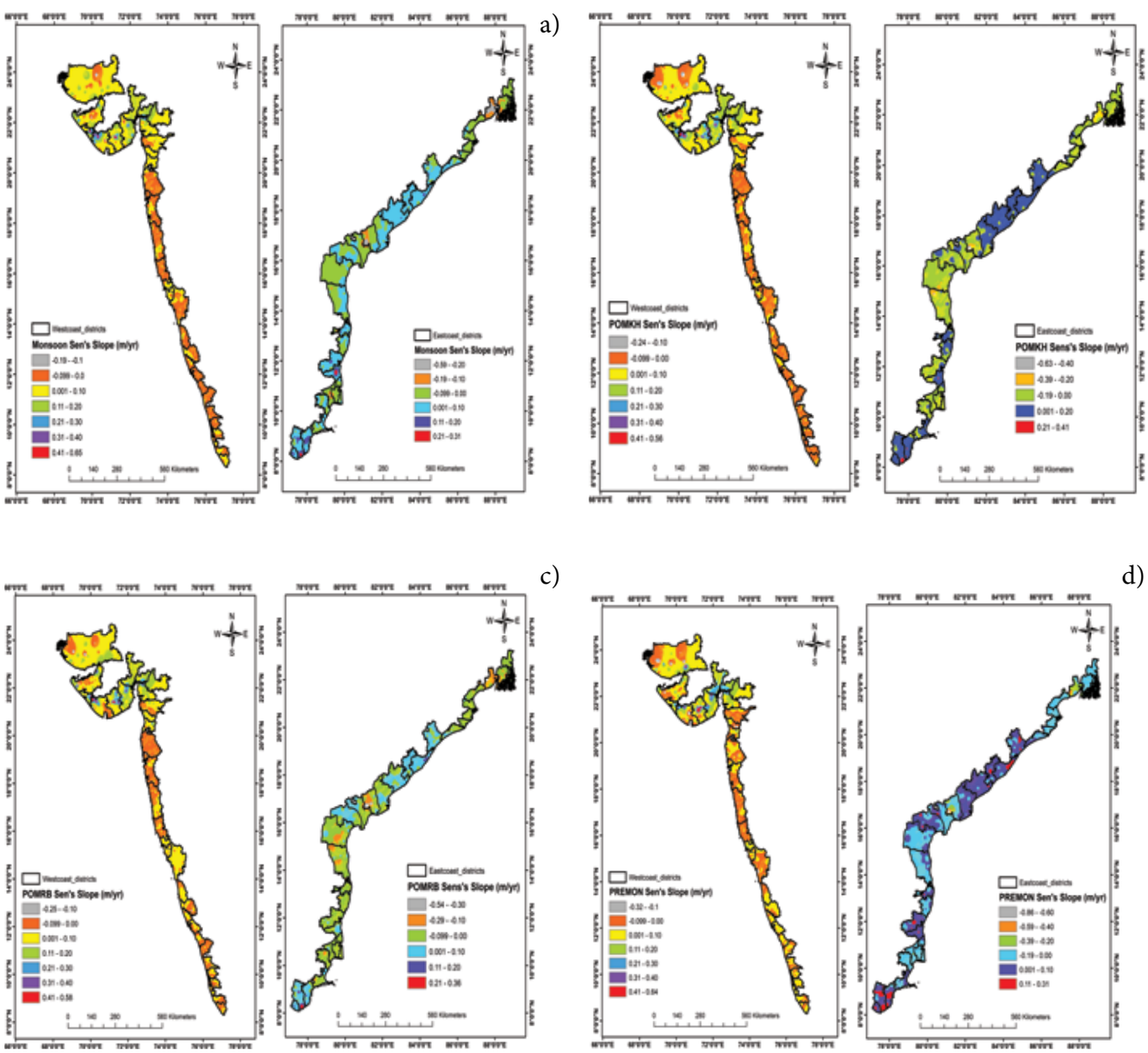
Sujeet Desai, Bappa Das, Sreekanth GB

Seasonal groundwater trend in the west and east coast regions

The trends in seasonal groundwater table depth in the west and east coast regions of India were assessed. The groundwater depth data was collected from the India WRIS site. The time-series data of groundwater table depth measured at 781 observation wells in the west coast districts of Gujarat, Maharashtra, Goa, Karnataka, and Kerala and 428 observation wells in the east coast districts of Tamil Nadu, Andhra Pradesh, Odisha, and West Bengal was collected from 1996-2018 (23 years). This data was used to analyze the spatio-temporal trends of change in groundwater depth for four different seasons,*viz.* monsoon, post-monsoon *kharif* (POMKH), post-monsoon *rabi* (POMRB), and pre-monsoon (PREMON). The non-parametric Mann-Kendall test was used to analyze the trend in time series, and Sen's slope was used to estimate the rate of change.

The trend analysis revealed that out of 781

observation wells in the west coast districts, 402 (51.4%), 407 (52.1%), 356 (45.5%), and 348 (44.5%) wells showed decreasing groundwater trend in monsoon, POMKH, POMRB and PREMON seasons, respectively. However, a significant increase or decrease trend was found in only 157 (20%), 166 (21%), 185 (23%), and 206 (26%) wells in monsoon, POMKH, POMRB and PREMON seasons, respectively. On the east coast, out of 428 observation wells, 180 (42%), 206 (48.1%), 220 (51.4%), and 192 (44.8%) wells showed decreasing groundwater trend in monsoon, POMKH, POMRB, and PREMON seasons, respectively. Whereas, the significant increasing or decreasing trend was found in 115 (26.8%), 93 (21.7%), 93 (21.7%), and 133 (31%) wells in monsoon, POMKH, POMRB, and PREMON seasons, respectively in the east coast. The spatial variability maps of the rate of groundwater change (Sen's slope, m/yr) for monsoon, POMKH, POMRB, and PREMON seasons for west and east coast regions were prepared. The maximum decrease rate in the groundwater depth in the west coast was -0.19, -0.24, -0.25, and -0.32 m/yr, whereas, the maximum rate of increase in groundwater depth was 0.65, 0.56, 0.58, and 0.64 m/yr during monsoon, POMKH, POMRB, and PREMON seasons, respectively. On the east coast, the maximum rate of decrease in the groundwater depth was -0.59, -0.63, -0.54, and -0.86 m/yr, whereas, the maximum increase rate in the groundwater depth was 0.31, 0.41, 0.36, and 0.31 m/yr during monsoon, POMKH, POMRB and PREMON seasons, respectively.



Seasonal rate of change in groundwater depth in the west coast and east coast a) monsoon b) post monsoon *kharif* c) post monsoon *rabi* d) pre-monsoon

Project: Assessment of the properties of the coastal saline soils and development of integrated nutrient management practices and crop establishment methods for improving its productivity

GR Mahajan, Ramesh R

Proper measurement of the soil salinity of the salt-affected soils of the west coast region of India

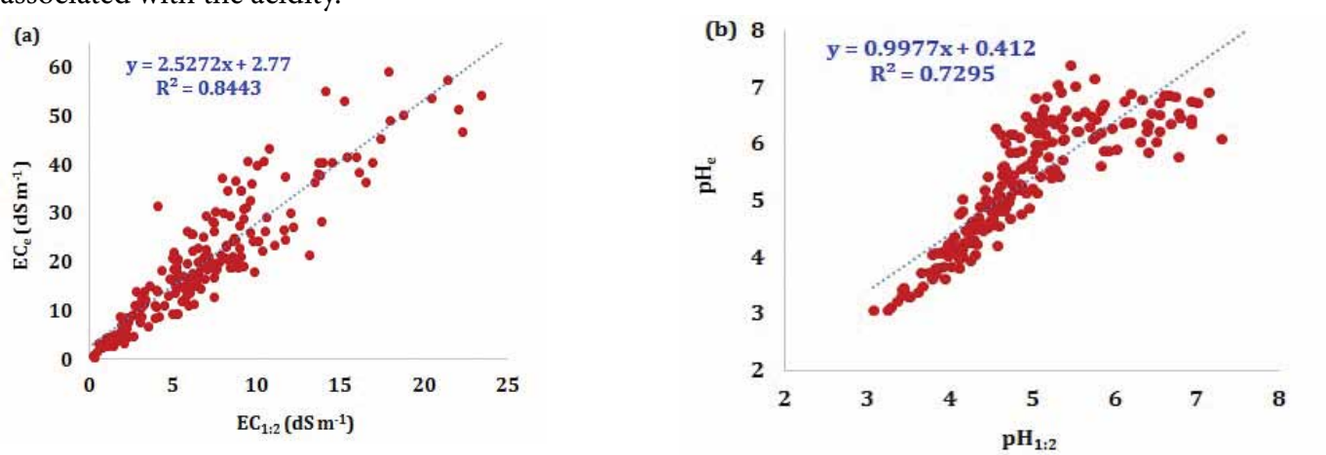
A selection of appropriate analysis methods of soil salinity is key to determine accurate estimates and reclamation measures. About 216 soil samples were collected from the salt-affected areas of the west coast of India (Maharashtra, Goa, Karnataka and Kerala). The soil pH and electrical conductivity (EC) in fixed ratios of 1:1, 1:2, 1:2.5, and 1:5 soil to water extracts and soil saturation paste extract were determined. The average soil pH measure in 1:1, 1:2, 1:2.5, 1:5 soil to water extract, and soil saturation paste (pH_s) extract was 4.32, 4.96, 5.01, 5.15, and 5.33, respectively, whereas the corresponding EC was 14.00, 7.65, 6.37, 3.52, and 19.96 dS m^{-1}. The pH_s and EC of soil saturation paste extract (EC_e) were in the range of 3.06-7.39 and 0.61-59.18 dS m^{-1}. The EC decreases with decreasing soil to water extract ratio, and it was highest in soil saturation paste extract. The relationship of the pH and EC in different ratios with respective pH_s and EC_e was studied. The coefficient of determination (R^2) of pH_s with pH of 1:1, 1:2, 1:2.5, and 1:5 soil extract ratio was 0.73, 0.73, 0.72, and 0.73 ($p<0.05$), respectively. The EC_e had a R^2 of 0.85, 0.84, 0.85, and 0.84 ($p<0.05$) with EC of 1:1, 1:2, 1:2.5 and 1:5 soil: water extract ratio. All these relationships were linear and significant. Thus, the regression relation of EC_e with $EC_{1:2}$, $EC_e = 2.5272 \times (EC_{1:2}) + 2.77$ (R^2=0.84, $p<0.05$) could be more useful for studies related to salinity of salt-affected soil of the west coast region of India where soil salinity is typically associated with the acidity.

Relationship of pH and EC in soil saturated paste extract with their respective soil pH and EC measured in different soil to water suspension ratio

Regression equation	Coefficient of determination (R^2)
pH	
$pH_s = 1.0371 \times pH_{1:1} + 0.3642$	0.73
$pH_s = 0.9977 \times pH_{1:2} + 0.412$	0.73
$pH_s = 0.9692 \times pH_{1:2.5} + 0.5013$	0.72
$pH_s = 0.9589 \times pH_{1:5} + 0.4155$	0.73
Electrical conductivity (EC)	
$EC_e = 1.3723 \times EC_{1:1} + 2.7241$	0.85
$EC_e = 2.5272 \times EC_{1:2} + 2.77$	0.84
$EC_e = 3.0298 \times EC_{1:2.5} + 2.8004$	0.85
$EC_e = 5.564 \times EC_{1:5} + 2.4574$	0.84

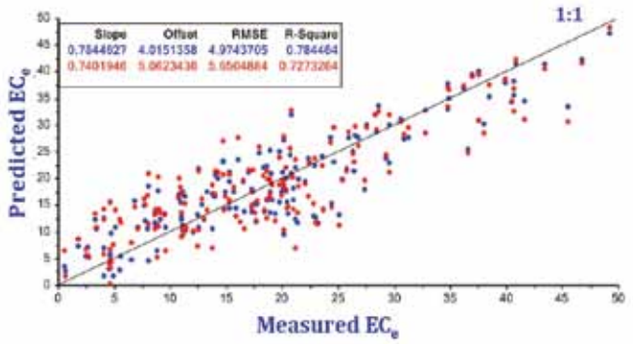
Hyperspectral remote sensing-based prediction of the soil pH and salinity in the soil to water suspension and saturation paste extract of salt-affected soils of the west coast region

Rapid and reliable measurement of the salinity of the salt-affected soils of the coastal region is vital for their effective management and sustainable utilization. Remote sensing could be one of the viable approaches to achieve spectroscopy-based salinity monitoring. The study aimed to investigate the application of hyperspectral remote sensing to predict the soil pH and salinity to water suspension and saturation paste extract of salt-affected soils in the west coast region.



Relationship between (a) EC measured in soil saturated paste extract (ECe) with that measured in 1:2 ($EC_{1:2}$) and (b) pH measured in soil saturated paste extract (pHs) with that measured in 1:2 ($pH_{1:2}$)

A spectral data of 216 samples (mentioned in the previous section) was measured in the wavelength range of 350-2500 nm. The data was divided into calibration dataset (70% of total) and validation dataset (30% of the entire dataset). The spectral data (raw spectral reflectance averaged at 10 nm) was modelled using multivariate analysis techniques – partial least square regression, principal component regression, and support vector regression. A good agreement between the actual and predicted pH and EC for different ratios and the extract were exhibited by the correlation coefficient ranging 0.48-0.79 and 0.70-0.87, respectively. Among other multivariate techniques tested, partial least square regression outperformed principal component regression and support vector regression. Among all the parameters, the best prediction was achieved for EC_e accuracy as r=0.87, R^2=0.76, RMSE=5.65, and rank=4 (lowest) with partial least square regression. Thus, the 'soil saturation paste extract salinity' of the salt-affected soils of the west coast region can be monitored using visible near-infrared remote sensing.

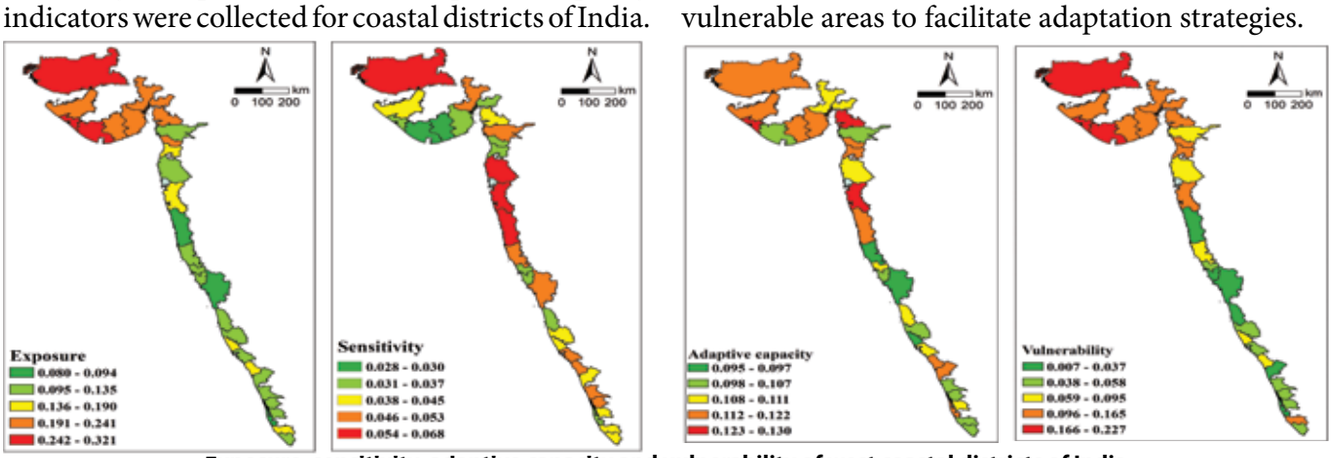


Agreement between the measured electrical conductivity in saturated paste extract and predicted using the partial least square regression of the visible near-infrared (350-2500 nm) spectral reflectance.

Project: Assessment of climate change vulnerability in coastal districts of India

Bappa Das, VK Sehgal

India, being a developing country facing serious problems such as insufficient land and water with an increasing impact of climate change. Climate change and extreme events will adversely impact agricultural production and increase vulnerability. Therefore, to ensure the food security of the country, appropriate mitigation and adaptation strategies need to be adopted. In this regard, vulnerability assessment of agriculture to integrated climate change is the pre-requisite for developing climate-smart strategies and technologies. Though climate change is a global phenomenon, its manifestations and impacts vary locally, so do the mitigation and adaptation strategies. So, local vulnerability assessment is needed to develop mitigation and adaptation strategies specific to the community's needs and priorities at the local level. Data about sensitivity, exposure, and adaptive capacity indicators were collected for coastal districts of India. Individual indices were calculated for sensitivity, exposure, and adaptive capacity using principal component analysis (PCA). The results showed that the maximum exposure was for Gujarat's Porbandar district (0.321), while the minimum exposure was recorded for Uttara Kannada (0.080). The maximum and minimum sensitivity were observed among the west coastal communities for Raigarh (0.068) and Amreli (0.028) districts. The districts of Maharashtra and the Kachchh district of Gujarat showed higher sensitivity to climate change. The maximum adaptive capacity was observed for Porbandar (0.130), and the minimum was recorded for Uttara Kannada (0.095). The districts of Gujarat showed maximum vulnerability to climate change, while districts of Karnataka and Kerala were found to be less vulnerable. Strategies and development activities should be channelized to the climate-vulnerable areas to facilitate adaptation strategies.



Exposure, sensitivity, adaptive capacity and vulnerability of west coastal districts of India

Project: Study of conservation agricultural practices for sustainability of rice-based cropping systems in the west coast of India

Parameshа V, GR Mahajan

Field experiment was conducted under different tillage management practices in rice-based cropping systems. The cropping system includes puddled transplanted rice (PTR)-PTR, direct-seeded rice (DSR)-DSR, rice-moong, rice-cowpea, and rice-baby corn. The objective of the study is to develop the suitable conservation agricultural (CA) practices for improved grain yield, above-ground biomass productivity, economics, energy efficiency, and sustainability of rice-based cropping system, and to know the effect of CA practices for soil carbon sequestration potential and different soil quality indicators. The rice equivalent yield data varied significantly due to other tillage management practices. Practising direct-seeded rice-zero tillage baby corn-zero tillage moong (triple cropping), the farmers can enhance the production (REY-12.1 t/ha) and profitability (net return- 1.1 lakh per hectare). Including baby corn after rice fallow has the scope to provide green fodder (6 tons /ha) for the livestock component. Summer moong cultivation enhanced soil fertility due to its inherent capacity to fix the atmospheric N and improved soil carbon sequestration (31 Mg C/ha). After rice harvest, the higher available nitrogen (125 kg/ha), phosphorus (13 kg/ha), and potassium (135 kg/ha) was observed in direct-seeded rice with brown manuring with zero tilled baby corn and summer moong. Under direct-seeded rice, saving of labour (220 MJ), fuel (249 MJ), and machinery (389 MJ) energy was observed over farmer's practice.

Effect of various CA practices on grain yield and other parameters

Treatments	Rice equivalent yield (t/ha)	Above-ground biomass (t/ha)	Total residue input (Mg ha^{-1})	Estimated gross C input (Mg ha^{-1})
T_1 - PTR - PTR (Farmers' practice)	9.8	13.2	5.56	2.22
T_2 - DSR+BM - ZT Cowpea	11.1	15.0	6.29	2.52
T_3 - DSR+BM-ZT Moong-ZT Baby corn	12.1	16.3	6.86	2.74
T_4 - DSR+BM-ZT Moong-ZT moong	11.3	15.3	6.41	2.56
T_5 - DSR+BM-ZT Moong	8.1	10.9	4.59	1.84
T_6 - DSR-DSR	7.1	9.6	4.03	1.61
T_7 –MBR + DSR-RR + ZT baby corn – BBR+ZT Moong	12.6	17.0	7.14	2.86

Conservation agricultural practices in rice based cropping system

Mega Project 2: Conservation and utilization of genetic resources in the coastal region

Project: Collection, evaluation of genetic resources and management of fruit and spices

AR Desai, SK Singh, Sujeet Desai, Paramesha V, Maneesha SR, Nibedita Nayak

Conservation of field germplasm bank

A total of 165 mango accessions including local variants of Mankurad and Hilario (136 nos.), pickling mango accessions (18 nos.), hybrids of IARI, Pusa, New Delhi (04 nos.), varieties of CISH, Lucknow (02 nos.) and exotic mango varieties (05 nos.) are conserved in the institute.

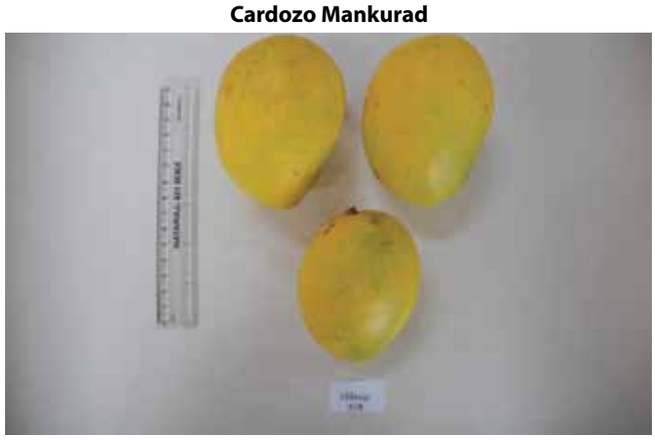
Evaluation of mango germplasm

Among the 37 germplasm accessions evaluated in the year 2020, the highest fruit weight was recorded in Bemcorad (569.00 g) and the lowest fruit weight was in HB-151 (93.00 g). Fruit circumference and fruit width was the highest in Bemcorad (30.07 cm; 9.1 cm respectively) and the lowest was in HB-151 (16.22 cm; 4.60 cm respectively). Fruit length was the highest in Totapuri (13.50 cm) and the lowest was recorded in HB-151 (7.08 cm). Neelgoa has the highest peel weight (80.33 g) and the lowest peel weight was in Totapuri (10.00 g). Stone weight was the highest in Mangarosa (60.25 g) followed by MDCH-1(59.33 g). The lowest stone weight was recorded in HB-151 (15.00 g). Pulp weight was the highest in Bemcorad (452.00 g) and the lowest was in HB-151 (62.00 g). Pulp- stone ration was the highest in Totapuri (12.71) and the lowest in Mankurad PWD (3.04). Pulp –peel ratio was the highest in Totapuri (35. 60) and the lowest was in KX B (2.50). Peel thickness was the highest in HB 56 (5.43 mm) and the lowest was in HB-151 (0.12 mm).

Evaluation of Mankurad accessions

Among the Mankurad accessions of parliamentary block, the highest fruit weight was recorded in Tree 51 (479.40 g) followed by Tree 13 (441.60 g) (Table 2). Fruit circumference was the highest in Tree 13 (26.3 cm) and the lowest in Tree 36 (1757 cm). Fruit length was the highest in Tree 13 (11.86 cm) and the lowest in Tree 19 (6.90 cm). Fruit width was the highest in Tree 13 (7.70 cm) and the lowest in Tree 21 (5.33 cm). Peel weight was the highest in Tree 51(89.20 g) and the lowest in Tree 46 (14.00 g). Stone weight was the highest in Tree 51 (58.20 g) and the lowest was in Tree 46 (12.00 g). Highest pulp weight was recorded in Tree 51 (332.00 g) and the lowest was in Tree 36 (83.60g). Pulp stone ratio was the highest in Tree 5 (9.96) and the lowest in Tree 45 (2.95). Pulp peel ratio was the highest in Tree 13 (5.58) and the lowest in Tree 38 (2.48). Peel thickness was the highest in Tree 21 (0.77 mm) and the lowest in Tree 6 (0.15 mm).

Cardozo Mankurad



Hilario

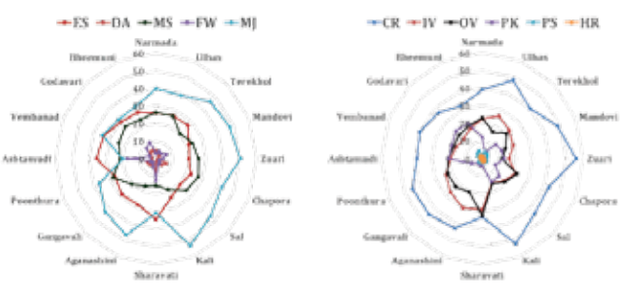
Alphoso

Project: Assessment, management and designing improvement options for fisheries in selected low impacted estuaries along west coast of India

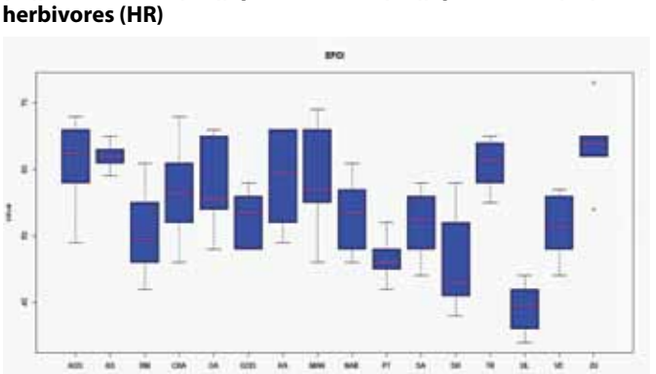
Sreekanth GB, Trivesh Mayekar

Assessment of fisheries resources from estuaries along the Indian coast

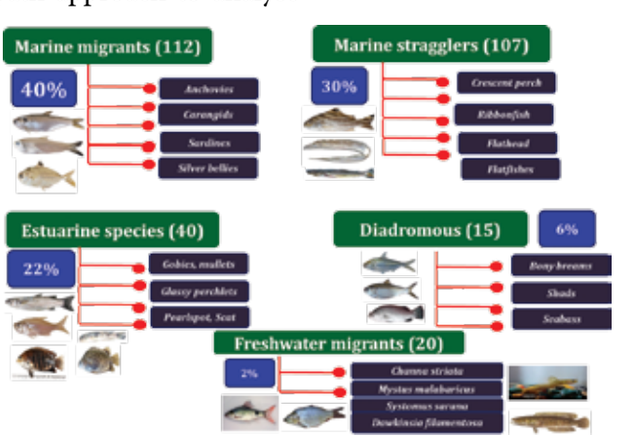
Fish community structure from a total of 14 estuaries from the west coast of India (Narmada, Ulhas, Terekhol, Chapora, Mandovi, Zuari, Sal, Kali, Sharavathi, Aganashini, Kochi, Poonthura, Ashtamudi and Vembanad) and two estuaries (Godavari and Bheemuni) from the east coast of India were characterized.In total, 202, 176, 156, 81, 64, 163, 122, 62, 80, 51, 55, and 45 species were collected from Zuari, Mandovi, Terekhol, Chapora, Sal, Kali, Aganashini, Sharavathi, Gangavali, Poonthura, Godavari, and Bheemuni estuaries respectively aggregating to a total of 302 species. For the rest of the four estuaries, secondary information is used (Ashtamudi-78, Vembanad-112, Ulhas-85, and Narmada-92). Fish diversity and richness was highest in Zuari and lowest in Mandovi, highest during pre-monsoon season and lowest in monsoon season, highest in lower reach and lowest in upper reaches. The evenness index did not follow a distinct pattern compared to diversity. However, the index peaked during pre-monsoon and post-monsoon seasons. The highest value of evenness was observed in the middle reach of the estuarine systems. The order of contribution of estuarine use guild followed marine juvenile migrants, marine stragglers, estuarine species, diadromous species and freshwater species. The order of contribution of feeding guild followed carnivores, invertebrate feeders, omnivores, planktivores, piscivores and herbivores. The estuarine fish community index (EFCI) was calculated for various estuaries based on species diversity and composition, nursery function and trophic integrity. The EFCI peaked in Zuari, Terekhol, Ashtamudi, Aganashini and lowest in Ulhas, Sharavathi, Poonthura, Bheemuni. Ecosystem models were constructed using Ecopath approach to analyse the trophic network and ecosystem structure of Zuari, Mandovi and Terekhol estuaries.Based on the size, total system throughput, eco-exergy index, ascendency, overhead and robustness indices, Zuari and Mandovi estuaries showed the highest values compared to Terekhol estuary indicated higher integrity of the former ecosystems compared to Terekhol.



Composition of fish guilds based on estuarine use (estuarine species (ES), marine juvenile migrants (MJ), marine stragglers (MS), diadromous species (DA), and freshwater migrants (FW)) and feeding type (carnivores (CR), Invertebrate feeders (IV), omnivores (OV), planktivores (PK), piscivores (PS) and herbivores (HR)



A preliminary estuarine fish community index (EFCI) calculated for various estuaries under the study (AGS: Aganashini, AS: Ashtamudi, BM: Bheemuni, CHA: Chapora, GA: Gangavali, GOD: Godavari, KA: Kali, MAN: Mandovi, NAR: Narmada, PT: Poonthura, SA: Sal, SH: Sharavathi, TR: Terekhol, UL: Ulhas, VE: Vembanad, ZU: Zuari). The published information was used for calculating the index for Narmada, Ashtamudi, Ulhas, and Vembanad.



Estuarine use fish guilds and their average contribution to the total fish catch in estuaries of India

Project: Genetic improvement of rice for coastal agro-ecosystem

Manohara KK, Paramesha V

Germplasm collection and conservation

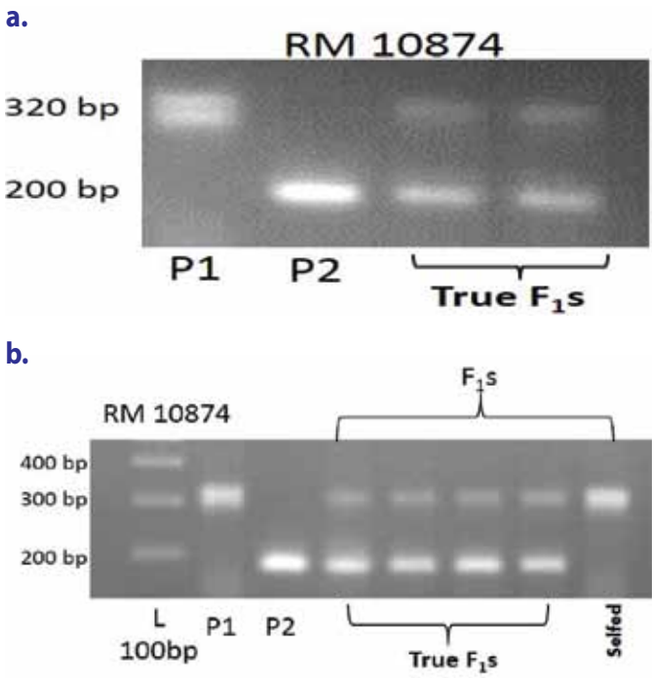
The rice germplasm collections of the Institute comprising of landraces (133) and wild rice (20) are being maintained at the Institute farm by growing every year during *kharif* season. The data on all the yield and its attributing characters are recorded for identifying promising liens for utilizing in pre-breeding programs to develop lines for future use. The collection includes salinity and submergence tolerant landraces and aromatic rice varieties, and a few are resistant to important insects and diseases prevailing in the west coast region.

Variability for grains in the germplasm accessions

Field view of rice germplasm block at the Institute farm during *kharif* 2020

Confirming hybridity of F_1 plants from new crosses using SSR markers

About 16 parents were selected during *kharif* 2019 for utilization in the hybridization program to develop a new set of Recombinants Inbred Lines. The parents chosen were high-yielding, some were salt-tolerant, some submergence tolerant, and a few were aromatic rice landraces. Altogether 27 different cross combinations were produced, and 10 F_1 plants from each of the 27 cross combinations were planted during the *kharif* season of 2020-21 to confirm their hybridity. Two highly polymorphic Simple Sequence Repeat (SSR) markers, namely RM10871 and RM21539, were utilized to check the hybridity in the F_1s. Based on the bands generated by the parents and F_1s, true F_1 plants were tagged, and seeds were collected for forwarding to F_2 and subsequent generations.



Gel images showing the true F_1s and selfed progenies using marker RM 10874 in cross a) CSR 27 × Pusa 44 and b) Guddadani Batta × Goa Dhan 4

Hybridization and generation advancement

A new set of crosses were initiated in *kharif* 2020 involving high-yielding popular varieties of the region, salinity and submergence tolerant varieties/ landraces to develop Recombinant Inbred Lines (RILs) for use in the development of dual stress-tolerant rice varieties for low lying coastal saline areas. The populations will also be utilized for mapping genes governing tolerance to salinity stress at seedling and reproductive stages. Altogether, 11 single crosses, five three-way crosses, and one double (four-way cross) crosses were developed. F_1 plants will be raised during *rabi* season 2020-21 to harvest F_2 seeds for advancing to further generations.

Hybridization in rice during *kharif* 2020

Hybridized rice during *kharif* 2020

Detail of crosses and parents involved to develop two way, three-way and three-way crosses

Two-way crosses	Goa Dhan 4 × Giddabhatta
Jyothi × Karjat 3	Goa Dhan 1 × Goa Dhan 3
Jyothi × Korgut	Goa Dhan 3 × Goa Dhan 4
Jyothi × Goa Dhan 2	**Three-way Crosses**
Jyothi × Giddabhatta	Goa Dhan 1 × CSR 27) × (Goa
Jyothi × Goa Dhan 4	Dhan 3)
Karjat 3 × Jyothi	Goa Dhan 1 × Jaya) × Jaddu Bhatta
Karjat 3 × Goa Dhan 2	Goa Dhan 3 × (Jaya × CSR 27)
Karjat 3 × Goa Dhan 4	(Jaya × CSR 27) × (Goa Dhan 1)
Jaya × Goa Dhan 2	(Jaya × CSR 27) × Jaddu Bhatta
Jaya × Jaddubhatta	**Double cross**
Goa Dhan 4 × Jyothi	(Goa Dhan 1 × Jaya) × (Pusa 44 × CSR 27)

Phenotyping of F_8 Recombinant Inbred Lines (RIL) derived from Karjat 3 × KS 19-2 under coastal salinity condition

About 112 F_8 RILs derived from Karjat 3 × KS 19-2 were phenotyped under coastal salinity conditions in experimental fields at Chorao Island, North Goa. Characters, namely, days to fifty per cent flowering, number of productive tillers per hill, number of grains per panicle, and grain yield were measured to identify promising lines suitable for coastal saline areas. Accordingly, seven lines were short-listed for further multiplication and involvement in station trial.

Field view of F_8 RIL populations (Karjat 3 × KS 19-2) under coastal salinity conditions

Selection of promising lines for further multiplication and involvementin station trial

Genetic variability parameters in F_8 RIL populations (Karjat 3 × KS 19-2) studied under coastal salinity conditions

Trait	Mean	Min	Max	SE	CV (%)	GCV	PCV	hBS	GAM
DFF	106.24	87.75	120.25	0.66	2.68	5.68	6.27	82.02	10.61
DM	137.85	118.83	148.83	0.7	2.17	4.44	4.94	80.99	8.25
PHT (cm)	145.22	80.03	170.81	1.6	3.2	8.38	8.93	88.09	16.22
NPT	5.68	3.1	9.44	0.13	17.24	18.3	24.9	54.04	27.76
PL (cm)	28.13	22.02	34.56	0.26	7.07	6.26	9.36	44.81	8.65
GPP	127.11	63.04	210.19	2.83	6.29	21.27	22.1	92.69	42.26
PF	71.28	50.8	89.06	0.54	6.14	4.27	7.46	32.81	5.05
GY (kg/ha)	2050.45	175.9	4457.36	90.92	12.58	44.16	46.06	91.91	87.34

DFF: Days to 50% flowering; DM: Days to maturity; PHT; Plant height in cms;
NPT: Number of productive tillers per hill; PL: Panicle length in cms; GPP: Grains per panicle;
PF: Per cent fertility; GY: Grain yield in kgs per ha
SE: Standard Error; CV: Coefficient of Variation; GCV: Genotypic Coefficient of Variation; PCV: Phenotypic Coefficient of Variation; hBS: Heritability in broad sense; GAV: Genetic Advance as per cent of mean

Project: Genetic variability of thermotolerance in selected breeds of livestock under coastal environment

Amiya Ranjan Sahu, EB Chakurkar, Gokuldas PP

The project was just initiated during the reported year, and the literature was reviewed. The blood samples were collected from the Shweta Kapila, Gir and Sahiwal cattle breeds, Agonda Goan Pig, and Konkan Kapila goats maintained in the Institute farm of ICAR-CCARI, Goa. Physiological parameters such as rectal temperature and respiration rate were recorded for the studied animals during the early morning and afternoon in the cool and hot period of the day. The Heat Shock Protein (HSP) genes will be amplified and validated for the presence of polymorphism in due course of the project period. The mean rectal temperature (°F) observed during the cool and hot period of the day were 101.79±0.46 and 103.95±0.62 in Agonda Goan pigs; 101.43±0.13 and 103.56±0.88 in Konkan Kanyal goats. The average respiration rate/minute recorded during the cool and hot period of the day showed as 36.82±0.79 and 39.29±0.42 in Agonda Goan pigs; 21.34±0.57 and 23.55±0.28 in Konkan Kanyal goats. The enzymatic activity of creatinine kinase and lactate dehydrogenase were estimated using serum samples by Biophotometer (Eppendorf™) and spectrophotometer reading.

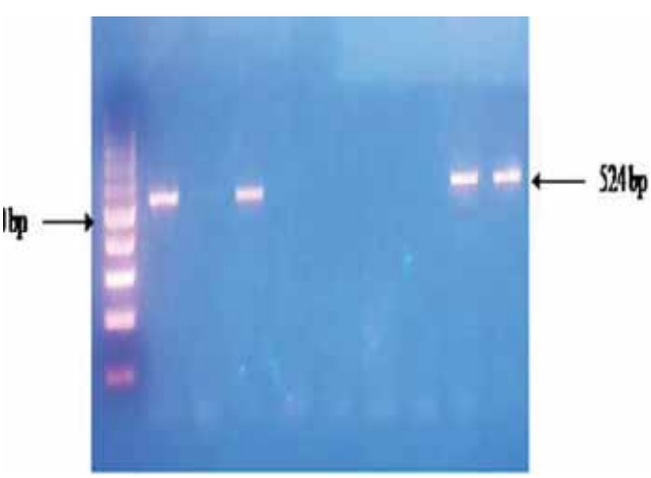
Reaction conditions for PCR amplification

Step	Process	Temp.	Duration
1	Initial denaturation	94°C	5 min
2	Denaturation	94°C	45 sec
3	Annealing	60.7°C	45 sec
4	Extension	72°C	45 sec
5	Back to steps 2 to 4	35 cycles	
6	Final extension	72 °C	5 min
7	Hold	4 °C	Till sample removal

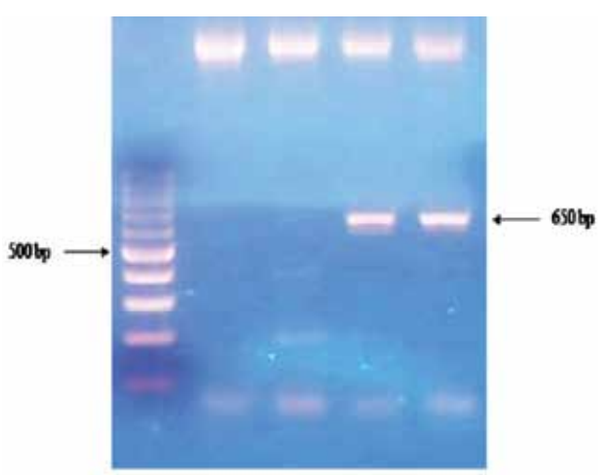
The mean enzymatic activity (IU/L) of creatinine kinase was 1611.0±173.7 and 2698.0±103.7; and lactate dehydrogenase was 705.0±40.7 and 904.0±29.7, respectively in the Agonda Goan pig estimated during the cool and hot period. The primers were designed by Primer3 software for heat shock protein genes (HSP70 and HSP90). The standardization of PCR amplification was done for the HSP70 gene using primers synthesized for a product size of 524 bp and 650 bp in a gradient PCR. The PCR products (524 bp and 650 bp) of both the amplified regions of the HSP70 gene were visualized under UV-transilluminator.

Details of primers used in PCR amplification

Gene	Primer Sequences (5'-3')	T_a (°C)	Size (bp)
HSP70 (5'UTR)	F: ATTGGTCCTTAGCGTTCT R: TCTTCATCTCACCCTTGTAC	60.7	524
HSP70 (promoter and coding region)	F: GATTGGTCCTTAGCGTTCTGGC R: CTGGGAGTCGTTGAAGTAAGCG	60.7	650



PCR amplicons of HSP70 gene (524 bp) in Agonda Goan pig (First lane: 100 bp DNA ladder and Lane 1, 3 8 and 9: Amplified of DNA samples)



R amplicons of HSP70 gene (650 bp) in Agonda Goan pig (First lane: 100 bp DNA ladder and lane 3-4: Amplified DNA samples)

Mega Project 3: Development and validation of production technologies of crops of the coastal region

Project: Study and the management of major diseases of vegetable crops in coastal regions

R Ramesh, Maruthadurai R

Field evaluation of bacterial wilt resistant varieties

Released bacterial wilt resistant brinjal varieties (Goa Brinjal-1, Goa Brinjal-2, Goa Brinjal-3 and Goa Brinjal-4) and the proposed lines (27-7-2 and 42-7-1) were evaluated along with susceptible local cultivars (Agassaim and Taligao) in the field. No wilt incidence was observed in all the released varieties and proposed lines. However, in susceptible lines, wilt was 91-100%. The mean number of fruits was higher in lines 27-7-2 and Goa Brinjal-2; yield (kg/plant) was higher in Goa Brinjal-2 and Goa Brinjal-4. Further, seeds of the released varieties were provided to the farmers for cultivation.

Field evaluation of bacterial wilt resistant varieties/ lines

Varieties/ lines	% wilt (90 DAP)	Mean no. of fruits/ plant	Yield (kg/ plant)	Yield (t/ha)
Goa Brinjal-1	0.00	10.22	1.32	39.53
Goa Brinjal-2	0.00	16.90	1.37	41.00
Goa Brinjal-3	0.00	15.36	1.26	37.77
Goa Brinjal-4	0.00	14.56	1.35	40.58
27-7-2 (Goa Brinjal-5)	0.00	17.51	1.20	36.02
42-7-1 (Goa Brinjal-6)	0.00	13.00	1.03	30.97
Agassaim	100.00	0.00	0.00	0.00
Taleigao	91.11	0.00	0.00	0.00
CV (%)	11.39	14.198	16.138	-
CD (0.05)	4.765	2.721	0.266	-

Mean of 4 years data of all the six bacterial wilt resistant varieties/lines indicated that bacterial wilt incidence was less than 3.0 % in Goa Brinjal-1, Goa Brinjal-2,Goa Brinjal-3, Goa Brinjal-4, 27-7-2 and 42-7-2. The above varieties/lines recorded fruit yield ranged from 22.7 to 30.2 t/ha.

Field evaluation of bacterial wilt resistant varieties/ lines (mean of 4 years)

Varieties/ lines	% wilt	Yield (kg/ plant)	Yield (t/ ha)
Goa Brinjal-1	0.56	1.01	30.27
Goa Brinjal-2	0.00	0.94	28.09
Goa Brinjal-3	2.78	0.76	22.78
Goa Brinjal-4	1.67	1.01	30.24
27-7-2 (Goa Brinjal-5)	0.00	1.01	30.27
42-7-1 (Goa Brinjal-6)	1.53	0.91	27.20
Agassaim	87.00	0.09	2.67
Taleigao	95.56	0.00	0.00
Surya	4.17	0.61	18.37

Viral disease complex in chilli

Samples of diseased chilli from the field were tested for Chilli Leaf Curl Virus (ChiLCV) and Chilli Veinal Mottle virus (CVMV) using available and new primers PCR and qPCR. Results showed the presence of the only ChiLCV in all the field samples. Only one sample was positive for CVMV polyprotein. One of the ChiLCV samples and one CVMV were selected, and the complete coat protein gene of ChiLCV and partial polyprotein gene of CVMV were cloned and confirmed through sequencing.

Different whitefly species (*Bemicia tabaci, Aleurodicus dispersus, A. rugioperculatus*) collected from different crops *viz*., chilli, coconut and henna were tested for the presence of ChiLCV coat protein gene by PCR and qPCR. The results indicated the presence of the virus in all the samples, and further characterization is in progress.

Field evaluation of eco-friendly chemicals/ inducers on chilli viral disease complex

A field trial was conducted with microbial insecticide (Spinosad), antagonistic bacterium (*B. methylotrophicus* RCh6-2b), entomophagous fungus (*Isaria tenuipes* RSP-2) and resistance inducing chemicals on chilli virus disease complex. Treatments

were given from the nursery stage and continued till 60 days after planting.

Growth parameters of chilli recorded in nursery indicated that shoot length and root length was higher in treatment where *I. tenuipes* was sprayed. Higher shoot weight was recorded in insecticide treatment and higher root weight was recorded in Rch6-2b treatment. Apart from insecticide application, treatment with *I. tenuipes* and antagonistic bacteria improved the plant growth parameters. Plant height after transplanting was high in *I. tenuipes* treatment. Percent disease index (PDI) of virus infection was comparatively less in Spinosad, Rch6-2b, *I. tenuipes* treatment and insecticide treatments for 130 days after planting. Total fruit yield was higher in Spinosad (37.5 t/ha) and Rch6-2b (33.5 t/ha), *I. tenuipes* treatments (33.3 t/ha).

Production of talc formulation of biocontrol agents for various experiments and field trials

Talc based formulation of *Trichoderma* (650 kg) was produced and was sold to farmer and agriculture department, Government of Goa and used in various experiments and field trials of the Institute. Bacterial antagonists (434 kg of Goa Bio-1 and Goa Bio-2) was produced and given to farmer's and Institute demonstration plots to treat black pepper plants for management of footrot and plant health management experiments of chilli and paddy.

Project: Studies on emerging insect pests whiteflies, fall armyworm and their management in the coastal region of India

Maruthadurai R, R Ramesh

Fall armyworm *Spodoptera frugiperda* damage incidence on fodder maize and its strains

Fall armyworm (FAW) (*Spodoptera frugiperda* J.E. Smith) is a destructive insect pest of several crop plants. FAW infestation on fodder maize ranged from 43 to 83%. An average of 0.67 larvae was found per plant, with a maximum of 1.16 larvae/plant during the vegetative stage. More larvae/plant was recorded in the vegetative stage than the reproductive stage. The mtCOI 5' based sequence analysis of FAW populations from Goa revealed both Rice (R) strain and Corn (C) strain which feeds on fodder maize and sweet corn. During the entire crop period, periodical sampling revealed the presence of 'R' strain and 'C' strain in Goa on fodder maize.

Potential natural enemies of fall armyworm and its predation by rove beetle

Generalist predators like an earwig, spiders, reduviid bug, rove beetle, coccinellids, and wasps predating on various stages of fall armyworm. Parasitoids, i.e., *Telenomus* spp and *Trichogramma* spp were found parasitizing the eggs. Rove beetle *Paederus fuscipes* Curtis (Coleoptera: Staphylinidae) is a generalist predator found predating on various stages of FAW. The adult rove beetle population varied between the vegetative and reproductive phases of the crop. The predatory adult beetle population was found significantly higher at the reproductive stage than at the vegetative phase within the season. Adult predators fed more first instar FAW larvae compared to eggs and second instar larvae. Conservation of this predator should be encouraged for the eco-friendly management of fall armyworm.

Rove beetles predation on FAW larvae

Predicting the potential distribution of fall armyworm, *Spodoptera frugiperda* based on MaxEnt modelling under future climate change

The current study was conducted to predict the potential distribution of FAW under present and future climate change scenarios in 2050 and 2070 with 19 bioclimatic variables through Maximum Entropy (MaxEnt) niche modelling. The MaxEnt model predicted the current and future distribution of FAW with a training AUC value of 0.940 and a test AUC value of 0.936, indicating a better ability of the model for discrimination between suitable and unsuitable habitat areas for S. *frugiperda*. Jackknife test for estimating the predictive power of the variables showed that annual precipitation, annual mean temperature, and temperature seasonality strongly influenced the distribution of

Fodder maize with intercrops

fall armyworm. There is a significant increase in the highly suitable areas for fall armyworm under future climatic conditions, mainly detected in southern and central India.

Management of fall armyworm through an intercropping system

A field trial was undertaken to study the effect of different intercrops on the management of fall armyworm. Fodder maize variety African tall was sown with intercrops like cowpea, green gram, groundnut and red gram. Weekly observations were recorded on the number of larvae/plant, natural enemies and per cent damage. Among the treatments, maize + cowpea has registered less per cent damage of 14.85 and higher green fodder yield followed by maize + green gram. Higher activities of natural enemies were recorded in maize with intercrops than the sole crop.

Damage incidence of whiteflies, host range and natural enemies in coconut based cropping system

A sampling of whiteflies incidence in coconut based cropping system revealed the presence of two invasive species *viz*., rugose spiralling whitefly (RSW) *Aleurodicus rugioperculatus* Martin, and nesting whitefly *Paraleyrodes minei*. Moderate to severe incidence of both the whiteflies were recorded in coconut. The whiteflies population were monitored with an instalment of yellow sticky traps. Besides coconut, the whiteflies infestation and its colonies were recorded on banana, guava, Areca nut, triandra palm, mango, black pepper, heliconia, papaya, citrus, avocado, chafa, Indian shot and maize. The predominant natural enemies feeding the whitefly population were predator *Mallada boninensis* Okamoto and parasitoid *Encarsia guadeloupae* Viggiani.

Project: Production and postharvest management of fruit crops kokum, jack fruit and breadfruit of West coast region of India

Maneesha SR, Gupta MJ

Evaluation of Kokum (*Garcinia indica*) accessions and other *Garcinia* species

Promising kokum (*Garcinia indica*) accessions (19) and other *Garcinia* species (3) *viz; G. tinctoria*, *G. hombroniana* and *G.mangostana* were evaluated along with released varieties; Konkan Amruta and Konkan Hatis. Among the accessions, a single graft of Kasarpal-11 (KAS-11) started bearing in 2019. In 2020, the four years old graft of KAS-11 produced 117 fruits (4.77 kg) with an average fruit weight of 47.89 g in May 2020. The average fruit length was 4.41 cm, and the fruit circumference was 5.01 cm. Fresh rind weight was 22.42 g, and rind thickness was 3.28 mm. The average number of seeds was 5.88 per fruit. Pulp TSS was 12.05° Brix. Another KAS-11 graft produced 1.92 kg fruits in 2020. Both these grafts showed early flowering again in December 2020.

KAS-11 in bearing stage during May, 2020

Variability of jackfruit accessions

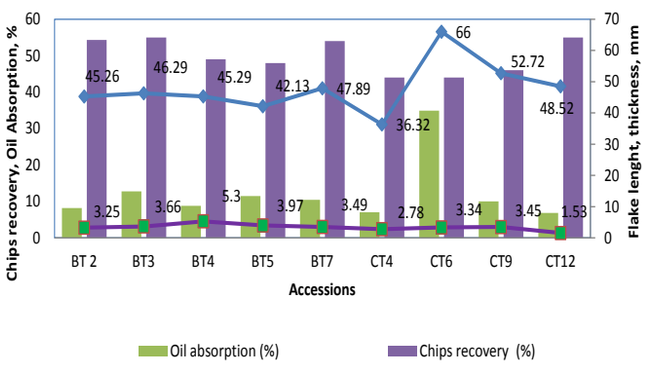
Among the jack fruit accessions of the campus, CT15 had the highest mean fruit weight (10.81 kg), fruit breadth (69.33 cm) and bulb weight (2.50 g). CT10 recorded the highest fruit volume (8300 cc). The highest fruit length (50.6 cm) and number of seeds 217.33, seed weight (1.21 g) and wastage (4.33 kg) were in CT12. CT6 had the lowest waste percentage (46.53).

Suitability of jackfruit accessions for chips

The suitability of jackfruit accessions was evaluated based on flake characteristics and the quality of the final product. For chips, taste, crispiness, colour, size, thickness, and papad taste and elasticity were considered for selection.

Kokum seed decorticator

A manual decorticator for facilitating kokum seed shelling for further processing into butter was designed and developed. The testing of the machine was carried out with three types of pre-treatments, T1-Dry roasting for 8 minutes, T2- oven drying at 60°C for 20 minutes and T3-control (untreated dry seeds). Results showed that the shelling efficiency was maximum for treatment T1 (91.56%) followed by T2 (84.66%), while the control had the minimum shelling (77.32%). The capacity of the decorticator was 15 kg/h.



Characteristics of jackfruit accessions suitable for chips

Yield characteristic of jack fruit accessions at CCARI campus during 2020

Accession No.	Fruit weight (kg)	Fruit length (cm)	Fruit breadth (cm)	Fruit volume (cc)	No. of seeds	Wastage (%)
BT 1	4.13	39.50	54.00	4500.00	56.50	74.88
BT 2	5.98	38.46	56.54	4817.19	124.00	59.66
BT 3	2.68	31.60	50.00	2400.00	43.40	67.03
BT 4	4.90	39.00	58.50	4750.00	70.00	61.70
BT 5	5.16	39.80	56.80	5440.00	104.40	58.15
BT 6	4.47	40.50	59.50	2002.25	143.50	69.89
BT 7	3.44	40.00	50.00	4900.00	44.50	64.99
CT 1	2.61	29.50	53.50	3500.00	33.00	53.02
CT 2	4.65	33.00	54.50	5100.00	106.00	51.89
CT3	5.70	35.17	56.67	5400.00	59.00	51.74
CT 4	2.89	30.17	47.67	3022.22	70.89	70.65
CT 6	6.22	43.50	55.50	3652.13	104.50	46.53
CT 10	5.38	44.00	62.00	8300.00	62.00	59.46
CT 11	6.50	40.50	64.00	8120.00	117.00	49.38
CT 12	7.66	50.67	61.33	7600.00	217.33	56.58
CT 15	10.81	46.33	69.33	5605.25	128.33	53.16

Project: Development of Good Agricultural Practices through integrated nutrient management for sustainable fruit crop production in coastal regions of India

Maneesha SR, R Ramesh, GR Mahajan

Effect of different nutrient management practices in growth and yield of banana varieties, Velchi (V1) and Grand Naine (V2) was evaluated in poorly fertile red laterite soil condition. The nutrient management treatments applied were absolute control (T1) with no application of fertilizers and manures, recommended dose of fertilizers (RDF-400: 200:400 NPK/ plant/ year) (T2), RDF+ integrated nutrient mixture (IN mixture) (T3), RDF+ commercially available nutrient mixture (T4) and organic cultivation practices (T5). Application of integrated nutrient mixture @ 1 kg/ plant at 3 months after planting had resulted in early harvest (337.73 days) and the highest bunch weight (26.52 kg) in Grand Naine. Velchi had the highest number of hands per bunch (8.92) and the highest number of fruits per hand (12.69). Fruit weight, fruit length and fruit circumference were the highest in Grand Naine treated with T3 treatment (131.85 g, 19.90 cm and 13.13 cm, respectively).

Bunches of Velchi(V1) and Grand Nine (V2) under T3 treatment

Project: Response of mango *(Mangifera indica L.)* to edaphic and climate factors in Indian coastal region

Maneesha SR, AR Desai, SK Singh, Priya Devi, Bappa Das

India leads in mango production with 207.98 million tons fruits from an area of 22.93 million hectare with a productivity of 9.2 t/ ha (Indiastat, 2020). Mango grows up well in tropical, subtropical and coastal conditions with pH ranging from 5.5 to 7.5 and salinity up to 4.5 dSm^{-1}. Annual mean temperature ranging from 21 to 27 °C is good for mango cultivation. Mango growth and flowering is highly dependent on soil and climate factors. The major climate factors affecting mango flowering are temperature and rainfall. Four mango varieties *viz.,* Amrapali, Alphonso, Mankurad and Kesar were selected for this experiment. Flushing and flowering behavior of these varieties with response to the weather parameters of Goa were observed. During August- October period, the number of days with night temperature below 20° C was nil. At the same time, a rainfall of 215 cm was recorded in October month over a period of 14 days. Due to this, mango trees produced vegetative shoots instead of reproductive shoots. In December, seven days were recorded with ≤ 20 °C night temperature and a single day with 54.2 mm rainfall. New flushes were developed during August-September and November-December. Heavy infestation of leaf webber (*Orthaga euadrusalis*) was also observed during this period.

Flushing and leaf webber infestation in 'Mankurad' during November 2020

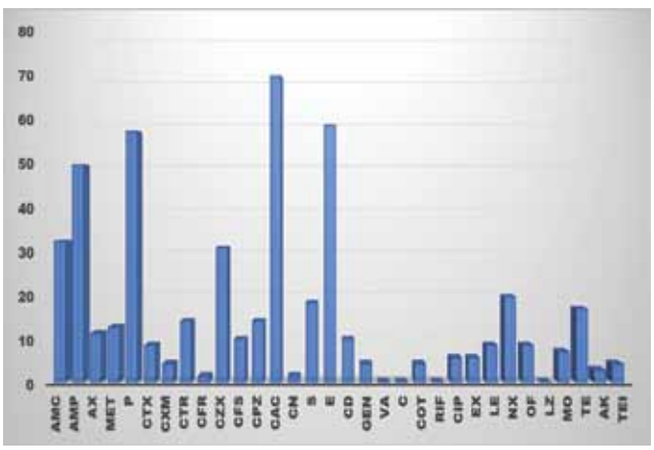
Mega Project 4: Development and validation of production technologies of livestock and fisheries

Project: Prevalence and impact study of the economically important diseases of dairy animals in coastal India

Susitha Rajkumar, Chethan Kumar HB

Species identification and antibiotic resistance profile of Coagulase-negative *Staphylococci* from bovine subclinical mastitis

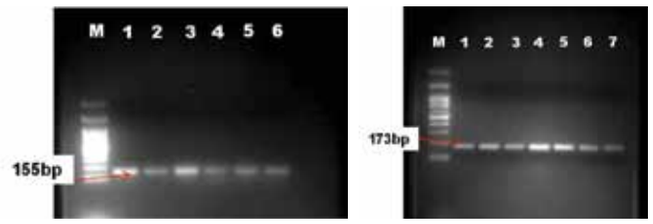
Mastitis including clinical and subclinical mastitis (SCM) is an economically very important disease of dairy animals including cattle and buffalo. In order to study major bacterial pathogens and their pathotypes, milk samples from SCM affected cattle and buffalo (135 nos) from small and large dairy units of West coast were screened. *Staphylococcus* spp., *Enterobacteriaceae* and *Bacillus* sp. were isolated from 85.45%, 10.9% and 1.8%, respectively from the samples. Species identification of coagulase negative *Staphylococci* (CNS) isolates (30 No) were carried out by biochemical tests and sequencing of *16srRNA* gene. Identified species were *S. chromogenes, S. cohnii, S. epidermidis, S. sciuri, S. warneri, S. haemolyticus, S. simulans, S. saprophyticus,* and *S. hominis.* The CNS isolates were subjected to antibiotic susceptibility testing against 32 antibiotics of veterinary and medical importance. Highest resistance (resistant and intermediate) was found against Ceftazidime/Clavulanic acid 30/10 µg (70.42%) followed by Erythromycin 15 mcg (59.15%) Penicillin G, 10 units (57.75%), Ampicillin 10 mcg (50.00%), Amoxycillin/ Clavulanic acid 30 mcg (32.39%), Ceftizoxime 30 mcg (30.99%), Norfloxacin 10 mcg (19.72%), Streptomycin 10 mcg (18.31%) and Tetracycline 30 mcg (16.90%). The veterinary antibiotics found effective against CNS isolates were Cephalexin 30 mcg (98.59% susceptible) followed by Gentamicin 10 mcg (95.77%), Enrofloxacin and Ciprofloxacin 5 mcg (94.37%), Levofloxacin 5 mcg and Ofloxacin 5 mcg (91.55%), Cefoperazone/ Sulbactam 50/50 mcg (90.14%), Ampicillin/ Cloxacillin (89.55%) and Cefoperazone 75 mcg and Ceftriaxone 30 mcg (85.92%). Intermediary resistance to Teicoplanin a glycopeptide antibiotic was observed in 3 CNS isolates of species *S. haemolyticus* and *S. saprophyticus.*



Percentage of CNS isolates resistant to various antibiotics

Screening of Coagulase negative *Staphylococci* associated with subclinical mastitis in cattle for antibiotic resistance genes

Coagulase-negative *Staphylococci* (CoNS), a group of multiple *Staphylococcus* species are minor mastitis pathogens, but are the highest isolated pathogens from bovine clinical and subclinical mastitis. The CNS strains isolated from subclinical mastitis were screened for genes associated with antibiotic resistance. Beta-lactam antibiotics like penicillin are one of the most frequently used drugs in veterinary medicine in India. Two primary resistance mechanisms in *Staphylococcus* spp. against beta lactams are the expression of beta-lactamase enzymes encoded by the *blaZ* gene and production of the penicillin-binding protein 2a (PBP-2a) resulting in a higher-level of resistance encoded by the mecA gene belonging to staphylococcal cassette chromosome (SCC*mec*). In the present study, the CNS isolates (98 No) were subjected to growth on Methicillin Resistance *Staphylococcus aureus* (MeReSa) agar containing antibiotic Cefoxitin and PCR screening for SCC *Mec A gene* which showed 8.33% and 18.03% positivity respectively. PCR screening *blaz* gene encoding beta lactamase enzyme associated with penicillin resistance showed positivity of 67.74%.



PCR showing amplification of *bla Z* gene (173bp) and MecA gene (155bp)

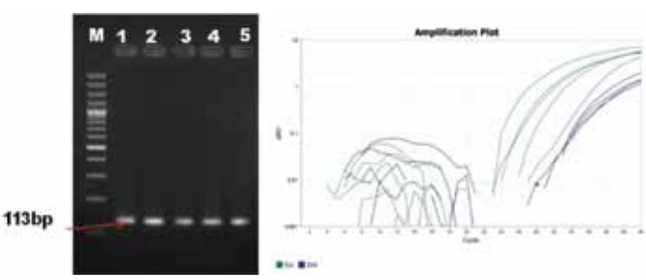
Screening of Coagulase-negative *Staphylococcus* spp. for virulence factors

The CoNS isolates (80 isolates) were screened for virulence factors like toxins and adhesins by PCR screening of encoding genes. The positivity for adhesins were found to be 83.56% for *Eno* gene (Laminin binding protein), 15.79% for *IcaA* (Inter cellular adhesin protein A associated with biofilm), 23.29% for *aap* (accumulation associated protein associated with biofilm), 23.19% for *atlE* (bifunctional adhesin and autolysin AtlE protein), 31.15% for *emb* (fibronectin adhesin), 37.50% for *fbe* (fibrinogen adhesion protein), 7.14% for *Luk* PV (Panton-Valentine leukocidin), 9.72% for *hlg* (g-hemolysin genes), 18.31% for *clfA*,30.0% for *clfB* (Adhesins for fibronectin), 9.72% for *cna* (Adhesin for collagen), 23.61% for *fnb* (Adhesin for fibronectin) and 5.56% for *sdrE* (serine–aspartate repeat protein E) by individual and multiplex PCR.

Multiplex PCR for detection of virulence genes [*Eno* (300bp), *emb* (455bp), *altE* (682bp) genes], duplex PCRs [*Aap* (289bp), *Luk* PV (450bp) genes] and [*hlg* (938bp), *clfA* gene (476bp)]

Standardization of conventional and Real-Time SYBR Green PCR for detection of *B. abortus*

Conventional PCR using *IS711* gene-derived oligonucleotide primer was standardised using DNA isolated from *Brucella abortus* RBPT antigen. PCR could detect *B. abortus* DNA from stomach contents and liver of aborted foetus and placenta. Real-Time SYBR Green PCR assay using the same oligonucleotide primer pair was also standardized to detect *Brucella abortus* DNA from the same samples.



Gel image showing amplification of IS711 gene (113bp) and graph showing Real-time amplification plot

Project: Augmentation of backyard poultry production through technological interventions in breeding, feeding and management aspects in Indian west coast

Nibedita Nayak, Gokuldas PP, Susitha Rajkumar

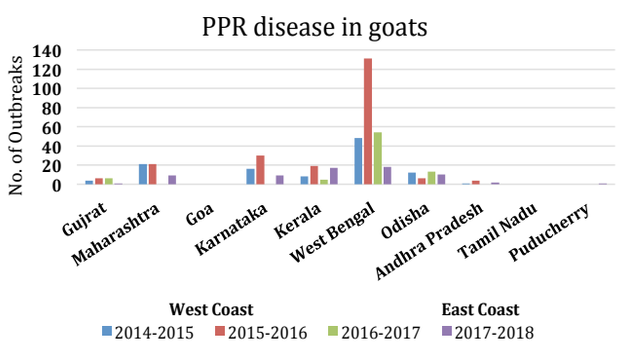
A total of 150 farmers having small scale backyard poultry units from two districts of each coastal state of Goa and north Karnataka were interviewed with a detailed questionnaire to study the current scenario of backyard poultry, including constraints. Data on socio-economic characteristics revealed that 70% of farmers belonged to a nuclear family with educational qualifications above matriculation. More than 90% of farmers preferred to have dual-purpose breeds, predominantly Vanaraja and Srinidhi followed by Gramapriya, Krishibro and Kadaknath. The source for chick purchase was mostly from ICAR Goa (52%), State Govt. Goa (30%), private and other sources (18%). Adoption of backyard poultry feeding practices revealed that 84% of people were supplementing with feed in addition to scavenging, while 8% of farmers solely depended on commercial feed. Chick production and recycling were only adopted by 60% of farmers, while others faced this constraint. More than 80% of people were rearing birds in the deep litter system. More than 65% of farmers agreed that poultry keeping was economical with respect to livelihood, nutrition and meeting emergency financial needs. On surveillance, the predominant diseases reported were Ranikhet disease, Coccidiosis, worm infection and Fowlpox. The employment generation through family poultry farming was 182 to 548 and 91 to 821 man-days per year for male and female farmers. The major constraints faced by poultry farmers were high feed cost, inadequate Govt. support, non-availability of stocks, climate issues, non-availability of skilled labourers and predator attacks. Hence technological package was made to facilitate quality egg production, incubation, hatching, feed formulation, feed storage, housing for high rainfall areas and breeding of germplasm. A feeding trial was also conducted with herbal feed additives in backyard poultry, reducing early chick mortality and improved growth in a pre-starter period.

Project: Impact analysis of diseases of meat animals (pigs, goats and sheep and poultry) in coastal India and strategies for their management

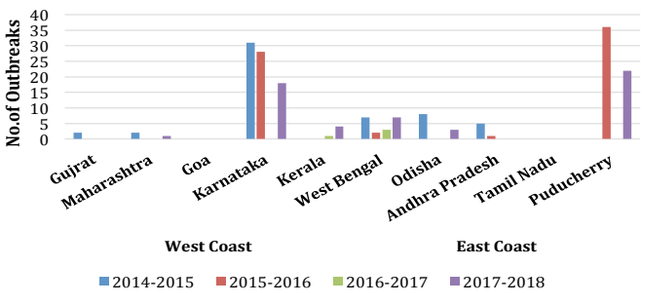
Shivasharanappa N, Chethan Kumar HB

A five-year disease prevalence data of the east and west coast were reviewed and compiled. The communication letters are prepared to Departments of AHVS, AICRP units of sheep, goats and pigs located in coastal regions, State veterinary colleges, KVKs and other departments for collecting primary disease information such as outbreaks and vaccination data in small ruminants and pigs.

A five year (2015-2020) disease prevalence and outbreak data were obtained from Animal Disease Research Institute, Cuttack (AH&VS) of Balesore, Bhadrak, Ganjam, Jagatsinghpur, Kendrapara and Puri of Odisha state. A Total of 23 outbreaks were documented with morbidity of 9.42% (868/9214) and mortality of 3.71% (342/9214). Similarly, four outbreaks of HS, two outbreaks of goat pox and bluetongue, three outbreaks of CCPP and one outbreak of enterotoxemia were documented in Odisha.

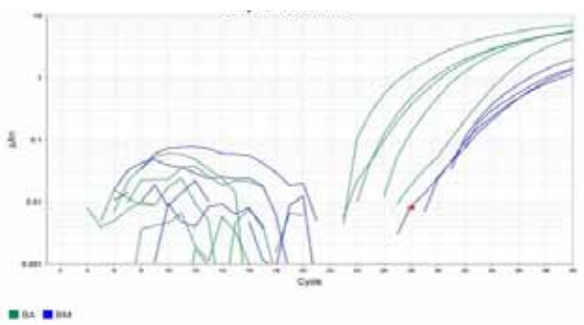


Four-year disease outbreak data in coastal states



Four-year disease outbreak data of Goat pox/sheep pox in coastal states

Real-Time SYBR Green PCR assay was standardized to differentiate *Brucella melitensis* and *Brucella abortus* infection in goats targeting OMP31 gene and Orf parapox viral infection was diagnosed using Real-Time SYBR Green PCR assay in goats. A total of 50 sera samples from goats were collected for ELISA based diagnosis of PPR from coastal parts of Goa and Sawantawadi.



Real-Time SYBR Green PCR assay to differentiate *Brucella melitensis* and *Brucella abortus* infection in goats targeting OMP31 gene

Number of disease outbreaks in goats and sheep in coastal districts of Odisha from 2015-2020

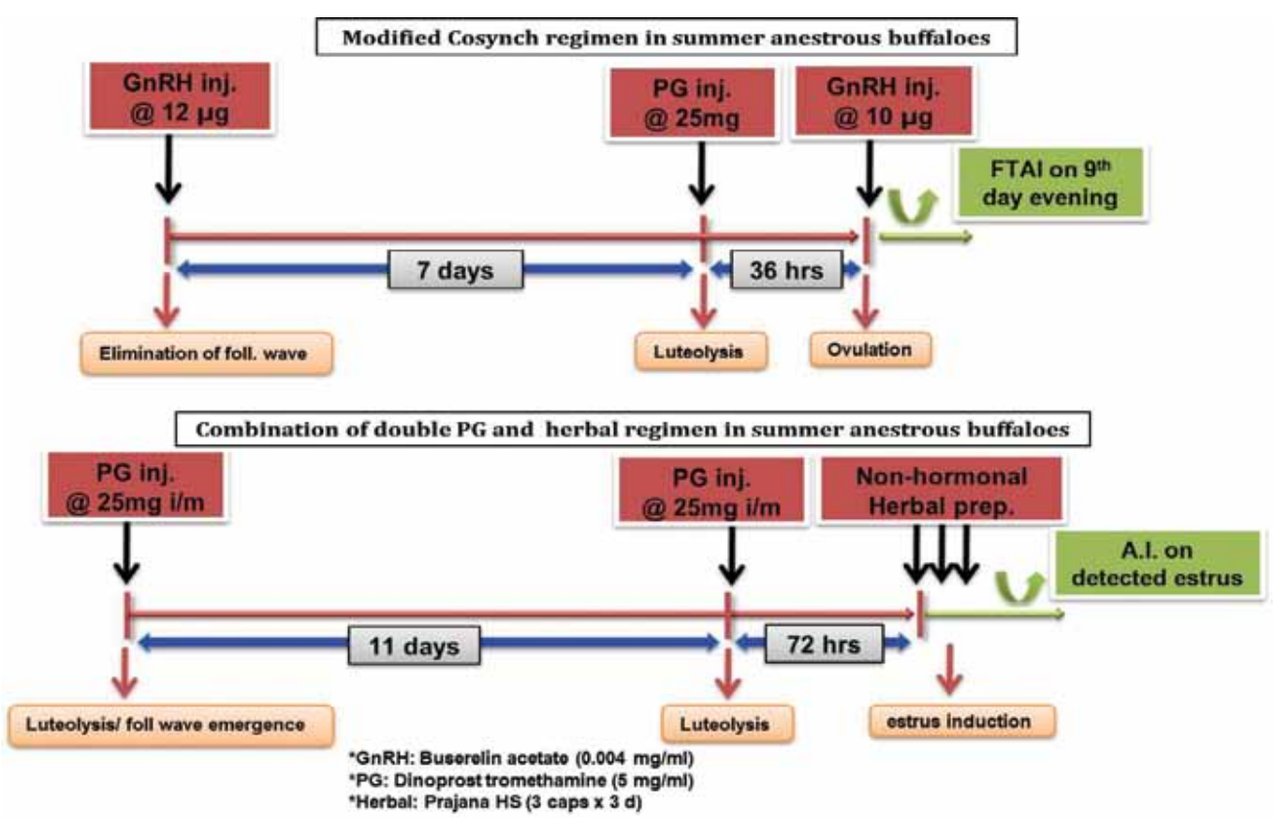
Name of disease	Year	District	Number of outbreaks	Susceptible population	Number of attacks	Number of deaths
HS	2015-16	Ganjam	1	2200	320	185
	2017-18	Ganjam	1	180	58	34
		Kendrapada	1	132	12	12
PPR	2015-16	Jagatsinghpur	6	645	228	74
	2016-17	Ganjam	12	7668	475	142
	2017-18	Kendrapara	2	315	25	13
		Ganjam	2	470	55	35
	2018-19	Jagatsinghpur	1	116	85	78
Goat pox	2018-19	Puri	1	181	27	12
		Kendrapara	1	925	30	16
Blue tongue	2016-17	Ganjam	2	2102	100	43
Enterotoxemia	2016-17	Kendrapara	1	191	45	43
CCPP	2019-20	Ganjam	3	410	99	86

Project: Seasonal modulation of reproductive performance in dairy buffaloes with special reference to west coast region

Gokuldas PP

This project was designed to investigate the impact of different bio-meteorological factors in different seasons on overall reproductive response in buffaloes reared under coastal climatic conditions. A novel approach using Heat Load Index (HLI) was employed for assessing the correlation of environmental factors with reproductive variables in buffaloes reared in the coastal climate. HLI consider additional environmental variables like Black Globe Temperature (BGT), Solar radiation (SR, Wm^{-2}), Wind Speed (WS, ms^{-1}) and Relative humidity (RH, %). HLI was found to be negatively correlated ($r = -0.97$, $p<0.05$) with the overall conception rate in winter and positively correlated ($r = +0.90$, $p<0.05$) with repeat breeding incidence in summer. HLI could be used as a good indicator of reproductive stress as a good correlation exists with reproductive attributes like conception rate and repeat breeding. Regardless of the effect of photoperiod, the sub-optimal reproductive performance marked by the higher incidence of sub-estrus, poor estrus expression, repeat breeding observed during summer. Ovarian perfusion and luteal numerical pixel data recorded using digital RTU and Colour Flow Mapping ultrasound imaging system were analysed. Significantly lower ($p<0.05$) luteal numerical pixel values indicating reduced luteal activity were recorded in buffaloes during the summer season.

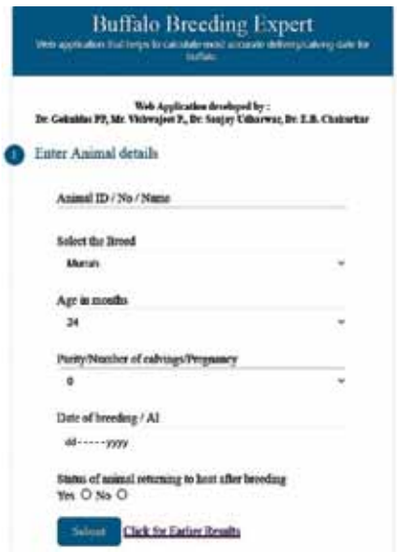
In summer, cases of sub-optimal reproductive performance due to summer anestrus, poor estrus expression, subestrus and prolonged calving to conception interval have been recorded in dairy buffaloes reared under a hot and humid coastal climate. An experimental trial was conducted to compare the efficacy of different hormonal and combination regimens for estrus induction and synchronization in summer anestrous buffaloes. Modified *Cosynch* protocol involving GnRH and prostaglandin analogue, double prostaglandin and herbal combination regimens were evaluated. A non-hormonal and herbal preparation rich in special trienoic fatty acids acting as precursors for biosynthesis of reproductive hormones was used in a combination regimen. Combination of double PG analogue with herbal preparation regimen was found to be more effective in inducing estrus and enhancing estrus expression in summer anestrous buffaloes with significantly ($p<0.05$) higher initial estrus induction rate (83.33%) as compared to modified Cosynch protocol (71.43%).



Different estrus induction and synchronization regimens in summer anestrus Murrah buffaloes

Comparison of different estrus induction and synchronization regimens in buffaloes

Parameters	Modified Cosynch regimen	Combined Double PG Herbal regimen	Overall
Initial Estrus induction rate (%)	71.43[a]	83.33[b]	78.57
Overall estrus induction (%)	71.43[a]	100.0[b]	85.72
% non-responders	28.57[a]	16.67[b]	40.00
% repeat breeding	42.86[a]	28.57[b]	35.71
Treatment to estrus Interval (h)	44.5[a]	20.0[b]	37.5



As a step towards creating more opportunities for smart dairy farming utilizing the Internet of things (IoT) and data-driven techniques, a web application, namely Buffalo Breeding Expert was developed that can assist farmers in calculating calving date with high degree accuracy as well as ideal weaning date for different breeds of buffalo. Various factors affecting gestation period like breed, age, parity of the animal, the season of breeding were factored in to predict a reliable calving date for buffaloes. Based on the input data on breeding, the application can help farmers to plan calving and weaning care management in buffaloes effortlessly. The application also provides an expert system on scientific buffalo farming.

Project: Conservation of major farm animal resources in the coastal region through evaluation of seminal traits, semen processing and preservation protocols

Gokuldas PP, EB Chakurkar, Chethan Kumar HB, Amiya Ranjan Sahu

This new project was designed to document and characterize seminal attributes, standardize and refine semen processing, preservation techniques, and subsequent use in assisted reproduction procedures are essential to the breed development programs and conservation of indigenous animal resources native to the coastal ecosystem. Major objectives are development and refinement of semen collection, and processing protocols, evaluation of qualitative and quantitative semen attributes, genetic polymorphism of candidate genes and their association with sperm quality and fertility traits and feasibility assessment of different semen preservation and insemination techniques in indigenous breeds of cattle, pig and goat reared in the coastal region. Procedures on bull breeding soundness examination, bull preparation and training for semen collection in the Shweta Kapila breed of cattle were initiated during the period. Initial survey work and preparation of a status report with baseline information on indigenous farm animal genetic resources native to the coastal region are under progress.

Shweta Kapila Cattle

Konkan Kanyal Goat

Project: Assessing status of coastal aquaculture practices and improvement through technology intervention for promoting livelihood of fish farmers in the west coast of India

Trivesh Mayekar, Sreekanth GB, GR Mahajan

Polyculture of Asian Seabass with Tilapia

The Asian Seabass (*Lates calcarifer)* is a highly preferred food fish known as Chonok in Goa. It is a hardy, euryhaline fish, suitable for coastal marine, inland saline, brackish water and freshwater ecosystems. An experimental trial has been initiated in polyculture mode in an open freshwater pond (2000 m^2) at the institute. Total 570 Seabass fingerlings (length: 2-3 inch, mean weight 20-30 gm) were stocked along with Tilapia (1500 nos, mean weight 50-100 gm) and advanced fry of Indian Major Carps (IMC) (2000 nos, 2-3 cm size) as feed for Seabass in freshwater pond integrated with ducks (20 nos). Daily 2 kg rice bran was provided as feed to Tilapia. Also, weed fishes such as *Systomus sarana, Puntius mahecola*, *Puntius vittatus,* and *Rasbora dandia* were also fed to Seabass regularly. After three months of culture, a total of 26 nos. of Seabass were drawn for length-weight analysis, which was found to be ranging between 20-25.4 cm and 100-300 g, respectively.

Gut analysis of Seabass showed juvenile Tilapia (8-10 cm) and other weed fish species (5-11 cm). Tilapia was sampled every month for length-weight analysis, ranging between 9-28 cm and 8-400 gm, respectively.

Environmental variables during the culture period

Water	Soil
Temperature (26-29˚C)	pH (6.0-7.0)
pH (6.5-7.6)	Electrical conductivity (100-400 µS/cm)
Dissolved oxygen (DO) (5.0-6.0 mg L^{-1})	Organic carbon (1.5-3%)
Alkalinity (50-80 mg L^{-1})	Phosphorous (0.05-0.5 kg/ha)
Ammonia-N (0.005-0.05 mg L^{-1})	Potassium K (200-400 kg/ha)
Nitrate-N (0.05-0.2 mg L^{-1})	

Polyculture experiment in farmer's field

Scientific polyculture was undertaken in farmer's field at Blue Harvest farm in Salem, Bicholim, Goa, in a total area of 1.8 ha as a livestock-fish-based Integrated farming system mode. The system included piggery, fishery, poultry, horticulture (pineapple, papaya, banana, and passion fruit), vermicompost, biogas, and kitchen garden. Seabass fish fingerlings (4500 nos each) were stocked in 3 ponds of 0.2 ha each and 1000 Tilapia fishes (100-150 g). In addition, 4000 Bhasa fish (*Pangasionodon hypophthalmus*) was stocked in a pond of 0.016 ha. Tilapia and Bhasa were fed with rice bran (15 kg/day) and Chicken waste (40 kg/day), respectively. After seven months of culture, the average weight of Seabass, Bhasa and Tilapia were 0.7 to 1.4 kg, 1-1.2 kg and 300-400 g, respectively.

Captive broodstock development, breeding and Seed production of Melon barb, *Haludaria pradhani* an indigenous ornamental fish from Goa

This activity mainly aims to conserve indigenous ornamental germplasm from Goa to provide Goan people livelihood options in ornamental fish breeding and rearing. The melon barb (*Haludaria pradhani*) is a common species of cyprinid fish endemic to rivers in Goa, Karnataka, Kerala and Tamil Nadu in the Western Ghats of South India. Specimens were collected from Keri, Goa (the upper stretch of Mandovi River). For broodstock development, they were acclimatized in a big aquarium tank (200 l) for 3 to 4 months with artificial feeding (2% of body weight). It exhibits clear sexual dimorphism; males and females were conditioned separately for three weeks before placing in spawning tanks at a 1:1 ratio. Seven pairs were set for breeding and released into spawning tanks with stones and dry leaves at

Seabass sampling

Tilapia sampling

Gut content analysis

Bhasa fish sampling

Integrated multi-species aquaculture

Sampling of Sea bass

Sea bass and Tilapia culture

the bottom and a square-shaped nylon net above to avoid egg eating by parents. Aeration was given continuously, and feeding was done twice a day. Spawning was observed within one week, with water quality parameters of temperature (24-27.5˚C), pH (6.5-7.5) and DO (3.5-4.6 mg L^{-1}). Spawn was collected after one week from the spawning tank and reared with live feed, initially green algae and later with *Artemia nauplii* and Daphnia.

Pond breeding of small indigenous fishes

Small indigenous fish species play an essential role in the rural population's life, livelihood, and health, especially the poor. So, to promote natural breeding in the pond system, various small indigenous fishes like *P. sarana* (32 nos.), *P. Mahecola* (150 nos.) *and P. Vittatus* (100 nos.), *and Rasbora dandia* (96 nos.) were collected locally from Goa and stocked in freshwater ponds (1000 m^2) for promoting natural breeding. They were fed rice bran regularly (2% of body weight). Young ones were used for feeding of Seabass polyculture experiment. For the conservation and management of small indigenous fishes, knowledge of their food and feeding, biology, and breeding is essential.

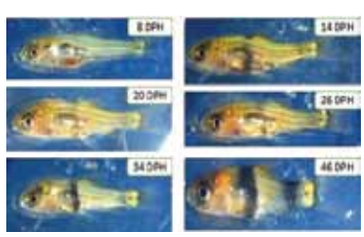
Lenght and weight of fish species

Fish species	Number	Length (cm)	Weight (g)
Puntius mahecola	150	5.0-11.0	1.0- 15.0
Systomus sarana	32	6.0 -20.0	3.0- 50.0
Rasbora dandia	96	8.0-12.6	3.0-17.0

Breeding tank set up

Breeding pair

Fish seed produce



Haludaria pradhani **larvae after hatching**

Systomus sarana

Puntius vittatus

Rasbora dandia

Puntius mahecola

Mega Project 5: Improving livelihood security through post-harvest technologies and other agri-enterprises

Project: Prospects and promotion of agro eco-tourism in coastal region of India

EB Chakurkar, AR Desai, V Arunachalam, M Thangam, MJ Gupta, GR Mahajan, Maneesha SR, S Priya Devi, Sreekanth GB

Expansion of plant diversity in AET unit

The diversity of different plant species in the AET unit was recorded in the year 2020. There were 150 species of medicinal and aromatic plants, 21 fruit crops, 15 spice crops, 5 plantation crops, 10 flowering ornamentals, 4 foliage ornamentals, 6 seasonal vegetables, 6 perennial vegetables and 5 other tree species. Dwarf areca palms were introduced to demonstrate mutant arecanut palms (*Areca catechu* L.). Clove (Lavang) (*Syzygium aromaticum*), the dwarf genotype of fishtail palm (*Caryota mitis*) (IC 553772) obtained from NBPGR RC Thrissur and hill neem (*Melia dubea*) were also introduced this year.

Demonstration of *Jeevamrut* preparation

A method of preparing *Jeevamrut* by mixing 2 kg each of cattle dung, jaggery, gram flour, 2 litres of cow urine, and 2 kg of fertile and biologically active soils with seven days incubation of application was demonstrated in the agro eco-tourism unit.

Steps in preparation of *jeevamrut*

Demonstration of Azolla cultivation

Azolla production unit (2.25 × 1.5 × 0.3 m) was constructed with 150 GSM silpaulin sheets in the AET unit for demonstration. Azolla produced in the unit was used as a feed for the ornamental poultry birds.

Azolla demonstration unit

Income generation from vermicompost unit of AET

Six tonnes of biodegradable waste was converted to 4 tonnes of vermicompost in two cycles (232 days) in the year 2020, with a conversion ratio of 0.67. The gross and net incomes were Rs. 88,000 and Rs. 56,000, respectively, with a benefit-cost ratio of 1.76.

Vermicompost unit

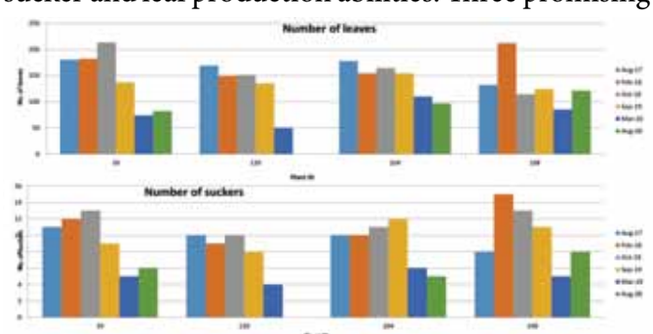
Project: Enhancing the utilization of pseudostem and leaves of banana

V Arunachalam, AR Desai, MJ Gupta

Amti (AAB) cultivar (syn. Mysore of Poovan group) was suitable in the areca garden as intercrop among the five banana cultivars screened *viz.*, Velchi, Amti, Raspali, Grand Naine and Robusta for the yield of fruits and leaves. Characterisation using the musalogue traits was completed in seedling progenies of *balbisiana* banana and five cultivated banana varieties. Five putative Velchi- Colchiploids plants have flowered and were characterized.

Open-pollinated Sugandhi seedlings

Diploid *M. balbisiana* (BB) seeded banana plants are good sources of leaves. Open-pollinated seedling progenies of Sugandhi (ABB) and Pisang Awak type bananas were evaluated along with suckers. About 137 sexual seedlings of cultivar Rupa with BB genome were raised and transplanted after six months in nursery bags. Seedlings varied in their sucker and leaf production abilities. Three promising plants (Plant ID: 39, 204, and 198) with the ability to produce a large number of suckers and leaves were identified as suitable for the leaf industry.



Number of leaves and number of suckers of promising progenies at six months interval

Biodegradable cups from banana pseudostem

The present study evaluated the physical, mechanical and biochemical properties of pseudostem of 4 banana varieties *viz.,* Amti, Red Banana, Raspali and Velchi and tested their suitability for making cups. The result showed that moisture content varied from 73.86 ± 14.12 % to 93.67 ± 4,87 (WB). The inorganics and ash content (81.09 ± 0.37 % to 90.14±0.27% of the dry sample), crude fat/ether extractives (0.622±0.9% to 1.90±0.3% of the dry sample), crude fibre (28.34±1.33% to 37.58±8.6% of the dry piece of the dry sample), puncture strength (fresh pseudostem (2.21±‘,61×10^4 to 2.5610^4×0.63±kgf/m^2 dried pseudostem (3.370.8610^4± to3.640.84±kgf/m^2). Single-factor ANOVA showed insignificant inter varietal variation of the properties studied but a significant increase in puncture strength with drying irrespective of the variety. The cobb value of the cups formed with the pseudostem was found hydrophilic with cobb values 130.0343.70±g/m^2 (Raspali variety) to 551.32222.37±g/m^2 (Red banana variety) as compared to 85.1543.70±g/m^2 (for cups made of arecanut leaf sheath). Thus the cups made of banana pseudostem could be used only for dry food. Further studies are in progress to make them suitable for wet food materials.

Preparation of biodegradable cups from banana pseudostem

Project: Harnessing palms for sustainable livelihoods of coastal India

V Arunachalam, SK Singh, V Paramesha

Palms are the major livelihood option in the coastal farming communities of India. Coconut, arecanut and oil palm are suitable in humid agro-climatic regions. Date palm and palmyra in the dry areas; Nypa and *Phoenix padulosa* palms in submerged /mangrove ecosystems. This new project aims to map the suitability of palms for biofuel, fruit, and other uses and tap the possibility of acting as a new source of income and livelihood, especially in marshy, swamp and mangrove locations of coastal India. The project also aims to understand the region-specific constraints and knowledge and resource gaps to formulate the research strategies for enhancing productivity, value addition, and utilization. The proposal explores the area, production, productivity, economic dependence, utilization activities, employment generation and livelihood security of people depending on cultivation/ utilization of select palms in each of the 75 coastal districts.

Geospatial data of soil survey maps of the coastal states were obtained. The census data of the human population in each district is compiled to understand the per capita requirements and availability of palm-based products. Preliminary investigations in the study reveal that coconut in the coastal districts of Kerala contributes to 1 % of the state GDP of Kerala. The area under coconut cultivation isabout 14 % ofthe total geographical area of the Kanyakumari district of Tamil Nadu and 52 % of the total geographical area of Mahe District of Puducherry Union Territory. The annual growth rate of the area under each palm is also worked out. Gujarat state has shown an increasing trend in the area under coconut and date palm.

Coconut varieties/hybrids grown in coastal India, namely, Malayan Yellow Dwarf (MYD), Chowghat Orange Dwarf (COD), Goan tall varieties; Calangute, Rivona and Benaulim, were characterised for the seedling traits. Seedlings raised from the selected plants of MYD varying for fruit shape (MYD23, MYD42, C13 C14), Gangabondom Green Dwarf (D5, D6) and Benaulim (C55), Goa Benaulim Pani (C10), D x T hybrid (from Sharvaraj Ecofarm, Sankhli), MYD, COD (Chowghat Orange Dwarf), and GBGD Gangabondom Green Dwarf (from ICAR-CPCRI, RC, Kidu), Rivona Long and Rivona Round (from Rivona village, Goa), along with a check of bulk fruits from wholesale coconut market at SavoiVerem Goa were evaluated.

Dwarf arecanut palms under evaluation

Project: Development of production technologies for successful management and semi-automation under suitable protected cultivation structures designed or adopted for West coast of India

MJ Gupta, AR Desai, M Thangam, R Ramesh, S Priyadevi, Maruthadurai R, Maneesha SR, Sujeet Desai

Production technology of tomato under double-span polyhouse

The production technology for tomato was developed; varieties studied were GS 600, Abhirang, Grafted tomato seedlings of Ghetto Farmers, Gujarat (Scion- Anshal and Rootstock –Solme. The performance of tomato seedlings was severely affected by nematodes and bacterial wilt (60-97% mortality), while grafts on soil performed better (20-40% mortality) and grafted seedlings in grow bags performed the best (0% mortality). The overall performance in grow bags were better than grow beds. Fertigation with N: P: K -106:171:266.7, Ca- 51.3, Mg- 22, S-28, B-3.1 had the highest average production (585.83±288.9 g/plant). The main pests faced in the modified DSGH were mealybugs (which could be easily managed without

any sprays, but towards the end of March, when the daytime temperatures started to increase, there was an infestation of whiteflies, and lesser flowering observed.

Standardization of production technology of cucumber under polyhouse conditions

Six F1 hybrids of cucumber *viz.*, Kian, Fadia, Terminator, Gurka (52-32), Beyaz, Y-225 were grown inside the polyhouse in different growing systems and fertigation treatments. The growth was inhibited by leaf spot disease infestation after the third month due to high night humidity and secondary infestation of mites and caterpillar *Diphania indica*. The yield was higher in mulched soil beds (1.20±0.10 kg/

Three years monthly average of environmental parameters in modified double-span and modified single-span polyhouses

Parameters	Modified double-span greenhouse	Modified single-span greenhouse
Crop	Tomato	Cucumber
Day time temperature		
Inside polyhouse	38.1±3.3°C (May) – Max., 31.4±2.61°C (August) - Min.	37.83±4.24°C (May) – Max., 30.96±2.79°C (July) – Min.
Ambient condition	37.5±3.1°C (May) – Max., 29.4±1.9°C (August)-Min.	37.45±3.13°C (May) – Max., 29.75±1.95°C (July) – Min.
Daytime relative humidity		
Inside polyhouse	78.9±6.5% (July) – Max., 54.4±10.6% (December)-Min.	80.90±7.09% (July) – Max., 48.89±15.10% (January) – Min.
Ambient condition	85.9±4.8 % (July) – Max. 68.9±11.1 % (December)-Min.	85.9±4.8 %(July) – Max., 57.98±13.93% (January) – Min.
Nighttime temperature		
Inside polyhouse	28.23±1.76°C (May) – Max., 21.35±2.61°C (January)- Min.	28.81±2.73°C (May) – Max., 21.26±2.68°C (January) – Min.
Ambient condition	8.19±1.83°C (May) – Max., 21.34±2.79°C (January)-Min.	28.19±1.83°C (May) – Max., 21.34±2.79°C (January) – Min.
Nighttime humidity		
Inside polyhouse	90.86±2.54 %(August) – Max., 81.52±1.7 % (May)-Min.	91.81± 3.85 % (August) – Max., 81.36±10.75 % (March) – Min.
Ambient condition	91.68±4.60 (August) – Max., 74.36±1.80% (May)- Min.	91.68±4.60 (August) – Max., 74.36±1.80% (May) – Min.
PAR		
Inside polyhouse	299.28 µMol/m^2/s^1 (November - forenoon) – Max. 141.90 µMol/m^2/s^1 (September – afternoon) – Min.	332.81 µMol/m^2/s^1 (November – forenoon) – Max. 179.49µMol/m^2/s^1 (August – forenoon) – Min.
Ambient condition	1458.14 µMol/m^2/s^1 (November-forenoon) – Max. 450.69µMol/m^2/s^1 (August-afternoon) – Min.	1458.14 µMol/m^2/s^1 (November – forenoon) – Max. 450.69µMol/m^2/s^1 (August – afternoon) – Min.
Transmissivity to PAR	53.26 (June-afternoon) – Max. 19.35(December - morning) – Min.	43.71 (August-afternoon) – Max. 19.67 (May-morning) – Min.
Light intensity	15.78 klux (March – forenoon) – Max. 4.42 klux (August – afternoon) – Min.	18.04 klux (March- forenoon) – Max. 4.30 klux (August-afternoon) – Min.
Transmissivity to solar radiation	20.8-40.5%	19.88-41.18%
Crop water requirement (October sown crop)	0.55 lit/day/plant (January – Mid season) 0.045 lit/day/plant (March – late season)	0.59 lit/day/ plant (December – Mid season) – Max. (0.21 lit/day/ plant (January – Late season) – Min.
April sown crop	-	0.65 lit/day/ plant (June – Mid season) – Max. 0.18 lit/ day/ plant (July – Late season) – Min.

plant) and grows bags (1.25±1.89 kg/plant), and the average yield was the highest in fertigation with N: P: K -67.9:122:173, Ca-27.6, Mg-14.1, S-17.6 B -2.1 kg/ha).

Performance of papaya, pineapple, medicinal and aromatic plants under polyhouse conditions

Papaya and pineapple crops were introduced to enhance ventilation and air movement inside the polyhouses cultivated with tomato. Dwarf papaya variety Pusa Nanha was suitable for cultivation inside polyhouse. Disease incidence and mortality percentage were lower than the open field raised crop. Pineapple was planted in the unused areas of a modified DSGH. Application of ethephon 25 ppm+ urea (2 %) + sodium carbonate (0.04%) can induce early flowering in pineapple inside polyhouse similar to outside conditions. Medicinal plants such as Aloe vera, Aswagandha, Centella and Brahmi can be successfully cultivated under polyhouse conditions. Seed germination of lemongrass (*Cymbopogon citratus*) variety 'Sugandhi'(OPD-19) was tested in different growing media in a vertical nursery structure (2 × 0.6 × 2.25 m) inside a double span polyhouse during the rainy season.

Cucumber crop in single span green house

Tomato crop in double span green house

Project: Assessment and development of cropping systems-based harvest and post-harvest management technologies for coastal India

MJ Gupta, AR Desai, R Ramesh, S Priya Devi, Maneesha SR

A project was proposed in 2020 to assess the processing needs of coastal districts and to develop new technology or introduce existing technologies from other places to improve secondary agriculture in coastal districts. The main objectives of the project are,

(i) To Survey the East and West Coast to assess existing cropping systems, their harvest and post-harvest management status

(ii) To analyze and propose suitable harvest and post-harvest technologies for the various cropping systems of coastal India.

(iii) To adopt or develop process machinery for the gaps identified.

(iv) To test, evaluate and standardize the proposed farming systems based on harvest and post-harvest management technologies for the Indian coastal ecosystem

Data on crops cultivated, area and production have been collected from various sources. Based on the area strength of the crops, primary crops and prevalent cropping systems have been decided. The relative yield index of these crops has been estimated to analyse the suitability for processing interventions. Stake holders' data collection, ground truth verification and development of unit operations for these crops and assessing their processing needs will be done in the subsequent years.

RESEARCH ACHIEVEMENTS

- All India Co-ordinated Research Projects (AICRP)
- Externally Funded Projects

Water harvesting pond at Bhupar, Canacona

All India Co-ordinated Research Projects (AICRP)

Project: All India Co-ordinated Research Project on Integrated Farming Systems

Paramesha V, EB Chakurkar, AR Desai, GR Mahajan, Sreekanth GB, HB Chethan Kumar, Gokuldas PP, Manohara KK

Development of rice-based lowland integrated farming system

Studies were continued on the rice-based farming system model (crops-dairy-fishery), standardized on a 0.5 ha area for typical lowland situations of Goa with components like crops vegetables, dairy, rice followed by cowpea/moong/vegetables like bhendi, chilli, leafy vegetables, forage, dairy, FYM unit, kitchen garden, fishpond and duckery. Production of 18.2 q of rice, 316 kg of baby corn, 184 kg of sweet corn, 132 kg of moong (2 crops), 73 kg of cowpea, and 2.9 tons of fodder maize with 1060 litre of milk was realized with a gross return of Rs. 2.71 Lakh. The highest percentage contribution was from crops (61%), followed by dairy (22%). The total quantity of crops straw/stover, green fodder, and crop residue produced from the cropping system was 7528, 4255, and 422 kg, respectively, which was recycled in the form of compost. Likewise, 5400 kg of cow dung was used within the farm. Employment of nearly 352 person-days worth Rs 52500 has been generated from this IFS model.

Development of plantation crop-based upland integrated farming system

Experiments in the IFS model for upland situations of Goa was established in the institute (0.8 ha) with enterprises such as plantation crops like cashew, coconut, noni, areca nut with intercropping of pineapple, tapioca and banana along with piggery, poultry, vermicompost and compost units and water harvesting ponds. The gross return of the system was around Rs. 1,92,700 and the net profit was Rs. 1,30,250. The highest contribution to net profit was from the piggery unit (37%), followed by the cashew-pineapple system (33%). About 1000 areca nut seedlings were produced and distributed to IFS farmers. The waste products in the form of crop residue and pig manure were recycled within the IFS unit. Employment of nearly 212 person-days worth Rs 37800 was generated from the IFS model.

Rice+fish IFS model

Plantation crop based IFS model

Project: All India Co-ordinated Research Project on Palms

V Arunachalam

Evaluation of coconut-based cropping system models

The pre-experimental coconut yield in the experimental plot was 47 nuts/year/ palm during July 2014-Jun 2015. The coconut yield after intercropping was observed to be 69 nuts/ palm/ year.

Mother blocks and production of quality planting material in areca nut

A nucleus seed garden of Hirehalli Dwarf, established phase-wise since 2010, is maintained (284 palms with 82 at the reproductive stage) at ICAR-CCARI. The vegetative characters recorded on 113 plants showed that the mean height of the plant from plant base to the base of the crown was 1.19±0.07 m in the 9th year of planting. Mean spadix length and breadth in 133 inflorescences of the study were 32.38±1.03 cm, 13.68±0.29 cm, respectively. The mean number of female flowers per inflorescence in the experiment was 120.07±0.22. Foliar glucose content in the leaf sap extract was measured, which significantly differed between Mangala tall (564.43±79.04 microgram/ml) and Hirehalli dwarf (855.26±67.40 microgram/ml) plants. The results of the past two years confirm the hypothesis of an association of the dwarf plant habit with high foliar glucose content and suggest its use as a diagnostic biochemical assay.

Yields and economic returns of intercrop treatments in coconut field

Treatments	Productivity of intercrop (kg/ha)	Gross return (Rs./ha)	Net return (Rs./ha)
Papaya	1040	152896.00	87296.00
Heliconia	14080 stems/ha	145460.00	79860.00
Banana-Lemon	-	117300.00	51700.00
Pineapple	1092	150071.00	84471.00
Annona (Soursop)	141	159492.00	93892.00
Crossandra	13	122652.00	57052.00
Monocrop coconut	-	117300.00	67700.00

Soil nutrient status in the different intercrop treatments in coconut field

Treatments	pH	OC (%)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)
Papaya Drumstick	6.15	0.80	149.48	13.28	224.00
Helconia	6.43	0.76	131.87	13.37	182.93
Banana-Lemon	6.14	0.84	125.48	11.97	186.80
Passion fruit-Pine apple	6.19	0.69	131.98	13.95	265.00
Annona	6.19	0.83	132.33	11.17	201.60
Crossandra	6.21	0.69	178.46	10.45	190.33
Monocrop coconut	6.41	0.87	127.73	16.15	207.73

Project: All India Co-ordinated Research Project on Vegetable Crops

M Thangam, R Ramesh

Under this national multi-location trials programme, trials on brinjal (varietal and hybrid practices), chilli (varietal and mixed trial), tomato (hybrid and resistant trials) and okra (resistant trial) were conducted at the institute.

Brinjal (Long) AVT- I

Two entries and two local checks were evaluated under the brinjal (long) AVT-I trial for yield and yield contributing traits during 2019-20. The highest fruit yield of 243.79 q/ha was recorded in Local Check-I, followed by 229.98 q/ha in the entry 2018/ BRLVAR-8.

Brinjal (Long) AVT - II

Nine entries, including check/s, were evaluated along with one local check under the brinjal (long) AVT-II trial for yield and yield contributing traits during 2019-20. The highest fruit yield, 275.55 q/ha, was recorded in the local check, followed by 240.48 q/ha in 2017/ BRLVAR-2.

Brinjal (Round) AVT - II

Eight entries, including check/s, were evaluated and one local check under Brinjal (Round) AVT–II trial for yield and yield component traits under Goa condition. The highest fruit yield of 264.85 q/ha was recorded in the Local check, which was statistically at par with 2017/BRRVAR-12 (261.04 q/ha). The lowest fruit yield of 200.47 q/ha was recorded in 2017/BRRVAR-10.

Brinjal Hybrid (Long) AVT - I

Seven entries, including check/s, were evaluated under the brinjal Hybrid (long) AVT-I trial for yield and yield contributing traits during the year 2019-20. The highest fruit yield of 315.35 q/ha was recorded in 2018/BRLHYB-4, statistically-at-par with 2018/ BRLHYB-2 (314.12 q/ha). The lowest fruit yield of 212.13 q/ha was recorded in 2018/ BRLHYB-6.

Brinjal Hybrid (Round) AVT - I

Eight entries, including check/s, were evaluated under the brinjal Hybrid (Round) AVT-I trial for yield and yield contributing traits during the year 2019-20. The highest fruit yield of 326.72 q/ha was recorded in 2018/BRRHYB-3, statistically-at-par with 2018/BRRHYB-1 (320.05 q/ha). The lowest fruit yield of 262.05 q/ha was recorded in 2018/ BRRHYB-5.

Chilli/Hot Pepper AVT- I

Two entries and two local checks were evaluated under Chilli/ hot pepper AVT-I trial for yield and yield contributing traits during 2019-20. The highest fruit yield of 69.21 q/ha was recorded in 2018/ CHIVAR-7, followed by 55.41 q/ha in the entry CHIVAR-1.

Chilli / Hot Pepper Hybrid AVT- I

Nine entries, including check/s, were evaluated under Chilli/ hot pepper hybrid AVT-I trial for yield and yield contributing traits during the year 2019-20. The highest fruit yield of 90.65 q/ha was recorded in 2018/CHIHYB-9, which was statistically at par with 2018/CHIHYB-12 (85.55 q/ha), followed by 2018/CHIHYB-3 (84.42 q/ha).

Tomato Hybrid Det. IET

Eight entries, including check/s, were evaluated under Tomato Hybrid Det. IET trial for yield and yield component traits. The highest fruit yield of 254.49 q/ha was recorded in 2019/ToDHYB-7, which was statistically at par with 2019/ToDHYB-1 (245.55 q/ha), followed by 2019/ToDHYB-6 (245.49 q/ha). The lowest fruit yield of 172.08 q/ha was recorded in 2019/ ToDHYB-5.

Tomato Hybrid Det. AVT- II

Four entries, including check/s, were evaluated under Tomato Hybrid Det. AVT-II trial for yield and yield component traits. The highest fruit yield of 327.37 q/ha was recorded in 2017/ToDHYB-6, which was statistically at par with 2017/ToDHYB-5 (314.85 q/ha), followed by 2017/ToDHYB-7 (292.65 q/ha).

Tomato (ToLCV) varietal IET

Eight entries were evaluated under the Tomato leaf curl virus (ToLCV) varietal IET trial. There was an incidence of ToLCV ranged from 21.55 to 35.43 PDI on entries evaluated. The lower values of ToLCV incidence 21.55 PDI, 21.88 PDI and 22.21 PDI were recorded in 2019/ToLCVRES-8, 2019/ToLCVRES-6 and 2019/ToLCVRES-4, respectively. The highest fruit yield of 229.40 q/ha was recorded in 2019/ ToLCVRES-6, which was statistically at par with 2019/ToLCVRES-8 (218.38 q/ha).

Tomato (ToLCV) Hybrid IET

Seven entries were evaluated under the Tomato leaf curl virus (ToLCV) Hybrid IET trial. There was an incidence of ToLCV ranged from 21.12 to 32.44 PDI on entries evaluated. The lower values of ToLCV incidence 21.12 PDI, 23.45 PDI and 24.07 PDI were recorded in 2019/ToLCVRES-1, 2019/ToLCVRES-5 and 2019/ToLCVRES-7, respectively. The highest fruit yield of 258.74 q/ha was recorded in 2019/ ToLCVRES-5, which was statistically at par with 2019/ToLCVRES-1 (239.12 q/ha).

Okra (YVMV) varietal IET

Thirteen entries were evaluated under Okra (YVMV) Varietal IET trial. There was an incidence of YVMV ranged from 0.00 to 9.61 PDI on entries under evaluation. The 0.00 PDI of YVMV incidences recorded in 2019/OKYVRES-1, 2019/OKYVRES-2, 2019/OKYVRES-5, 2019/OKYVRES-8, 2019/ OKYVRES-9. The highest fruit yield of 125.84 q/ ha was recorded in 2019/OKYVRES-5, which was statistically at par with 2019/OKYVRES-8 (123.95 q/ha), followed by 2019/OKYVRES-7 (116.40 q/ha).

Project: All India Co-ordinated Research Project on Pigs

EB Chakurkar

All India Coordinated Research Project (AICRP) on Pigs has been continuously carried out at the Institute since the year 2000. As per the mandate laid out to Goa Centre, it is required to produce, maintain and study the performance of crossbred pigs (exotic breed and local breed). Accordingly, crossbred pigs with 75% of exotic Large White Yorkshire (LWY) and 25% of local Agonda Goan inheritance were produced and studied for their performance. In the pig unit, 45 breeding sows and 17 breeding boars of 75% crossed lineage were maintained. The selection criterion and the breeding policy were followed as per the approved guidelines of AICRP on Pigs. Generation-wise growth data of four generations were recorded, and accordingly, the genetic gain was calculated. Also, the litter performance parameters of crossbred pigs were recorded. The performance of crossbred pigs improved over the generation and the fourth generation achieved the highest birth weight (1.06±0.04 kg), weaning weight 8.04±0.27 kg), and weight at marketing (75.48±1.40kg) compared to the previous generations. Artificial Insemination (AI) technology was implemented in the studied herd as a breeding method. Also, AI technology was disseminated in the farmers' field to utilize good quality boar semen in a better way and prevent inbreeding in farmers' herds. Along with 75% Crossbreed pigs (LWY x AG), pure breeds of Agonda Goan and Large White Yorkshire pigs are maintained in the Institute Pig Unit. The average total herd strength was 185 pigs during this reported year, and 328 piglets were born. The piglets were selected and grown in batches. The birth weight, weaning weight, and fortnightly weights till 12 months of age were recorded. High pedigree piglets and adult pigs of different genetic lineage were supplied to pig producers for the backyard and commercial farming across the state and neighbouring states of Goa. A total of 285 pigs were sold, generating revenue of Rs. 13.34 lakhs.

SCSP and STC distribution under AICRP on pigs

The crossbred piglets developed under AICRP on pigs were distributed to the farmers belonging to the SC and ST community from Sullia Taluk of

Dakshina Kannada district, Karnataka. Total four SC and two ST farmers were provided with three females and one male piglet each (total 24 piglets) for breeding purposes. The pig farming activity has improved farmers' economic status and livelihood by rearing fattening pigs for meat purposes.

Mean body weight of crossbred pigs (kg)

Fixed effects (Factors)	Birth weight (1090)	Weaning weight (862)	Two months weight (568)	Three months weight (224)	Four months weight (157)	Five months weight (141)	Six months weight (138)	Seven months weight (137)	Eight months weight (135)	Nine months weight (108)	Ten months weight (106)
Overall	1.00±0.01	7.57±0.07	10.55±0.13	17.90±0.57	23.38±0.67	31.84±0.93	41.50±1.11	51.53±1.30	61.57±1.52	70.16±1.83	81.58±1.96
Generation - wise	*	**	**	*	*	*	*	**	*	*	**
First	1.01ab±0.03 (210)	7.60ab±0.24 (159)	9.77b±0.40 (120)	17.72b±4.51 (75)	20.47^{c}±1.21 (56)	26.32c±1.81 (40)	35.20c±2.09 (39)	43.46c±2.23 (39)	49.79^{c}±2.59 (39)	57.32^{c}±2.56 (31)	66.85^{c}±3.06 (29)
Second	0.97b±0.02 (452)	6.91^{c}±0.16 (347)	10.05b±0.27 (175)	14.16b±4.47 (60)	17.13^{c}±1.25 (24)	22.36c±1.42 (24)	29.13d±1.67 (24)	35.50d±2.43 (24)	44.88^{c}±2.27 (23)	55.08^{c}±2.99 (23)	68.44^{c}±2.99 (23)
Third	0.99ab±0.03 (273)	6.94^{bc}±0.21 (215)	10.32b±0.34 (153)	16.12b±6.14 (29)	24.53b±1.37 (18)	33.92b±1.59 (18)	44.54b±1.60 (18)	55.68b±1.43 (18)	65.90^{b}±1.40 (18)	75.95^{b}±1.60 (18)	86.58^{b}±2.46 (18)
Fourth	1.06^{a}±0.04 (155)	8.04^{a}±0.27 (141)	12.01^{a}±0.41 (120)	21.01^{a}±6.04 (60)	28.36^{a}±0.84 (59)	38.81^{a}±1.06 (59)	50.05^{a}±1.24 (57)	62.70^{a}±1.20 (56)	75.48^{a}±1.40 (55)	87.97^{a}±1.97 (36)	101.21^{a}±1.68 (36)

(Number of observations in parentheses)

Project: All India Co-ordinated Research Project on Animal Disease Monitoring And Surveillance (ADMAS)

Shivasharanappa N, Susitha Rajkumar

Livestock disease outbreak investigations and monthly outbreak reporting are the main objectives of this project. The principal livestock diseases reported were Lumpy skin disease (LSD) in dairy cattle during the period. In this study, skin nodular biopsy specimens, whole blood, and serum samples (n= 66) were collected from clinical LSD cases and processed for diagnosis of LSD by histopathological and molecular diagnosis by gel-based PCR and TaqMan™ probe Real-time PCR. PCR detection of LSDV was carried out by targeting envelope protein gene (P32), Fusion protein gene (F), and DNA-dependent RNA polymerase 30 kDa subunit (RPO30) gene. TaqMan™ probe Real-Time PCR was standardized targeting the EEV glycoprotein gene (LSDV126) for the rapid diagnosis of LSD from subclinical and clinical cases. Forty-six out of 66 clinical cases examined showed generalized skin nodules and papules of various sizes (0.5-6.5 cm) present all over the body particularly, the neck, face, nose, tail, perineum, and udder. Twenty cases showed few small patchy nodules at the neck, face, and lumbar region. Fever, drastic reduction in milk yield, lymph node enlargement, and oedema of lower limbs were consistent. In the Histopathological lesions, a diffuse granulomatous reaction in dermis and epidermis (39/66, 59%), vacuolar degeneration of epithelial cells (15/66, 22.7%), hyperkeratosis (46/66, 69.6%), spongiosis (34/66, 51.5%), acanthosis (12/66, 18.1%), the proliferation of keratinocytes, histiocytes and inflammatory cells in dermis and epidermis (46/66, 69.6%) existed. The most prominent finding was focal to diffuse vasculitis and lymphangitis (39/66, 59%). The eosinophilic intracytoplasmic viral inclusions in keratinocytes and epithelial cells were detected in 23/66 (34.8%) cases, pathognomonic features of LSDV. PCR assay targeting P32 gene detected LSD viral genome in 55 (83%), F gene in 48 (72%), and DNA dependent RNA polymerase (RPO30) gene in 51 skin biopsy samples (77%). In contrast, the TaqMan™ probe assay detected LSDV in 62 skin biopsy samples (94%), proving that this assay could be very sensitive and rapid in detecting LSDV from field outbreaks. Sequencing and phylogenetic analysis of the RPO30 gene revealed, isolates from this study were grouped in one cluster and closely related with those from China, Bangladesh, Kenya, and other Indian isolates from field outbreaks in Odisha and north Indian isolates, which were characterized during 2019-20.

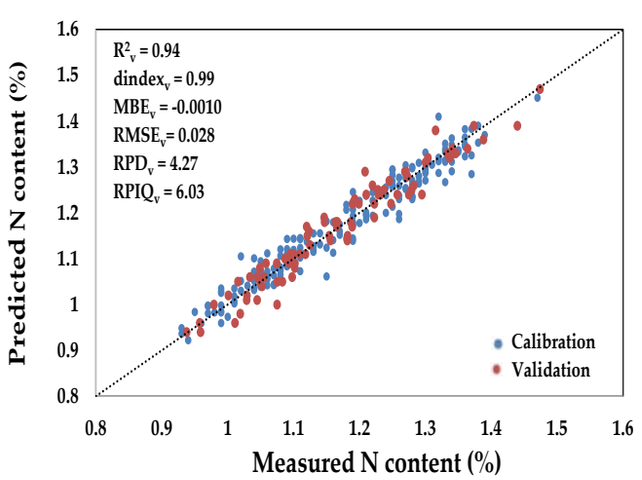
Skin nodules in LSD infected cattle. Diffuse skin nodules on face, eyes, near muzzle, neck and ears; Hyperkeratosis of the dermis and epidermal layer of skin in LSD infection

Project: Hyperspectral remote sensing of the foliar nutrients in crops (ECRA, SERB, DST)

GR Mahajan

Monitoring the foliar nutrients status of mango using spectroscopy-based spectral Indices and PLSR-combined machine learning models

Conventional methods of plant nutrient estimation for nutrient management need a considerable number of leaf or tissue samples and extensive chemical analysis, which is time-consuming and expensive. Remote sensing is a viable tool to estimate the plant's nutritional status to determine the appropriate amounts of fertilizer inputs. The study aimed to use remote sensing to characterize the foliar nutrient status of mango through the development of spectral indices, multivariate analysis, chemometrics, and machine learning modelling of spectral data. A spectral database within the 350–1050 nm wavelength range of the leaf samples and leaf nutrients was analyzed to develop spectral indices and multivariate model development. The normalized difference and spectral ratio indices and multivariate models partial least square regression (PLSR), principal component regression, and support vector regression (SVR) were ineffective in predicting any of the leaf nutrients. Combined machine learning models were found to be the best to expect most of the nutrients. Based on the independent validation performance and summed ranks, the best performing models were cubist ($R^2 \geq 0.91$, the ratio of performance to deviation (RPD) $\geq$ 3.3) and the ratio of performance to interquartile distance (RPIQ) $\geq$ 3.71) for nitrogen, phosphorus, potassium, and zinc, SVR (R2 $\geq$ 0.88, RPD $\geq$ 2.73, RPIQ $\geq$ 3.31) for calcium, iron, copper, boron, and elastic net (R2 $\geq$ 0.95, RPD $\geq$ 4.47, RPIQ $\geq$ 6.11) for magnesium and sulfur. The study results revealed the potential of using hyperspectral remote sensing data for the non-destructive estimation of mango leaf macro-and micro-nutrients. The developed approach is suggested to be employed within operational retrieval workflows for precision management of mango orchard nutrients.



Performance of the best performing partial least square regression combined Cubist model to predict the foliar nitrogen concentration in mango leaf

Predicting the cashew foliar nutrients status using spectroscopy-based spectral Indices and PLSR-combined machine learning models

The study aimed to use visible (350-1050 nm) remote sensing to predict the cashew leaf nutrient status through the development of spectral indices, multivariate analysis, chemometrics and machine learning modelling. The normalized difference and spectral ratio indices and multivariate models – partial least square regression (PLSR), principal component regression and support vector regression (SVR) were ineffective in predicting any of the leaf nutrients. Using PLSR-combined machine learning models was found to be the best to predict most of the nutrients. Based on the independent validation performance and summed ranks of PLSR-combined models, the best performing models were Cubist (R^2 = 0.46-0.72, RPD = 1.30-1.71, and RPIQ = 0.83-2.28) for nitrogen, phosphorus, zinc and copper, SVR (R^2 = 0.51-0.84, RPD = 1.42-2.45, RPIQ = 1.56-2.65) for calcium, magnesium and iron and Elastic net (R^2 = 0.48-0.80, RPD = 0.80-1.32, RPIQ = 0.68-1.71) for sulphur, manganese and boron. Among the three different approaches tested, an approach using PLSR-combined machine learning models was the best to predict most of the nutrients. The study results revealed the potential of using hyperspectral remote sensing data for the non-destructive estimation of cashew leaf macro and micro-nutrients. The spectral algorithms are suggested to be employed to retrieve cashew leaf nutritional status for precision management.

Project: Empowerment of farmers through the adoption of sustainable and eco-friendly integrated pest and disease management technologies in major vegetable crops in Goa (NABARD)

Maruthadurai R, R Ramesh

The project was to popularize and encourage Eco-friendly Integrated Pest and Disease Management (IPDM) technologies in major vegetable crops. Front line demonstration on chilli IPDM was undertaken at six places *viz*., Canacona, Sanguem, Quepeum, Tiswadi, Bicholim, and Mapusa. Plant protection inputs like Goa Bio 1, Goa Bio II, spinosad, chitosan, and sticky traps were distributed to 200 farmers. The hands-on training was provided to the farmers on nursery drenching of biocontrol agents, main field application, application of sticky traps and their preparation, and spraying of bio-pesticides. Demonstration plots were monitored from transplanting to till harvest. Observations on insect pest incidence and disease scoring were recorded after every spray. Relatively less incidences of whiteflies, aphids and diseases were recorded in IPDM demonstration plots compared to control. Higher chilli yield was recorded in plots that received IPDM technologies. Wilt resistant Goa Brinjal-1, 2, 3 and 4 were distributed to the farmers under this project.

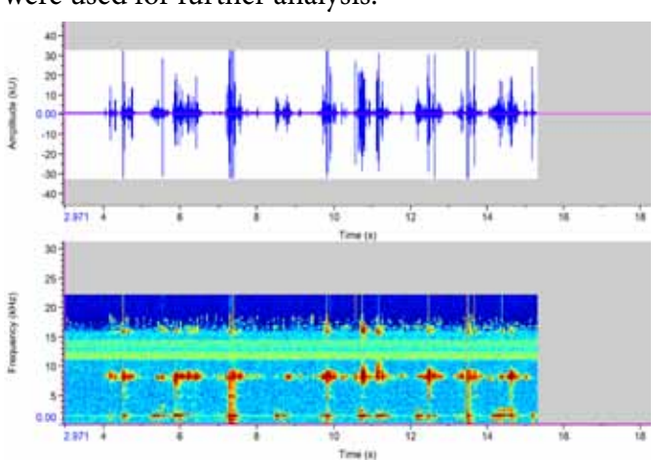
Chilli integrated pest and disease management demonstration plots

Project: Design and development of acoustic methods for early detection of stem and root borer *Plocaederus* spp. infestation in cashew (DST-SERB)

Maruthadurai R, T Veerakumar

The project's main objective was to investigate the acoustic behaviour of stem and root borers in cashew and standardize the methodology for early detection of cashew stem and root borer infestation. Grubs of stem and root borer were reared on fresh cashew bark under laboratory conditions. Different larval instars viz., first, second, third, fourth and fifth instars were selected for the experiment. New cashew logs measuring 1m in length was chosen for the introduction of grubs. A pre-drilled hole/ gallery was made on cashew logs (same size of stem borer grubs), and the grubs were introduced, and the gallery was sealed. The waveguide is a stainless steel bar and acts as a sound coupler. It was installed on a cashew log above the placement of grub. The waveguide was attached to an accelerometer sensor. Grub feeding sound inside the cashew log was recorded. Feeding sounds or grub movement can be heard through the headphone. Feeding sound, vibrations, or movement of different larval instars inside the cashew log was recorded and stored as audio files. The audio files of different larval instars were used for further analysis.

Recording of feeding sounds of CSRB grub through the acoustic device



Recording of CSRB grub vibrations and spectrogram of the recording

Project: Popularizing good post-harvest management practices for Field Crops of Goa through research, training, and demonstrations (NABARD)

Mathala Juliet Gupta, Maruthadurai R

The project's main objective was to sensitize the Goan farmers about the post-harvest losses occurring during various unit operations in field crops of Goa and train them on the use of good post-harvest management practices to overcome the same. In the project, four sensitization training on post-harvest losses and their management for North and South Goa farmers, 8 trainings on the use of mini parboiling units, 14 trainings on good harvest, drying and storage practices covering a total of 437 farmers across the state were conducted. Under the project, two modified Pusa bins for high rainfall conditions were constructed in Khandola, Marcel, North Goa and Cotigaon, Canancona, South Goa. The project was concluded on May 31, 2020.

Gilmpses of various programmes on Pusa Bin in benefeciary farmer's fields

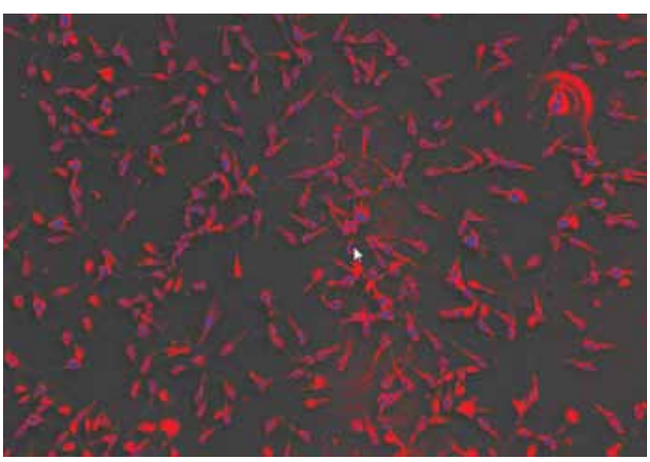
Project: Augmenting rural goat farming in Goa for sustainable income through advanced technological interventions in reproductive, nutrition, and health management (DBT)

Shivasharanappa N, EB Chakurkar, Susitha Rajkumar

CASA analysis and preservation of Konkan kanyal goat semen

In the coastal region, particularly Goa state, only natural breeding is practiced in goats for genetic up-gradation, which takes longer to obtain the results. Facilities for AI and semen analysis by utilizing existing infrastructure like CASA were developed in Goa. Under this project, semen collection and preservation protocols in the liquid state were standardized in the Konkan Kanyal breed. A detailed study of semen was made, including all macroscopic and microscopic characteristics like quantity, colour, density, total sperm count, mass motility, activity, live and dead sperms, and abnormal sperm count. Sperm cell concentration of semen ejaculates was estimated using Accucell Photometer (IMV, France). Semen samples were extended using different semen extenders such as Egg yolk citrate buffer (EYCB) and Natural Boar Semen Extender (NBSE). Neat semen samples with more than 70% forward motility and

sperm cell concentration of more than 100 million/ml were selected for preservation using Egg Yolk citrate Buffer and OviXcell buffer (IMV, France). OviXcell extender (IMV Ltd) was used to preserve liquid goat semen, which was developed to improve goat semen preservation at four °C for ٢٤ hours. The extended semen samples were stored at five °C in a BOD incubator. They were evaluated for sperm cell motility every 24 hours during storing until the motility was reduced to below 30%. From this semen, AI was carried out at the institute farm and in farmer's goat farms. From diluted liquid semen with a concentration of 400x106/ml, 480 semen doses were prepared and used for AI.



Distinguishing sperm head and tail in CASA analysis

Staining of goat spermatozoa under Eosine-Nigrosine stain for dead and live sperms

Artificial Insemination in Farmers field

Trial 1: Farmer field at Ponda Taluk, Keri village: Seven primiparous goats were selected for the study. Oestrus synchronization using PGF2α analogue (Dinoprost @ 5mg/ml) and AI was carried out with diluted semen in egg yolk citrate extender, and pregnancy results were negative.

Trial 2: Karmali, Old Goa: a total of 10 goats were synchronized with PGF2α analogue (Dinoprost @ 5mg/ml), and AI was carried out using diluted semen, and two goats were found positive for pregnancy with a conception rate of 20% (2/10) and single kids were born.

Trial 3: Mapusa, Alteno, North Goa: A total of 22 goats of the one-year age group were given PGF2α analogue (Dinoprost @ 5mg/ml) @ 2ml/animal intramuscular route and observed for oestrus signs on the 5th day. AI was carried out using diluted semen in NBSE (Natural boar semen extender) developed by ICAR-CCARI, Old Goa. Out of 22 goats inseminated, five were found pregnant with a conception rate of 22.72%.

Trial 4: Nileli, Sawantwadi, Konkan kanyal breeding farm: A total goats 180 goats, among which 40 goats were selected of 13-14 month age group. Oestrus synchronization was carried out in 40 goats using PGF2α analogue (Dinoprost @ 5mg/ml) @ 2ml/animal intramuscular route and observed oestrus signs till 5th day. On the 11th day, the second dose of PGF2alfa was given. However, animals did not exhibit any oestrus signs.

Goat kids born through AI in Konkan kanyal goat unit

Twins born by AI using liquid semen from Konkan kanyal goat

Twins in farmers field by artificial insemination using Konkan kanyal goat semen

Project: ICAR Network Project on Functional Genomics and Genetic Modification (NPFGGM) in crops

Manohara KK

Screening of rice germplasm collections for salt stress at seedling stage

The experiment was carried out during *kharif* season 2020 in an augmented design accommodating 160 genotypes in four tanks with each tank having 40 genotypes. Three check varieties, *viz*., FL478 & Pokkali (tolerant checks) and IR29 (sensitive check), were used in the experiment and repeated in all four tanks. A single row was maintained for each genotype with 16 seedlings per row spacing 15 cm between the rows and 10 cm between the hills. Germinated seeds were sown directly in the micro plots of size 8 m length, 1.8 m width, and 1.2 m depth. After the emergence of the second leaf, saltwater was introduced in the tank, and the electrical conductivity (EC) of the irrigation water was raised slowly till it attained the final EC of 12 dS/M on the 14th day. Later salinity level was maintained at EC~12 dS/M till the sensitive check variety (IR29) showed a highly sensitive (HS) reaction (SES score 9). Scoring was done as per the IRRI standard evaluation scoring method. Among the genotypes screened, eight genotypes showed tolerant (T) reaction to salt stress, 20 genotypes were moderately tolerant (MT), and the remaining 132 genotypes showed sensitive (S) to a highly sensitive (HS) reaction.

Tolerant genotypes from the study are *Goa Dhan 2, Goa Dhan 4, CST 7 1, Korgut, Kaveri Gidda, GWR 016, Dodgi,* and *KS 04*. The observations were recorded for seedling vigour, shoot length, root length, fresh shoot and root weight, and dry root and shoot weight. From this study, we identified eight genotypes showing tolerance reaction to salt stress at the seedling stage. These genotypes can be utilized as donors alternate to frequently used FL478 and Pokkali to develop new high-yielding salinity tolerant varieties.

Tolerant genotype Goa Dhan 2

Tolerant genotype WR 019

Tolerant genotypes under induced salt stress (EC~12 dS/m) along with tolerant check FL478 and sensitive check IR29

Project: Production and formulation technology refinement of bacterial bio-agents for soil-borne plant disease management under coastal ecosystems (ICAR)

R Ramesh

Evaluation of alginate formulations of *B. methylotrophicus* (RCh6-2b and STC-4)

Sodium alginate formulation of RCh6-2b was prepared according to the standardized method. Sago was added @ 1:5 (Imported alginate: sago) and 2:4 (Himedia alginate: sago). The bacterial population in the formulation was 9.0-10.0 Log CFU g^{-1} till 24 months. In STC-4 (Himedia alginate alone), the population was 8.0 Log CFU g^{-1} till 24 months. It indicates that low-cost materials like sago can be used along with sodium alginate to prepare granular formulation without compromising the quality.

Shelf-life evaluation of different formulations of *B. methylotrophicus*

Value-added formulations of B. *methylotrophicus* (RCh6-2b & STC-4) were prepared as per the standardized method with the addition of amendments like agro by-products (AP1) and other nutrient supplements (NS1, 2, 3, 4, C). The bacterial population in various value-added formulations of RCh6-2b and STC-4 was above 9.0 Log CFU g^{-1} till 26 months. Results indicate that agro by-products could be added up to 10% (w/w) to the formulation, and the other nutrient supplements could add value to the formulation without any adverse effects. In liquid formulations, results indicated that the population of RCh6-2b and STC-4 was above 8 Log CFU mL^{-1} till 21 months, and the population in the synthetic medium formulation was also the same. Hence, the value-added liquid formulation can be prepared without compromising the shelf life and the population. It would be an added advantage to the formulation to improve plant growth by providing additional nutrients.

Evaluation of novel formulations of bacterial bio-agents

Capsule and tablet formulations of bacterial bio-agents were standardized and evaluated for shelf life and release into the soil. The bacterial population in the capsule formulation was above 8 Log CFU g^{-1} (RCh6-2b & STC-4) till 24 months. In tablet formulation, the population was above 9 Log CFU g^{-1} till 24 months. Evaluation of capsule formulation of RCh6-2b on brinjal and tomato indicated that % increase of growth parameters viz. shoot length, root length, shoot weight, root weight was higher when the dilutions were sprayed at 10 and 20 days after planting. Capsule formulations are being evaluated in black pepper cuttings in the institute and the farmer's field for foot rot disease management. Studies on the population of the tablet formulation of RCh6-2b and STC-4 in the soil over 24 months indicated that the bacteria released to the earth within seven days of application. The population of the applied bacteria was 6 Log CFU/g of soil till 24 months. These results indicate that the introduced bacteria from tablet formulation survive well in the soil and provide better growth benefits and protection to the crop.

Studies on the population of *B. methylotrophicus* RCh6-2b and STC-4 talc formulations amended seaweed (*Sargassum tenerimum*) powder

Formulations of *B. methylotrophicus* (RCh6-2b & STC-4) were prepared as per the standardized method with seaweed (*Sargassum tenerimum*) powder as amendment @ 5, 10 and 20%. The population of bacteria in the product was above 8.5 Log CFU/ g in both the products (RCh6-2b and STC-4) till nine months and 8 Log Log CFU/g till 18 months. Amending the product with seaweed would reduce the cost of production and utilization of waste in the bio-product.

Disease management and growth promotion in vegetables using bacterial bio-agents agents

On chilli disease management, field evaluation of talc formulation of bacterial bio-agents (RCh6-2b, STC-4 and RP-7) was carried out. There was no significant incidence of soil-borne diseases in both the varieties (VNR and Nisha hybrid) during the trial period. However, there was a severe incidence of the chilli leaf curl virus, and the data indicated no difference in the severity (PDI) of disease among the treatments. Further, it was recorded that the application of bio-agents improved plant growth and yield in both the hybrids.

A. Seed Production in Field Crops

Manohara KK

Breeder seed and Truthfully Labelled seed production in rice

During *kharif* 2020, seed production (Breeder seed) of four released salt-tolerant rice varieties *viz*., Goa Dhan 1 (KS 12), Goa Dhan 2 (KS 17), Goa Dhan 3 (GRS 1), and Goa Dhan 4 (JK 238) was taken up at the Institute farm. Heavy rain and submergence for an extended period during the critical stages caused damage to the seed production plots. The following quantities of breeder seeds were produced in each of the above four varieties. Apart from this, truthfully labelled seeds (TLS) of paddy varieties *viz*., Jaya, Jyothi, Karjat 3 and Sahbhagi Dhan were also produced in small quantities to meet the demand from the Department of Agriculture, Govt of Goa.

Varieties	Class of seed	Quantity produced (q)
Goa dhan 1	BS	2.50
Goa dhan 2	BS	1.50
Goa dhan 3	BS	3.00
Goa dhan 4	BS	0.50
Jaya	TLS	0.50
Jyothi	TLS	0.65
Sahbhagi dhan	TLS	0.90
Karjat 3	TLS	0.60

Maintenance breeding in released salt-tolerant rice varieties

Four salt-tolerant rice varieties, namely, Goa Dhan 1, Goa Dhan 2, Goa Dhan 3, and Goa Dhan 4, were planted in panicle to progeny rows in 20 rows of 8 m length to produce nucleus seed. About 25 kg nucleus seeds were produced, and panicles were collected to create the next nucleus seed cycle.

Field view of nucleus seed production plot at the Institute farm

Capacity building/technology dissemination

As part of the capacity building under the ICAR seed project, training was imparted to farmers in Gaodongrim and Cotigao villages about quality seed production. Farmers were apprised about the importance of using quality seed production in increasing production. Farmers were educated about the importance of using quality seeds in realizing higher production. Farmers were given training on seed treatment and identifying important insect pests and disease symptoms in the field to take the appropriate control measure. Two trainings and one field day were organized during the *kharif* 2020.

Training and field days conducted in Gaodongrim and Cotigao villages of South Goa

C. Seed Production in Horticultural Crops

V Arunachalam

Four shade net houses were maintained during the year to augment the planting material generation. Quality planting materials numbering 5944 from 12 major horticultural crops and others were generated. A revenue of Rs.7,00,533/- was generated during the year (Jan to Dec 2020) from the project by the sale of the above planting materials and farm produce. The seed money of Rs 5,00,000 was entirely refunded during the year.

Planting material generated and sold under the project

Crops	Number of planting materials produce
Arecanut	1572
Black Pepper	1126
Coconut	1310
Mango	402
Cashew	220
Wax apple	205
Banana	191
Soursop	151
Sitaphal	151
Lemon	122
Pineapple	107
Bilimbi	95
Others	292
Total	5944

C. Seed Production in Ornamental Fisheries

Sreekanth GB

Distributed a total of 1730 ornamental fish seeds, fish feed, seedlings of aquatic plants were produced and distributed to the farming community and generated an income of Rs. 45000.00

Items	Particulars	Nos.	Total (Rs.)
Fish seeds	Guppy, molly, platy, koi carp, swordtail, gouramies, tilapia, Amur carp	1500	30000.00
Fish feed	Ornamental fish feed (kg)	10	10000.00
Fish posters	Posters on fisheries resources	20	2000.00
Aquatic plants	Aquatic plant seedlings	200	3000.00
	Total	1730	45000.00

Project: Poultry Seed Project (ICAR)

Nibedita Nayak

The poultry breeds of Vanaraja and Krishibro parents stocks were reared at this centre during the year. The bodyweight of parent stock was recorded at regular intervals. In Vanaraja parents, the hatchability on fertile egg set (FES) basis was 60-69% at 40th week and 75-82% at 63rd week. The average daily egg production was 43.18% during 40th to 63rd weeks of age, and the mean egg weight was 55.20 ± 0.35g for Vanaraja birds. Improved chicken germplasms (41,696) were distributed to 1,342 farmers of Goa, Maharashtra and Karnataka, earning Rs. 4,76,714/-.

Chick and brooder birds rearing

SCSP and STC distribution

Around 2750 numbers of Vanaraja, Gramapriya and Krishibro chicks along with poultry feed and feed supplements, medicines, etc. were distributed to 57 farmers of Goa, Karnataka and Maharashtra under the budgetary provision of SCSP and STC (TSP) component in the Poultry Seed Project (PSP), as well as the institute.

Distribution of poultry feed and supplements

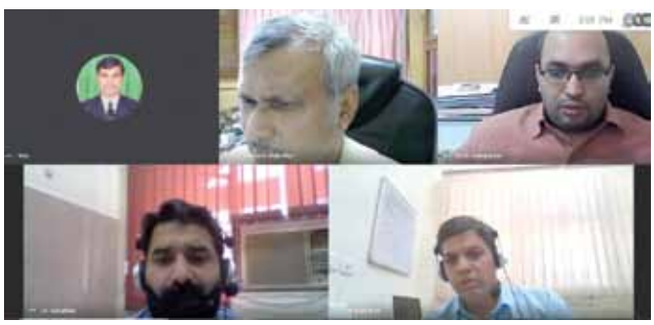
SIGNIFICANT ACCOMPLISHMENTS

- Intellectual Property Rights (IPR) Cell
- Technology Evaluation
- Ongoing Research Projects
- Awards and Recognitions
- Publications

Intellectual Property Rights (IPR) Cell

MUM/2015 (Extender for the preservation of boar semen): Reply to First Examination Report (FER) and application for National Biodiversity Authority (NBA) approval for the patent application "Extender for the preservation of boar semen" was communicated to Patent Attorney in May 2020.

- In September 2020, the Director of ICAR-CCARI signed an agreement with the NBA (application no. INBA3202001964 | Patent application No. 3037/MUM/2015) and forwarded it to the patent attorney for further action.
- IPR cell facilitated the notarization of additional data, relevant thesis pages, and deed of assignment and communicated it to the attorney and the attorney made a final submission to the Patent Office in this regard on December 17, 2020.
- Meeting with Attorney, Mr. Deshpande, for post-hearing discussion and submission of additional data under affidavit in the patent application no: 3037/MUM/2015 (Extender for the preservation of boar semen) on 10-12-2020.



Meeting with Institute IPR Attorney for post-hearing discussion in the matter of patent application No. 3037/MUM/2015

Variety Release Proposal

- Variety release proposals (Goa brinjal-5 and Goa brinjal-6) resubmitted in new Performa with required documents to the Director, Directorate of Agriculture, Government of Goa in October 2020. All formalities of revised submission completed in November 2020.

Meeting of Director, Dr A R Desai & IPR Cell coordinator with Mr Vinayak Angle, turmeric farmer, on availing processing facilities

Dr A R Desai explaining about turmeric processing facilities to Mr Vinayak Angle, the turmeric farmer

Technology Evaluation

Performance evaluation of process machinery

We evaluated six process machinery: 1) Pepper Threshing machine of M/s Datson Industries 2) Maharaja Two Belt Arecanut De-husker of M/s Easy Life Enterprises 3) Maharaja Single Belt Arecanut De-husker of M/s Easy Life Enterprises 4) Trolley Mounted Earth Auger with Honda Engine of M/s Easy Life Enterprises 5) Arecanut Tree Climber (Motorized) of Maben's Engineering Solutions and 6) Coconut Tree Climber (Motorized) of Maben's Engineering Solutionsand gave performance evaluation reports to the farmer innovators. This machinery would be helpful in the horticulture based cropping systems of the coastal region. All six machines performed well and were certified as good.

Name	:	**Pepper Threshing machine**
Function	:	Threshing of pepper (separating pepper berries from spike)
Capacity	:	138.6±26.6 kg/h for pepper threshing [Average moisture content (W.B.) of berries
	:	21.65±1.33] with separation efficiency > 95% for berries Diameter < 7.8mm
Material	:	Body and Stand: Mild Steel
Screen	:	Stainless Steel
Power Source	:	1 Hp, Single Phase Motor
Dimension in mm	:	63 kg (1000 × 300 × 1000) (length × width × height)

Name	:	**Two Belt Arecanut De-husker**
Function	:	De-husking of arecanuts
Capacity	:	119.4 ± 25.61 kg/h of mixed grade whole arecanut (M.C.= 7.38± 0.65 % D.B.) with de-husking efficiency > 90 % or 88.01±2.91 kg/h of mixed grade chali (M.C.= 5.68± 0.35 % D.B.) with de-husking efficiency > 90 %
Material	:	Mild Steel except for sheller, which is of S.S.
Power Source	:	1 Hp, Single Phase Motor

Weight and Dimension: 240 kg (143 × 135 × 118 cm) (length × width × height)

Name	:	**Single Belt Arecanut De-husker**
Function	:	De-husking of arecanuts
Capacity	:	83.95 ± 5.65 kg/h of mixed grade whole arecanut (M.C.= 7.38± 0.65 % D.B.) with de-husking efficiency > 90 % or 47.75±1.49 kg/h of mixed grade chali (M.C.= 5.68± 0.35 % D.B.) with de-husking efficiency > 90 %
Material	:	Mild Steel except for sheller, which is S.S.
Power Source	:	1 Hp, Single Phase Motor

Weight and Dimension: 160 kg (153 × 138 × 112 cm) (length × width × height)

Name : **Trolley Mounted Earth Auger**

Function : Digging of pits

Capacity : 116.74.93± **8.3 pits/h of dimensions 38.33±1.25* cm depth and 20 cm diameter**

(Soil moisture content 11.45±0.38% D.B.) 2.0±0.2 km/h speed of moving between

Pits.Fuel consumption 1.33 lph.

Material : Powder Coasted Mild Steel except for Blade, which is of S.S.

Power Source : GX50 , 4 Stroke Engine

Dimension : 12", Length : 750mm, Output shaft Dia: 200 mm.

Name : **Arecanut Tree Climber**

Function : Climbing Arecanut trees for harvesting, pruning, and spraying,etc

Capacity : Average tree to tree distance =2.7 m, Average tree height =7.87 m

Average harvesting time per tree (assumed)= the 30s Trees harvested per/h)

Trees gathered per/h - 30 (for the trained operator) and 18 (for an untrained operator, assuming 30% efficiency)

Fuel consumption : 125 trees/l (trained operator) and 75 trees/l (untrained operator)

Power Source : Petrol Engine -2.2 Hp

Name : **Coconut Tree Climber**

Function : Climbing Coconut trees for harvesting, pruning, and spraying,etc

Capacity : Average tree to tree distance =7.5 m, Average tree height =12.7 m

Average harvesting time per tree (assumed) = the 60s

Trees harvested per/h - 16 (for a trained operator), 10 (for an untrained operator, considering 30% efficiency)

Fuel consumption : 83 trees/l (trained operator) and 50 trees/l (untrained operator)

Power Source : Petrol Engine -2.5 Hp

Ongoing Research Projects

INSTITUTE FUNDED PROJECTS

No.	Project Title	PI	Co-PI (s)	Duration
Mega Project I : Conservation and management of natural resources of coastal region Project Leader : SK Singh				
1.	Assessment and mapping of trends in hydro-climatic variables over west and east coast regions of India	Sujeet Desai	Bappa Das Sreekanth GB	2019–22
2.	Assessment of the properties of the coastal saline soils and development of integrated nutrient management practices and crop establishment methods for improving its productivity	GR Mahajan	R Ramesh	2017–22
3.	Study of conservation tillage practices for sustainability of rice based cropping systems in west coast of India	Paramesha V	GR Mahajan	2019–24
4.	Assessment of climate change vulnerability in coastal districts of India	Bappa Das	VK Sehgal	2019–22
5.	Genesis of soils and associated evaporates in the coastal ecosystem for sustainable land use options and carbon management in India	SK Singh	GR Mahajan Bappa Das Sujeet Desai Sreekanth GB	2020 – 22
Mega project II: Conservation and utilization of genetic resources in the coastal region Project Leader: AR Desai				
6.	Collection, evaluation of genetic resources and management of fruit and spices	AR Desai	SK Singh Sujeet Desai Paramesha V Maneesha SR Nibedita Nayak	2011 – 23
7.	Assessment, management and designing improvement options for fisheries in selected low impacted estuaries along southwest coast of India	Sreekanth GB	Trivesh Mayekar	2017–22
8.	Genetic improvement of rice for coastal agro-ecosystem	Manohara KK	Paramesha V	2020–25
9.	Integrated strategies for crop improvement and organic production in cashew for coastal climate resilience	AR Desai	Manohara KK Paramesha V	2020–25
10.	Study on status of vegetable cultivation and survey for traditional crop varieties in major vegetable crops in coastal region for sustainable production	M Thangam	BL Kashinath	2020–25
11.	Genetic variability of thermo tolerance in selected breeds of livestock under coastal environment	Amiya Ranjan Sahu	EB Chakurkar Gokuldas PP	2020–25
Mega project III: Development and validation of production technologies of major crops of coastal region Project Leader: R. Ramesh				
12.	Study and the management of major diseases of vegetable crops in coastal region	R Ramesh	Maruthadurai R	2017–22

13.	Studies on emerging insect pests (white flies and fall army worm) and their management in coastal region of India	Maruthadurai R	R Ramesh	2019–22
14.	Production and postharvest management of fruit crops kokum, jackfruit and breadfruit of west coast region of India	S Priya Devi	MJ Gupta	2018–22
15.	Development of detection methods/ diagnostics for important and emerging plant and animal pathogens of coastal region	R Ramesh	Shivasharanappa N Susitha Rajkumar Chethan Kumar HB	2020–25
16.	Response of mango (*Mangifera indica* L.) to edaphic and climate factors in Indian coastal region	Maneesha SR	AR Desai SK Singh S Priya Devi Bappa Das	2020–25
Mega project IV: Development and validation of production technologies of livestock and fisheries Project Leader: EB Chakurkar				
17.	Prevalence and impact study of the economically important diseases of dairy animals in coastal India	Susitha Rajkumar	Chethan Kumar HB	2019–24
18.	Surveillance of major zoonotic diseases in livestock of coastal India	Chethan Kumar HB	Shivasharanappa N Himani Dhanze	2019–22
19.	Augmenting backyard poultry production through technological interventions in breeding, feeding and management aspects pertaining to Indian West coast	Nibedita Nayak	Gokuldas PP Susitha Rajkumar	2019–22
20.	Impact analysis of diseases of meat animals (pigs, goats and sheep and poultry) in coastal India and strategies for their management	Shivasharanappa N	Chethan Kumar HB	2020–25
21.	Conservation of major farm animal resources in the coastal region through evaluation of seminal traits, semen processing and preservation	Gokuldas PP	EB Chakurkar, Chethan Kumar HB Amiya Ranjan Sahu	2020-25
22.	Development of sustainable aquaculture practices through technology intervention to promote fisheries livelihood in the coastal ecosystem of India	Trivesh S Mayekar	Sreekanth GB GR Mahajan	2020-23
Mega project V: Improving livelihood security through post-harvest technologies and other agri-enterprises Project Leader: V Arunachalam				
23.	Prospects and promotion of agro ecotourism in coastal region of India	EB Chakurkar	AR Desai V Arunachalam M Thangam MJ Gupta GR Mahajan Maneesha SR S Priya Devi Sreekanth GB Sujeet Desai	2017–25
24.	Harnessing palms for sustainable livelihoods of coastal India	V Arunachalam	SK Singh V Paramesha	2020–25

25.	Assessment and development of cropping systems based harvest and postharvest management technologies for coastal India	MJ Gupta	AR Desai R Ramesh S Priya Devi Maneesha SR	2020–25

AICRP PROJECTS

No.	Project Title	PI	Co-PI (s)
1.	All India Co-ordinated Research Project on Integrated Farming Systems	Paramesha V	EB Chakurkar AR Desai GR Mahajan Sreekanth GB HB Chethan Kumar Gokuldas PP Manohara KK
2.	All India Co-ordinated Research Project on Palms	V Arunachalam	-
3.	All India Co-ordinated Research Project on Vegetables	M Thangam	-
4.	All India Co-ordinated Research Project on Pig	EB Chakurkar	-
5.	All India Co-ordinated Research Project on Animal Disease Monitoring and Surveillance (ADMAS)	Shivasharanappa N	Susitha Rajkumar

EXTERNALY FUNDED PROJECTS

No.	Project Title	PI	Co-PI (s)
DST			
1.	Hyperspectral remote sensing of the foliar nutrients in crops	GR Mahajan	-
2.	Design and development of acoustic methods for early detection of stem and root borer *Plocaederus* spp. infestation in cashew	Maruthadurai R	T Veerakumar
3.	Phenotyping for salinity stress of crop plants through thermal hyperspectral remote sensing	Bappa Das	Manohara KK
NABARD			
4.	Empowerment of farmers through adoption of sustainable and eco-friendly integrated pest and disease management technologies in major vegetable crops in Goa	Maruthadurai R	R Ramesh
DBT			
5.	Augmentation of rural pig production for socio economic upliftment of rural poor in Goa through artificial insemination	Shivasharanappa N	EB Chakurkar, Susitha Rajkumar
ICAR			
6.	ICAR Network Project on Functional Genomics and Genetic Modification in Crops (ICAR NPFGGM)	Manohara KK	-
7.	Production and formulation technology refinement of bacterial bio- agents for soil borne plant disease management under coastal ecosystem	R Ramesh	-
8.	Seed production in agricultural, horticultural crops and fisheries	Manohara KK	V Arunachalam Sreekanth GB
9.	Poultry seed project	Nibedita Nayak	-

Awards and Recognition

Dr. R Ramesh

- Invited as speaker to deliver presentation "Bacterial wilt: Diversity, virulence of *R. solanacearum* and management strategies" on 7th International Conference on Phytopathology in Achieving UN Sustainable Development Goals during 16-20, January, 2020 at IARI, New Delhi, India.
- Awarded best oral presentation for presenting research paper during National seminar on spices: Emerging trends in production, processing and marketing (21-22, January, 2020) at ICAR-CCARI, Goa, India.
- Nominated as subject expert in the Selection Committee for direct recruitment to the post of Assistant Professor in Microbiology, Marine Microbiology and Biotechnology of Goa University.

Dr. M J Gupta

- Panel member for review of Indian Standards related to Surface covered cultivation, Food and Agriculture Division, Bureau of Indian Standards, New Delhi.
- Member of Scientific Committee of Greensys 2021- International Symposium on New Technologies for Sustainable Greenhouse Systems, to be held between 24-28, October, 2021 at Cancun, Mexico.
- Awarded certificate as "Master Trainer -Fruits & Vegetables Processing" under PMFME Scheme November, 2020.

Dr. Sreekanth GB

- Young Scientist Award in Fisheries Resource Management by the Society of Fisheries and Life Sciences, College of Fisheries Campus, Mangaluru, Karnataka, India.
- Resource person for the invited lecture "Estuarine fisheries and pandemics: management strategies". In: online webinar on "COVID-19 and FISHERIES: Potential impacts, mitigation and management" organized by College of Fisheries (CAU), Tripura under National Agricultural Higher Education Project during June 15-19, 2020.

Dr. Maneesha SR

- Best oral paper presentation award in National seminar on spices: Emerging trends in production, processing and marketing on 21-22, January, 2020 at ICAR-CCARI, Goa.

Dr. Bappa Das

- Selected for ICAR-Postdoctoral Fellowships – 2020.
- Young Scientist Award, 2020, Indian Society for Plant Physiology, New Delhi.

Dr. Sujeet Desai

- Received the Best Oral paper award in the National Seminar on Landslide Mitigation and Slope Management held from 28-29, February, 2020 at ICAR-IISWC, RC, Udhagamandalam.
- Professional member of the World Association of Soil and Water Conservation (WASWAC), Beijing, China.

Publications

Research Articles

Arunachalam V, Fernandes C M and Salgaonkar D C. 2020. Quick method to quantify the potassium and sodium content variation in leaves of banana varieties. *Analytical Sciences* **36** (10): 255–1260. https://doi.org/10.2116/analsci.20P096.

ArunachalamV, Vaingankar J D and Kevat N. 2020. Foliar traits in papaya plants intercropped in coconut. *National Academy of Science Lett*er https://doi.org/10.1007/s40009-020-00981-5.

Asolkar T and Ramesh R. 2020. The involvement of the Type Six Secretion System (T6SS) in the virulence of *Ralstonia solanacearum* on brinjal. *3 Biotech* 10, 324. doi.org/10.1007/s13205-020-02311-4.

Banerjee K, Krishnan P and Das B. 2020. Thermal imaging and multivariate techniques for characterizing and screening wheat genotypes under water stress condition. *Ecological Indic*ator 119, pp. 106829.

Barman K, Banik S, Thomas R, Gokuldas PP, Kaushik P, Kumar S, Das BC, Das AK, Konwar D and Rajkhowa S. 2020. Effects of replacing conventional diets with brewer's rice by-products on performance of crossbred (Hampshire × Ghungroo) grower pigs *Indian Journal of Animal Health* **59** (1): 62–66.

Basavalingaiah K, Ramesha Y M, Paramesh V, Rajanna G A, Jat S L, Dhar Misra S, Kumar Gaddi A, Girisha H C, Yogesh G S, Raveesha S, Roopa T K, Shashidhar K S, Kumar B, El-Ansary D O and Elansary H O. 2020. Energy Budgeting, Data Envelopment Analysis and Greenhouse Gas Emission from Rice Production System: A Case Study from Puddled Transplanted Rice and Direct-Seeded Rice System of Karnataka, India. *Sustainability* **12** (16): 6439.

Behera U K, Paramesh V and Amit Kumar. 2020. Comparative economics of indigenous Kulagar and Integrated Farming Systems under coastal agro-ecosystem of Goa. *Indian Journal of Agricultural Sciences* 90 (8): 1555–62.

Chary L K, Sreekanth G B, Deshmukh M K and Sharma N. 2020. Marine Soundscape and Fish Chorus in an Archipelago Ecosystem comprising Bio-Diverse Tropical Islands off Goa Coast, India. *Aquatic Ecology* https://doi.org/10.1007/s10452-020-09754-0.

Das B, Nair B, Arunachalam V, Reddy K V, Venkatesh P, Chakraborty D and Desai S. 2020. Comparative evaluation of linear and nonlinear weather-based models for coconut yield prediction in the west coast of India. *International Journal of Biometeorology* 1–13. https://doi.org/10.1007/s00484-020-01884-2.

Das B, Manohara K K, Mahajan G R and Sahoo R N. 2020. Spectroscopy based novel spectral indices, PCA-and PLSR-coupled machine learning models for salinity stress phenotyping of rice. *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy* 229:117983. doi: 10.1016/j.saa.2019.117983.

Desai S, Singh D K, Islam A and Sarangi A. 2020. Impact of climate change on the hydrology of a semi-arid river basin of India under hypothetical and projected climate change scenarios. *Journal of Water and Climate Change* https://doi.org/10.2166/wcc.2020.287.

Desai S, Singh D K, Islam A and Sarangi A. 2020. Multi-site calibration of hydrological model and assessment of water balance in a semi-arid river basin of India. *Quaternary International* https://doi.org/10.1016/j.quaint.2020.11.032.

Goel Akshat, Bhanja Subrat Kumar, Nayak Nibedita, Mehra Manish and Karuppasamy K. 2020. Effects of supplementing silver nano-particles during early embryogenesis on the hatchability and post hatch performance of broilers. *Indian Journal of Animal Science* **90** (5): 749–753.

Gupta M J, Maruthadurai R, Vanjari S S, Pandurang S C and Pitre A M. 2020. A systematic assessment of paddy losses at various stages from harvest to storage for two cropping years in the state of Goa. *Journal of Agricultural Engineering* **57**(2): 138–150.

Gupta M J, Thangam M and Arunachalam V. 2020. Microclimatic Studies in a Double-span Greenhouse under Wind Driven and Fan Ventilated Conditions in West Coast of India, *Acta Horticulturae* 1271: 227–234.

Lal D M, Sreekanth G B, Soman C, Ramteke K K, Ratheesh Kumar R and Abidi Z J. 2020. Fish community structure as an indicator of the ecological significance: A study from Ulhas River Estuary, Western coast of India. *Journal of Environmental Biology* **41** (4): 745–754.

L.K. Tyagi, Rejani Chandran1, SangeetaMandal, Trivesh S. Mayekar, Amit Singh Bisht and Sanjay KumarSingh,2020. People's Perception on the Status of Fisheries Resources and Habitats in Mahanadi River Basin. Journal of Community Mobilization and Sustainable Development.Vol. 15(1), 39-48.

Mahajan G R, Das B, Gaikwad B, Murgaokar D, Morajkar S, Desai A, Patel K P and Kulkarni R M. 2020. Monitoring properties of the salt-affected soils by multivariate analysis of the visible and near-infrared hyperspectral data. *Catena* 198: 105041. DOI: 10.1016/j.catena.2020.105041.

Mahajan G R, Das B, Manivannan S, Manjunath B L, Verma R R, Desai S, Kulkarni R M, Latare A M, Sale R, Murgaonkar D, Patel K P, Morajkar S, Desai A and Barnes N. 2020. Soil and water conservation measures improve soil carbon sequestration and soil quality under cashews. *International Journal of Sediment Research* **36**(2): 190–206. DOI: 10.1016/j.ijsrc.2020.07.009.

Mahajan G R, Das B, Morajkar S, Desai A, Murgaokar D, Kulkarni R M, Sale R and Patel K. 2020. Soil quality assessment of coastal salt-affected acid soils of India. *Environmental Science and Pollution Research* **27**(21):26221–26238. DOI: 10.1007/s11356-020-09010-w.

Manju Lekshmi N, Sreekanth G B, Singh N P, Vennila A, Ratheesh Kumar R, and Pandey P K. 2020. Ecopath modelling approach for the impact assessment of coastal aquaculture systems in Goa, India. *Indian Journal of Fisheries* **67**(3): 39–51.

Maruthadurai R. 2020. Field evaluation of roosting plants with food bait spray in managing melon fly, *Zeugodacus cucurbitae* in cucumber, *Cucumis sativus*. *International Journal of Pest Management*. https://doi.org/10.1080/09670874.2020.1791370.

Maruthadurai R and Ramesh R. 2020. Mass trapping of red palm weevil and rhinoceros beetle in coconut with aggregation pheromone. *Indian Journal of Entomology* **82** (3): 439–441.DOI: 10.5958/0974-8172.2020.00114.5.

Maruthadurai R and Ramesh R. 2020. Occurrence, damage pattern and biology of fall armyworm, *Spodoptera frugiperda* (JE smith) (Lepidoptera: Noctuidae) on fodder crops and green amaranth in Goa, India. *Phytoparasitica* **48**:15–23. doi.org/10.1007/s12600-019-00771-w.

Nayakwadi S, Ramu R, Kumar Sharma A, Kumar Gupta V, Rajukumar K, Kumar V and Basalingappa KM. 2020. Toxicopathological studies on the effects of T-2 mycotoxin and their interaction in juvenile goats. *PloS one* **15**(3): e0229463.

Nirmal T, Jaiswar A K, Sreekanth G B. 2020. Plasticity in shell selection behavior by the endemic hermit crab, *Diogenes alias* (Anomura: Diogenidae) from Northeastern Arabian sea, India. *Crustaceana* **93**(9-10):1135–1152.

Paramesha V, Sreekanth G B, Parajuli R, Chakurkar E B, Chetan Kumar H B, Gokuldas P P, Mahajan GR, Manohara KK and Ravisankar N. 2020. Trophic network and ecosystem network analysis in a smallholder integrated crop-fish-livestock system for coastal lowland situation in tropical humid conditions of India. *Sustainability* **12**(12): 5017.

Paramesh V, Sreekanth G B, Chakurkar E B, Chethan Kumar H B, Gokuldas P P, Manohara K K, Ramdas Mahajan G, Rajkumar R S, Ravisankar N and Panwar A S. 2020. Ecosystem Network Analysis in a Smallholder Integrated Crop–Livestock System for Coastal Lowland Situation in Tropical Humid Conditions of India. *Sustainability* **12**(12):5017.

Reddy K V, Paramesh V, Arunachalam V, Das B, Elansary H O, Parab A, Reddy D D, Shashidhar K S, El-Ansary D O, Mahmoud E A and El-Sheikh M A. 2020. Assessment of Sustainability and Priorities for Development of Indian West Coast Region: An Application of Sustainable Livelihood Security Indicators. *Sustainability* **12**(20):8716.

Sahu AR, Jeichitra V, Rajendran R and Raja A. 2020. Association analysis of novel SNPs in exon 10 of the growth hormone receptor gene with growth traits in Indian sheep. *Veterinarski Arhiv* **90** (6): 593–602.

Sreekanth G B, Jaiswar A K, Shivkumar H B, Manikandan B and Chakurkar E B. 2020. Fish composition and assemblage structure in four tropical monsoonal estuaries from India: A functional trophic guild approach. *Estuarine, Coastal and Shelf Science* DOI: 10.1016/j.ecss.2020.106911.

Sridhara S, Ramesh N, Gopakkali P, Das B, Venkatappa S, Sanjivaiah S, Kumar Singh K, Singh P, El-Ansary D, Mahmoud E and Elansary H. 2020. Weather-Based Neural Network, Stepwise Linear and Sparse Regression Approach for *Rabi* Sorghum Yield Forecasting of Karnataka, India. *Agronomy* 10:1645.

Sri Hari M, Pradhan SK, Pavan Kumar A, Bhushan S, Nayak BB, Sreekanth G and Abidi Z J. 2020. Morphometric and meristic analyses of Randall's threadfin bream, Nemipterus randalli Russell, 1986 along the Indian coast. *Indian Journal of Fisheries* **67**(4): 143–148.

Susitha Rajkumar, Maddula Ramkoti Reddy, and Ramesh Somvanshi. 2020. Molecular Typing of Indian *Mycoplasma synoviae* Isolates. *Indian Journal of Animal Research* online first article DOI: 10.18805/IJAR.B-4153. Article Id: B-4153.

Tyagi L K, Chandran Rejani, Mandal Sangeeta, Mayekar Trivesh S, Bisht Amit Singh and Singh Sanjay Kumar. 2020. People's Perception on the Status of Fisheries Resources and Habitats in Mahanadi River Basin. *Journal of Community Mobilization and Sustainable Development* **15**(1): 39–48.

Paper Presented/ Conference / Abstracts

Das B, Sahoo R N, Pargal S, Krishna G, Verma R, Viswanathan C, Sehgal V K and Gupta V K. 2020. Evaluation of different uni- and multi-variate techniques for water-deficit stress phenotyping of rice through spectroscopy *in* International Plant Physiology Virtual Conference-2020 Prospects of Plant Physiology for Climate Proofing Agriculture during 6-7 December, 2020.

Desai Sujeet and Chakurkar E B. 2020. Landslide events of Kerala, their causes and impacts: A case study of Puthumala landslide in Wayanad district. National Seminar on Landslide Mitigation and Slope Management held from 28-29 February, 2020 at ICAR-IISWC RC, Udhagamandalam.

Desai Sujeet, Desai A R and Patel Nikita Kiran. 2020. Complementary influence of turmeric as an intercrop on soil and water conservation measures in coconut plantations. National Seminar on Spices: Emerging Trends in Production, Processing and Marketing" held from 21-22 January, 2020 at ICAR-CCARI, Goa.

Gupta M J, Arunachalam V, Desai A R, Kolpe D S and Kharat K B. 2020. Studies on Physical, Mechanical and Bio-Chemical Properties of Banana Pseudo stem and its Use for Cup Making, paper presented in 54th Annual Convention of ISAE and International Symposium on "Artificial Intelligence Based Future Technologies in Agriculture", at Hyaat Regency, Vimannagar, Pune, January 7-9, 2020.

Maneesha S R, Mahajan G R and Ramesh R. 2020. Effect of an integrated nutrient mixture on growth and development of banana (*Musa* sp.) varieties Velchi (AB) and Grand Nain (AAA) in red lateritic soils of Goa. International Conference on Banana-2020, Tiruchirappalli, India during 22-25 February, 2020.

Maneesha S R, Desai A R and Chakurkar E B. 2020. Medicinal uses of tropical spices: Traditional wisdom and scientific evidences. In: Souvenir and Abstracts of National seminar on spices: Emerging trends in production, processing and marketing on 21-22, January, 2020 at ICAR-CCARI, Goa.

Maneesha S R, Desai A R and Chakurkar E B. 2020. Scope of spice gardens as Agro –Eco Tourism centers in Konkan –Malabar coasts of India. In: Souvenir and Abstracts of National seminar on spices: Emerging trends in production, processing and marketing on 21-22, January, 2020 at ICAR-CCARI, Goa.

Maruthadurai R, Bappa Das and Ramesh R. 2020. Impact of climate change on habitat suitability of fall armyworm, *Spodoptera frugiperda* based on MaxEnt modeling. Presented on International virtual conference on biodiversity and ecosystem services in a climate change perspective during 10-11, December, 2020.

Nayakwadi S**,** Shivaramu K and Paula J Cray. 2020. CRISPR-Cas9 mediated knockout/disruption of blaCTXM genes in Extended Spectrum Beta Lactamase *E. coli* from food animal origin; Abstract presented in 6th World One Health Congress Edinburgh held on 30th October to 3rd November, 2020.

Priya Devi S, Gupta M J, Lamani K and Desouza V. 2020. Status of Kokum Marketing in Konkan Region. Paper Presented in "National Symposium on Spices: Emerging Trends in Production, Processing and Marketing, held at ICAR-CCARI, Ela 21-22 January 2020.

Ramesh R, Achari G A, Gaitonde S, Asolkar T and D'Souza M. 2020. Bacterial wilt: Diversity, virulence of *R. solanacearum* and management strategies. 7th International Conference on Phytopathology in Achieving UN Sustainable Development Goals held during 16-20, January 2020 at IARI, New Delhi. India. Pp 389.

Ramesh R, Gaonkar T, Meena S N and Mhadeshri P. 2020. Evaluation of bacterial bio-formulations for the management of soil borne diseases in chilli. 7th International Conference on Phytopathology in Achieving UN Sustainable Development Goals held during 16-20, January 2020 at IARI, New Delhi. India. Pp 365.

Ramesh R, Gaonkar T and Mhadeshri P. 2020. Field evaluation of bacterial bio-agent formulations (RCh6-2b and STC-4) for the management of foot rot in black pepper. National seminar on spices: Emerging trends in production, processing and marketing held during 21-22, January 2020 at ICAR-CCARI, Goa. India. Pp 220.

Sreekanth G B. 2020. Fish and Fisheries in Goa. In Online Webinar on diversity of fishes of Goa organised by Govt. College of Arts, Science, and Commerce, Sanquelim-Goa on August 17, 2020.

Sreekanth G B. 2020. Estuarine fisheries and pandemics: management strategies. In: online webinar on "COVID-19 and FISHERIES: Potential impacts, mitigation and management" organised by College of Fisheries (CAU), Tripura under National Agricultural Higher Education Project during June 15-19, 2020.

Sreekanth G B. 2020. The food web structure and ecosystem health status of a small and shallow tropical estuary along the west coast of India. In: International Conference on Impact of Climate Change on Hydrological Cycle, Ecosystem, Fisheries and Food Security (CLIMFISHCON-2020) at Kochi, Kerala from November 11-14, 2020.

Susitha Rajkumar, Nibedita Nayak and Chethan Kumar H B. 2020. An outbreak of Favus in a breeder poultry flock in Goa" World Veterinary Poultry Association (WVPA) (India) Conference -2020 on the theme "Advances in Poultry Science for One Health" on 28 February, 2020 at ICAR-NIANP.

Popular / Technical Articles

Gokuldas P P 2020. Estrus induction and synchronization as a reproductive management tool in pig breeding. Vikaspedia e-Portal, India Development Gateway (InDG), Ministry Electronics & IT (MeitY), Govt. India

Nayak Nibedita, Maruthadurai R and Sahu A. R. 2020. Black soldier fly larvae: as converter of waste to wealth and alternate feed source for poultry. Poultry World, July 2020, Pp: 44–45.

Udharwar S V, Gokuldas P P and Prabhu H R C. 2020. Importance of feeding mineral and vitamin mixture in dairy animals. Technical Folder No. 23/2020, ICAR-KVK, North Goa, Goa. pp: 1–8.

Udharwar S V, Gokuldas P P and Prabhu H R C. 2020. Importance of Artificial Insemination in dairy farming. Technical Folder No. 25/2020. ICAR-KVK, North Goa, ICAR-CCARI, Goa. pp:1–8.

Udharwar S V and Gokuldas P P 2020. Gestation Table of Buffalo. Extension Folder 20. ICAR-KVK, North Goa, ICAR-CCARI, Goa. pp:1–4.

Book Chapters/ Books/ Compendia

Chethan Kumar H B, Shivasharanappa N, Susitha Rajkumar, Chakurkar E B. 2020. Salmonellosis in Pigs; In: Pig Diseases and Management (2021): 55-66 Editors: S.S. Patil, K.P. Suresh and Parimal Roy; Today & Tomorrow's Printers and Publishers, New Delhi-110002 (India), ISBN No: 9788170196761.

Gokuldas P P, Chethan Kumar, Rajkumar R S and Chakurkar E B. 2020. Status of production and productivity of dairy animals in coastal India. In: Coastal Agricultural Resource Inventory: An overview and way forward. ICAR–CCARI, Old Goa, Goa, India. ISBN - 978-93-5406-829-4, pp: 283.

Mahajan G R, Das B, Gaikwad B, Murgaokar D, Patel K and Kulkarni M. 2020. Spectral and Smartphone-Based Tools to Monitor Plant and Soil Nitrogen Status for Site-Specific N Management in Crop Plants. Mandal N, Dey A, Rakshit (eds.) R: Soil Management for Sustainable Agriculture - New Research and Strategies. CRC Press Taylor and Francis Group. Apple Academic Press.

Pradeep H K, Jagadeesh P, Sheshasayee M S and Desai S. 2020. Irrigation system automation using finite state machine model and machine learning techniques. Intelligent computing and communication, Advances in intelligent systems and computing 1034, Pg 495-500.

Ramesh S V, Arunachalam V and Rajesh M K. 2020. Genomic Designing of Climate-Smart Coconut. In Genomic Designing of Climate-Smart Fruit Crops (pp. 135-156). springer, Cham.

Institute as Publisher

Publications	Authors/ Editors/ Publishers
Reports	
Annual Report (2019) pp.1-93	EB Chakurkar, V Arunachalam, MJ Gupta, Manohara KK, GR Mahajan and Sreekanth GB
Technical Bulletins	
Training manual on good postharvest management practices for field crops of west coastal ecosystem Technical Bulletin No 68 pp 1- 59	MJ Gupta and Maruthadurai R
Fresh water ornamental fish culture and management Technical Bulletin No 69 pp 1-39	Sreekanth GB, EB Chakurkar, Trivesh Mayekar, Poorva, Tincy Varghesse, Sikhendar Kumar and Sudhir Kumar
Extension Folders	
Incubation and Hatching: Problems and prevention. Extension Folder No. 98	Nibedita Nayak, Amiya Ranjan Sahu and Ashita K
Poultry: Accomplishment in agro-eco-tourism Extension Folder No.99	Nibedita Nayak, EB Chakurkar and Amiya Ranjan Sahu
Extension Leaflets	
Improved parboiling technology Extension Leaflet 05	MJ Gupta, Maruthadurai R and Kiran Kharat
सुदारीत अर्द शेजोवणेचें तंत्रगिन्यान Extension Leaflet 06	MJ Gupta, Maruthadurai R and Kiran Kharat
Modified Pusa Bin for use in High Rainfall Coastal Regions Extension Leaflet 07	MJ Gupta, Maruthadurai R and Kiran Kharat
खूब पावस पडपी दर्यादेग वाठारां खातीर सुदारीत पुसा बिन Extension Leaflet 08	MJ Gupta, Maruthadurai R and Kiran Kharat
Method of application of Goa Bio -1 Extension Leaflet 09	GR Mahajan and R Ramesh
News Letters	
Vol. XXI. No 2, May- August, 2019 pp1-17	S Priya Devi, Manohara KK, Susitha Rajkumar and Bappa Das
Vol. XXI. No 3, September - December, 2019 Pp 1-22	S Priya Devi, Manohara KK, Susitha Rajkumar, Bappa Das and Sujeet Desai
Vol. XXII. No 1, January - April, 2020 Pp 1-15	Manohara KK, Susitha Rajkumar, Bappa Das and Sujeet Desai

EDUCATION, TRAINING AND HUMAN RESOURCE DEVELOPMENT

- Education and Training
- Human Resource Development

Visit of Fisheries minister, Goa state to ICAR-CCARI stall at Aqua Goa Festival

SCSP Training held at Arshinageri, Mundugod, Uttara Kannada District

Training on Turmeric production, processing and marketing

Education and Training

Education

AR Desai	External Examiner of the UHS, Bagalkot, for conducting the Qualifying examination of Masters and PhD students.
Sreekanth GB	Member of the advisory committee of Mr. Sudhan C, FRM PA8-07, PhD student, FRM Division of ICAR-CIFE, Mumbai Member of the advisory committee of Ms. Ashwini Gopi Kumar, PhD student, FRM, KUFOS, Kochi Member of the advisory committee of Ms. Keerthana, PhD student, FRM, KUFOS, Kochi

Lectures delivered by the Scientists

Date	Lecture Topic/Programme	Participants	Venue
V Arunachalam			
20-02-2020	Importance of plantation crops and coconut cultivation	Trainees	KVK, North Goa
02-09-2020	Coconut management practices	Delegate trainees	Virtual platform
04-11-2020	Training & demonstration of coconut climbing devices	Trainees	Priol village South Goa
R Ramesh			
04-01-2020	Disease management in vegetable crops	Farmers	Menkurem
14-01-2020	Disease management in vegetable crops	Farmers	Guirem-Parra
06-02-2020	Post-harvest diseases of fruits and their management	Students	Dept. of Botany, Goa University
25-02-2020	Diseases of coconut and their management	Farmers	ASCI programme, KVK, ICAR-CCARI
Mathala J Gupta			
06-01-2020	Greenhouses for enhancing production and doubling farmers income	State Agricultural officers from across India	ICAR- NIASM, Baramati, Maharashtra
06-01-2020	Abiotic stress management in vegetable crops under protected cultivation		
09-03-2020	Mechanization in Turmeric Production	Stakeholders and turmeric farmers from Haryana	ICAR- CCARI, Old Goa
20-03-2020	Coconut Harvesting machines	Farmers of Goa	KVK, North Goa
17-11-2020	Management of Vegetable Seedling under Protected Structures	Beneficiary farmers of Govt. of Goa	Virtual platform by ATMA, North Goa
Maruthadurai R			
24-02-2020	Integrated pest management in coconut	Farmers	KVK, North Goa
26-02-2020	Principle and practices of Integrated pest management in major crops	Farmers	KVK, North Goa
GR Mahajan			
28-02-2020	Integrated nutrient management in coconut	Farmers	KVK, North Goa,
04-03-2020	Introduction to fertilizer and its type and INM in Major crops	Farmers	KVK, North Goa
06-07-2020	Knacks of Preparation: Soil Science Competitive Exams	Students	Virtual platform by ICAR

05-08-2020	Plant Nutrition Management for Fruit Crops in Goa	Farmers	Virtual Platform by RCPR School of Agriculture
10-09-2020	गोव्यातील फळ भाज्या पिकांचे अन्नद्रव्य व्यवस्थापन	Farmers	Virtual Platform by RCPR School of Agriculture
05-11-2020	Nutrient deficiency symptoms in plants: Identification and management	Officers	Farmers Training Center, Old Goa
Susitha Rajkumar			
17-03-2020	Disease Management in Animals	Farmers	KVK North Goa
Sreekanth GB			
08-01-2020	Potential of aquaculture in Goa.	Women farmers and entrepreneurs	GIPARD, Old Goa
27-01-2020	Taxonomy on finfishes	Students	GP College of Education, Harmal, Pernem, Goa
17-02-2020	Taxonomy on finfishes	Students	Carmel College, Margao, Goa
Trivesh Mayekar			
09-11-2020	Aquarium fish keeping: turning hobby into a professional career	BSc. students and faculty	Govt. College of Arts, Science, and Commerce, Sanquelim-Goa
27/01/2020	Molecular Taxonomy and its applications in fishes	BSc. students and faculty	GP College of Education, Harmal, Pernem, Goa
Shripad Bhat			
09-11-2020	Recent initiatives of Supply and Value Chain Management in Agriculture and Allied Sectors	Officers	Virtual platform by Directorate of Extension, UAS, Raichur
Maneesha SR			
15-02-2020	Home grown herbs for healing	Participants	Sanskruti Bhawan, Panjim, Goa.
07-03-2020	Agro Tourism	Farmers	KVK, North Goa
10-03-2020	ICTs in Turmeric production	Trainees	ICAR-CCARI, Old Goa
19-03-2020	Pineapple as intercropping in coconut	Farmers	KVK, North Goa
9-03-2020	Important medicinal plants in nutrition garden and its cultivation practices	Farmers	KVK, North Goa
Sujeet Desai			
05-03-2020	Soil Moisture conservation techniques and appropriate irrigation in coconut	Farmers	KVK, North Goa
09-03-2020	Resource conservation technology-micro-irrigation, mulching, water harvesting and development of watershed	Farmers	KVK, North Goa
Bappa Das			
27-11-2020	Use of Artificial Neural Network in yield forecasting	Trainees	Virtual mode, IMD, New Delhi
Nibedita Nayak			
20-02-2020	Community hatchery establishment and rural poultry farming	Trainees	KVK, North Goa, Old Goa
Amiya Ranjan Sahu			
28-02-2020	Improved breeding techniques in animals	Farmers	KVK, North Goa
Trivesh Mayekar			
13-02-2020 to 15-02-2020	Organized a scientific exhibition stall for the institute in the second AQUAGOA mega fish festival-2020 organized by Directorate of Fisheries, Govt. of Goa	Fish farmers	Aqua Goa Fish Festival

Human Resource Development

Training and Capacity Development

Date	Name	Programme	Venue
29-07-2020 to 01-08-2020	**Maneesha SR**	Training programme on "Good Agricultural and Collection Practices for Medicinal Plants	Virtual platform by ICAR-DMAPR, Anand,
18-08-2020 to 02-09-2020	**Maneesha SR**	ABC of Scientific writing	Virtual platform by KVK, ICAR-NRRI, Cuttack
12-09-2020 to 28-09-2020	**Gokuldas PP** **Shripad Bhat**	Workshop-cum-Training on IPR in Agricultural Research and Education in India	Virtual platform by IP&TM Unit, ICAR, New Delhi
12-10-2020 to 17-10-2020	**GR Mahajan**	An 'e-MDP on PME in Agricultural Research Projects'	Virtual platform by ICAR-NAARM, Hyderabad
21-10-2020 to 30-10-2020	**Paramesha V**	Training on climate risk assessment and its management through agrometeorological approaches	Virtual platform by Dryland Agriculture Research Station, Rangreth SKUAST, Kashmir
22-10-2020	**Shripad Bhat**	Training program on effective health management for enhancing work efficiency of ICAR employees	Virtual platform by ICAR-IIHR, Bengaluru
09-11-2020 to 17-11-2020	**Amiya Ranjan Sahu**	Training Programme on analysis of experimental data using SAS	Virtual platform by ICAR-NAARM, Hyderabad
17-11-2020 to 21-11-2020	**Mathala Juliet Gupta**	Master trainers training program on Fruits and vegetable processing under PM-FME scheme	Virtual Platform by IIFPT, MOFPI, Tanjavur, TN
28-11-2020	**Shripad Bhat**	National Workshop on "Intellectual Property Management in Agriculture"	Organized by ICAR-IIAB, Ranchi
14-12-2020 to 18-12-2020	**V Arunachalam**	Training on big data, machine learning, and deep learning the paradigm shift	Virtual platform by SRM Institute of Science and Technology, Vadapalani
16-12-2020	**R Ramesh**	Training course in cybersecurity	Virtual platform by Ministry of Electronics and Information Technology (MeitY), Government of India

Participation in Conference / Seminar/ Symposia/ Workshops/Meetings

Date	Name	Programme	Venue
07-01-2020 to 09-01-2020	**MJ Gupta**	International symposium on artificial intelligence-based future technologies in agriculture	Hyatt Regency, Pune
16-01-2020 to 20-01-2020	**R Ramesh**	7th International conference on phytopathology in achieving sustainable development goals	ICAR-IARI, New Delhi
11-02-2020 to 14-02-2020	**Sreekanth GB**	International conference on impact of climate change on hydrological cycle, ecosystem, fisheries, and food security	Kochi, Kerala
22-02-2020 to 25-02-2020	**Maneesha SR**	International conference on banana- 2020: innovations in sustainable production and value chain management in banana.	Tiruchirappalli, Tamil Nadu
28-02-2020	**Susitha Rajkumar**	World Veterinary Poultry Association (WVPA) (India) Conference -2020	ICAR-NIANP, Bengaluru
28-02-2020	**Sujeet Desai**	National Seminar on Landslide Mitigation and Slope Management	ICAR-IISWC, RC, Udhagamandalam
04-03-2020	**Sreekanth GB**	Workshop on "Integrating Technology for Biodiversity Conservation"	Hotel Crown, Altinho, Panaji
19-05-2020	**R Ramesh**	Review meeting with DDG (NRM) on Scientific achievements and way forward of ICAR-CCARI	Virtual platform by ICAR, New Delhi
15-06-2020 to 19-06-2020	**Sreekanth GB**	Webinar on "COVID-19 and FISHERIES: Potential impacts, mitigation, and management."	College of Fisheries (CAU), Tripura
01-07-2020 to 02-07-2020	**R Ramesh**	AMAAS Review Workshop 2020	Virtual platform by ICAR, New Delhi
06-07-2020	**Gokuldas PP**	International Webinar on Human-Animal-Environment Interface: recent approaches for containing the global zoonotic burden	Virtual platform by KVASU, Kerala
06-07-2020	**Shivasharanappa N**	Using genomics to study antibiotic resistance; a one health approach	Virtual platform by ICAR-NRC on Meat, Hyderabad
10-07-2020	**R Ramesh**	AMAAS new project review meeting	Virtual platform by ICAR, New Delhi
15-07-2020	**R Ramesh**	Webinar on Sensitization on uploading data in KRISHI Repositories	Virtual platform by ICAR, New Delhi
21-07-2020 to 22-07-2020	**Gokuldas PP**	National Webinar Training on 'Application of Flow Cytometry in Semen Analysis'	Virtual platform by SRS, ICAR-NDRI, Bengaluru
02-07-2020	**R Ramesh**	Video Lecture on NABL Accreditation of ICAR Laboratories by IP&TM Unit, ICAR Hqrs	Virtual platform by ICAR, New Delhi

22-07-2020 to 24-07-2020	**Paramesh V** **Sujeet Desai**	International Webinar on Achieving Land Degradation Neutrality	Virtual platform by ICAR-IISWC Dehradun
25-07-2020	**Maneesha SR**	Webinar on 'Precision farming in banana.'	Virtual platform by ICAR-NRC Banana, Thiruchirapalii
28-07-2020	**R Ramesh**	Recent trends in developing molecular diagnostics of virus and virus-like pathogens of citrus	Virtual platform by Indian Phytopathological Society, New Delhi
28-07-2020 to 30-07-2020	**Amiya Ranjan Sahu** **Nibedita Nayak**	International Webinar on Role of Poultry Sector in Boosting the Post COVID Indian Economy	Virtual platform by College of Avian Sciences and Management, KVASU, Thiruvazhamkunnu
29-07-2020	**Amiya Ranjan Sahu**	National Webinar on Modern genetic approaches for improvement of indigenous cattle organized	Virtual platform by Department of Animal Genetics and Breeding, C.V.Sc. & A.H., Mathura
29-07-2020	**R Ramesh**	Webinar on integrated disease management in banana	Virtual platform by NRCB, Trichy
04-08-2020	**R Ramesh**	Webinar on Integrated Insect Pests and Nematodes Management in Banana	Virtual platform by NRCB, Trichy
05-08-2020 to 06-08-2020	**Maruthadurai R**	International Web Conference on Ensuring Food Safety, Security and Sustainability through Crop Protection	Virtual platform by Bihar Agricultural University, Sabour, Bhagalpur, Bihar.
07-08-2020	**R Ramesh**	Webinar on Phytophthora: A major threat to horticultural industry and webinar on Current scenario of bio-pesticides in India, regulatory requirements and commercialization	Virtual platform by Indian Phytopathological Society, New Delhi
07-08-2020	**V Arunachalam**	Webinar on Planting Material in Banana: Present and Next Generation technologies	Virtual platform by ICAR-National Research Centre on Banana, Tiruchirapalli
08-08-2020	**Shripad Bhat**	Webinar on Export Challenges and Mitigation Strategies for Fresh and Processed F&V in COVID-19 Times	Virtual platform by Department of Agriculture and Environmental Sciences, NIFTEM, Sonipat
10-08-2020	**Maneesha SR** **Paramesh V**	National webinar on Under-utilized Crops for Augmenting Farmers' Income in Abiotic Stress Region	Virtual platform by ICAR-NIASM, Baramati, and SARAS
10-08-2020 to 13-08-2020	**V Arunachalam**	XXIX annual group meeting of palms	Virtual platform by ICAR-CPCRI Kasaragod
12-08-2020 to 13-08-2020	**R Ramesh**	Webinar on Bioinformatic Analysis on Soil Microbial Community Sequence Data	Virtual platform by ICAR-IARI, New Delhi
17-08-2020	**Sreekanth GB**	Webinar on Fish and Fisheries in Goa	Virtual platform by Govt. College of Arts, Science, and Commerce, Sanquelim-Goa

19-08-2020	**R Ramesh**	Webinar on spicing up science	Virtual platform by ICAR- IISR, Calicut
21-08-2020	**V Arunachalam**	Approaches and Strategies for Augmenting Export of Bananas from India	Virtual platform by ICAR- National Research Centre on Banana, Tiruchirapalli
22-08-2020	**GR Mahajan**	Workshop on 'Towards self-reliance coastal agriculture: Challenges and way forward.'	Virtual platform by ICAR-CSSRI, Canning Town, West Bengal
27-08-2020	**GR Mahajan** **Paramesh V** **Shripad Bhat**	Webinar on Abiotic Stress in Agriculture: Geospatial Characterization and Management Options	Virtual platform by ICAR-National Institute of Abiotic Stress Management, Baramati
01-09-2020 to 05-09-2020	**Gokuldas PP**	Management Development Programme on Intellectual Property Valuation and Technology Management	Virtual platform by ICAR-NAARM, Hyderabad
08-09-2020	**R Ramesh** **Maruthadurai R**	International Webinar on Red Palm Weevil	Virtual platform by Don Bosco College of Agriculture, Sulcorna, Quepem, Goa,
09-09-2020	**GR Mahajan**	Webinar on Drone Remote Sensing in Agriculture	Virtual platform by ICAR-Indian Agricultural Research Institute, New Delhi
11-09-2020	**GR Mahajan**	Webinar on Soil survey and land use planning for realizing sustainable development goals of the United Nations	Virtual platform by Indian Society of Soil Survey and Land Use Planning, Nagpur, Maharashtra
12-09-2020	**Shripad Bhat**	Webinar series on Intellectual Property Rights in Agricultural Research & Education in India	Virtual platform by ICAR, New Delhi
17-09-2020	**Shripad Bhat**	Orientation Workshop for Nodal Officers	Virtual platform by CII
28-09-2020	**Shivasharanappa N**	One health approach for prevention and control of Emerging zoonoses and Rabies in India	Virtual platform by RAJUVAS, Jaipur
23-09-2020	**R Ramesh**	Workshop for discussing issues involved in the commercialization of microbe based technologies	Virtual platform by NBAIM, MAU, UP.
25-09-2020 to 27-09-2020	**R Ramesh**	38th Annual Group Meeting of AICRP on vegetable crops	Virtual platform by AICRP on vegetable crops
26-09-2020 to 27-09-2020	**Amiya Ranjan Sahu**	National Webinar on Concepts of Statistical Methodologies in Animal Sciences	Virtual platform by LCVSc, AAU, Joyhing, Assam
01-10-2020	**GR Mahajan**	Webinar on Soil Spectroscopy: An Emerging for a Rapid Soil Health Assessment	Virtual platform by ICAR-Indian Institute of Soil Science, Bhopal

14-10-2020	**Paramesh V**	National Webinar on Nanotechnological Interventions in Agriculture	Virtual platform by Sri Karan Narendra Agriculture University, Jobner
20-10-2020	**Shripad Bhat**	Webinar on Innovation Excellence Indicators for Public Funded R&D Organizations	Virtual platform by CII
01-10-2020 to 23-10-2020	**Shivasharanappa N**	National webinar series om ON Agricultural production and entrepreneurship development in the Andaman Islands in COVID Scenario through technological interventions	Virtual platform by ICAR-CIARI, Port Blair,
06-10-2020	**R Ramesh**	Meeting on Biopesticides - Registration and Quality Control: Issues - Way Forward	Virtual platform by NBAIR, Bengaluru
13-10-2020	**Sreekanth GB**	Webinar on the invasive Mussel, *Mytella strigata*: Impacts on fisheries and farming	Virtual platform by ICAR-CMFRI, Kochi, Kerala
19-10-2020 to 21-10-2020	**Shivasharanappa N**	VAIBHAV Summit	Virtual platform by ICAR-Indian Veterinary Research Institute, Izatnagar
20-10-2020	**Sreekanth GB**	Australian Society of Fisheries Biology 2020 Annual General Meeting and Award ceremony (online)	Virtual platform by Australian Society of Fisheries Biology
20-10-2020	**Shivasharanappa N**	Multi-stakeholder National Workshop for Peste des Petits Ruminants (PPR) Control and Eradication from India	Virtual platform by Dept of Animal Husbandry and Dairy, Govt of India
28-10-2020	**R Ramesh**	APAARI-ICAR Expert Consultation meet on AIMs	Virtual platform by APAARI and NBAIM
29-10-2020	**R Ramesh**	International webinar on protecting plant health in a changing world	Virtual platform by NIPHM, Hyderabad
31-10-2020	**GR Mahajan**	National webinar on quality improvement and proficiency testing of soil laboratories in India	Virtual platform by ICAR - Indian Institute of Soil Science, Bhopal,
03-11-2020	**GR Mahajan**	International salinity webinar on resilient agriculture in saline environments under changing climate	Virtual platform by ICAR - Central Soil Salinity Research Institute, Karnal, Haryana
03-11-2020	**Susitha Rajkumar** **Amiya Ranjan Sahu** **Nibedita Nayak**	National webinar on climate resilient livestock production: opportunities and threats	Virtual platform by ICAR-National Institute of Abiotic Stress Management, Baramati
03-11-2020	**Trivesh Mayekar**	Webinar on Climate Resilient Livestock Production: Opportunities and Threats	Virtual platform by NIASM
06-11-2020	**Trivesh Mayekar**	Webinar on Biofloc based Aquaculture: A way forward"	Virtual platform by CIBA, Chennai

09-11-2020	**Sreekanth GB**	Webinar on aquarium fish keeping: turning a hobby into a professional career	Govt. College of Arts, Science, and Commerce, Sanquelim-Goa
09-11-2020	**Trivesh Mayekar**	Webinar on aquarium fish keeping: turning a hobby into a professional career	Govt. College of Arts, Science, and Commerce, Sanquelim-Goa
10-11-2020 to 12-11-2020	**Susitha Rajkumar**	28th Annual Review Meeting of AICRP-ADMAS	Virtual platform by ICAR-NIVEDI, Bengaluru
11-11-2020 to 12-11-2020	**Trivesh Mayekar**	Webinar on Ai and IoT for smart aquaculture	Virtual platform by CIFE, Mumbai
13-11-2020	**Susitha Rajkumar**	National Webinar on Awareness to Mitigate outbreaks of Lumpy Skin Disease	Virtual platform by Veterinary College, KVAFSU, Bidar
17-11-2020 to 23-11-2020	**Gokuldas PP**	National webinar series on controlled breeding programmes in livestock species	Virtual platform by ICAR-CIARI, Port Blair
23-11-2020 to 24-11-2020	**Shripad Bhat**	Workshop and Annual Review Meeting of ZTMCs/ ITMUs/ABIs under ICAR institutes of NRM, Agril Engg., and Agril. Education Divisions	Virtual platform by ICAR, New Delhi
24 -11-2020	**Trivesh Mayekar**	Webinar on Dissolved oxygen monitoring: the key to healthy aquaculture system	Virtual platform by In-Situ, Delhi
26-11-2020	**GR Mahajan**	Online brainstorming session on frontier research in soil science	Virtual platform by Dr. BSKKV Dapoli,
28-11-2020	**Shripad Bhat**	National workshop on intellectual property management in agriculture	ICAR-IIAB, Ranchi, Jharkhand
06-12-2020 to 07-12-2020	**Bappa Das**	International Plant Physiology Virtual Conference-2020	Virtual platform by Sher-e-Kashmir University of Agricultural Sciences & Technology, Jammu & Indian Society for Plant Physiology (ISPP), New Delhi.
10-12-2020 to 11-12-2020	**Maruthadurai R**	International virtual conference on biodiversity and ecosystem services in a climate change perspective	Virtual platform by Centre for Climate Change Environment Management, Policy Research Institute, Bengaluru.
18-12-2020	**Trivesh Mayekar**	Webinar on Entrepreneurship opportunities in Prawn/Shrimp aquaculture in India	Virtual platform by NIVEDI, Bangalore
30-12-2020	**Trivesh Mayekar**	Webinar on Alternatives to Plastics for Sustainable Soil and Environmental Health	Virtual platform by IISS, Bhopal

TRANSFER OF TECHNOLOGY

- ICAR-Krishi Vigyan Kendra, North Goa
- Technology Dissemination

Survey of marine cage culture

Awareness of creation about endangared fish species to stakeholders

ICAR-Krishi Vigyan Kendra, North Goa

With the mandate of Technology assessment, refinement, demonstration and capacity building, Krishi Vigyan Kendra was established at the Institute in 1983. The major extension activities carried out are given below.

Trainings

Training programmes were conducted to impart knowledge on advanced technologies to farmers at different farmers' fields and were focused on skill development. During 2020 111 training programmes were conducted by the KVK involving 1626 participants. The major training programmes were, production and management technology (Black pepper), nutrient use efficiency, soil and water testing, dairy, poultry and goat management, design and development of low/minimum cost diet, value addition, women empowerment, integrated pest management and integrated disease management.

Participation of KVK in different forums

Different kinds of extension activities like advisory services, diagnostic visits, field day, exhibition, plant/animal health camps, method demonstrations, farmers visit KVK, the celebration of important days – *Vanmohatsav, Swachta pakhwada,* Soil health day, exposure visits, honey bee day, farmers group meeting etc. were undertaken.

Details of on-farm trials and FLD conducted by KVK, North goa

No.	Programmes	Particulars
A.	**On-Farm Trials (OFT)**	**No. of Trials**
1.	Evaluation of value-added products using *Moringa oleifera*	10
2.	Assessment of ready to cook tender/mature jackfruit	05
3.	Assessment of High yielding finger millet varieties	5
4.	Assessment of tomato varieties in the agro-climatic situation of Goa	5
5.	Assessment of improved poultry varieties	5
6.	Assessment of Salt tolerant varieties of paddy	4
7.	Assessment of yield potential of Red Amaranthus varieties	5
8.	Assessment of the application of Jivamrut in chilli	5
B.	**Front Line Demonstrations (FLD)**	**No. of Demonstrations**
1.	Popularization of High yielding salt-tolerant rice variety – Goa Dhan -1	08
2.	Popularization of Sweet corn var. COB-1	10
3.	Popularization of cowpea var. Goa Cowpea-03	10
4.	Management of Stem & Root Borer	10
5.	Popularization of High yielding multiple cashew varieties – Goa Cashew 1, Goa Cashew 2, Goa Cashew 3, Goa Cashew 4	01
6.	Popularization of high yielding variety - Arka Manik	10
7.	Popularization of high yielding variety – CO-5	10
8.	Evaluation of Breeds	05
9.	Evaluation of Breeds	06
10.	Animal Nutrition Management	20
11.	Disease Management	20
12.	Jackfruit Chips making machine	2
13.	Nutrition garden with HYV and Hybrid varieties	4

Tree plantation at Nashtra Garden by Dr. K. K. Krishnakumar, Ex DDG (Hort)

Celebration of Poshan Maah

Technology Dissemination

Demonstrations and Front-Line Demonstrations

Establishment of water harvesting ponds through farmers participatory approach

Water harvesting ponds were established at three different locations at farmers' fields in Bhupar and Badsare villages of Canacona taluka under STC activities of the Institute. A perennial source of spring water was available at all three locations. On suitable sites, ponds were excavated, layered withfine soil and paddy straw (cushioning material) on the sides and bottom and lined with 300 GSM Silapulin polyfilm to prevent the percolation of water. All the activities were carried out through the farmers' participatory approach. The water harvesting ponds' capacity was 4 lakh litres, 2 lakh litres, and 45,000 litres at Bhupar, Badsare (lowland) and Badsare (upland) villages. The ponds serve the dual purpose of collecting rainwater in the monsoon season and storing water diverted from natural spring during the dry season. The ponds are located at a higher elevation of 500 m and 550 m above MSL. Thus, the land's natural slope was utilized by connecting the gravity-based drip irrigation system for irrigating the area below these ponds. Thus, the entire system reduces the cost involved in establishing water harvesting ponds and irrigation systems.

Constructions of water harvesting ponds with the help of farmers

Front Line Demonstration on salt-tolerant rice varieties, namely, Goa Dhan 3 & Goa Dhan 4

Front Line Demonstrations on new high-yielding salinity tolerant paddy varieties Goa Dhan 3 and Goa Dhan 4 were taken up in farmers' fields in the low-lying salt-affected coastal saline soils. About 22 FLDs were conducted covering 14 ha areas both in North Goa and South Goa districts. The new salt-tolerant rice varieties recorded a more than 3.0 t/ha grain yieldthan the local variety with 1.8 t/ha.

Further, breeder seed production of these two rice varieties was taken up in Institute farms and State govt farms for meeting the demands during *kharif* 2021.

Breeder seed production in the state department of agriculture run farms KVK, South Goa and Ella farm North Goa

Front Line Demonstration (FLD) on upland rice variety Sahbhagi Dhan

Two villages *viz*., Gaodongrim and Cotigao in the Canacona block of the South Goa district were selected for FLD on upland cultivation of SahbhagiDhan, a drought-tolerant variety developed at ICAR-NRRI-CRURRS, Hazaribag in collaboration with IRRI Philippines. Altogether 42 FLDs were conducted covering 28 ha area. The components of FLD were quality seeds, proper tillage operation, seed treatment, balanced dose of fertilizer application, weed management, and improved plant protection measures. The yield data, collected in both demonstration (improved technology) and farmers' practice by random crop cutting method, indicated that SahbhagiDhan recorded grain yield ranging from 44.0 to 49.42 q/ha against the farmers' practice ranging from 34.12 to 39.45 q/ha. Overall, SahbhagiDhan recorded 29.62% more grain yield compared to the farmers' practice. The net returns of Rs. 68620 per hectare was recorded in improved technology compared to the farmers' method, which generated Rs. 47580 with a Benefit-Cost ratio of 2.75 for SahbhagiDhan and 1.90 for farmers' practice. The variety SahbhagiDhan,popularly called '*Dhove* Jyothi' (*Dhove* meaning white in Konkani),has covered more than 450 ha in the last five years and is the recommended variety for cultivation in the upland areas of Goa state.

Field view of FLDs on SahbhagiDhan rice variety at Gaondongrim and Cotigao villages of Canacona block of South Goa district.

Front line demonstrations on integrated pest and disease management technologies in Chilli

Front line demonstrations on chilli integrated pest and disease management technologies was undertaken at six taluks *viz*., Canacona, Sanguem, Quepeum, Tiswadi, Bicholim and Mapusa. A total of 10 front line demonstrations on chilli were undertaken on the above places. Plant protection inputs like Goa Bio 1, Goa Bio II, spinosad, chitosan and sticky traps were distributed to 210 farmers. Hands on training was provided to the farmers on nursery drenching of biocontrol agents, main field application, installment of sticky traps and its preparation, and spraying of bio-pesticides. Percent disease index was less in demonstration plots compared to control. Relatively less incidences of whiteflies, aphids and diseases were recorded in IPDM demonstration plots compared to control. Higher chilli yield was recorded in plots received integrated pest and disease management technologies.

Chilli IPDM demonstration plot

Artificial Insemination in Farmers field

Trial 1: Farmer field at Ponda Taluk, Keri village: Seven primiparous goats were selected for the study. Oestrus synchronization using PGF2α analogue (Dinoprost @ 5mg/ml) and AI was carried out with diluted semen in egg yolk citrate extender, and pregnancy results were negative.

Trial 2: Karmali, Old Goa: a total of 10 goats were synchronized with PGF2α analogue (Dinoprost @ 5mg/ml), and AI was carried out using Konkan kanyal semen, and two goats were found positive for pregnancy with a conception rate of 20% (2/10) and single kids were born.

Trial 3: Mapusa, Alteno, North Goa: A total of 22 goats of the one-year age group were given PGF2α analogue (Dinoprost @ 5mg/ml) @ 2ml/animal intramuscular route and observed for oestrus signs on the 5th day. AI was carried out using Konkan kanyal semen diluted in NBSE (Natural boar semen extender) developed by ICAR-CCARI, Old Goa. Out of 22, 5 goats were found positive for pregnancy (5/22) with a conception rate of 22.72%.

Trial 4: Nileli, Sawantwadi, Konkan kanyal breeding farm: A total goats 180 goats, among which 40 goats were selected of 13-14 month age group. Oestrus synchronization was carried out in 40 goats using PGF2α analogue (Dinoprost @ 5mg/ml) @ 2ml/animal intramuscular route and observed oestrus signs till 5th day. On the 11th day,the second dose of PGF2alfa was given. However, animals did not exhibit any oestrus signs.

Goat kids borne with AI in Konkan kanyal goat unit at Institute and at farmer field

Training

Training programmes on brinjal grafting and use of bio-agents

Two one-day training programmes on "Brinjal grafting, use of bio-agents viz. Goa Bio-1 and Goa Bio-2 for vegetable disease management and other aspects of pest and disease management in vegetable crops" were conducted for the farmers on January 4, 2020, at Menkurem, Goa and on January 14, 2020, at Guirim-Parra, Goa

Training Programme on Turmeric Production, Processing and Marketing

A training programme on 'Turmeric Production, Processing and Marketing' was organized during 9-13 March 2020, exclusively for 15 farmers representing the Panchkula and Ambal districts of Haryana State, sponsored by the Haryana State Horticulture Department. Dr EB Chakurkar, Director, ICAR-CCARI, inaugurated the programme. Dr Jitendra Singh, Training Organizer, HTI, Uchani, Haryana, was also present. The training was comprised of theoretical presentations followed by practical demonstrations. Shri Vinod Todkar, a progressive turmeric farmer from Sangli, Maharashtra, was felicitated in the function. He shared his practical experience about commercial turmeric cultivation, organic production and marketing to motivate the trainees.

Online Vocational training on "Scientific management of goats."

A three-days online vocational training programme was conducted on "Scientific management of goats" during 19-21 October 2020. Dr EB Chakurkar, Director (A), ICAR – CCARI, Goa, spoke on the breeding management of goats and the importance of artificial insemination in goats and advised farmers to start value addition goat meat and milk for profitable goat farming. In the programme. A total of 32 participants from different parts of Goa attended the training.

Training Program on Nutrition Garden

A state-level two-days training program was organized on Nutrition Garden for Officers of Directorate of Women and Child Development, Govt. of Goa during 9-10 November 2020. Mrs. Deepali Naik, Director, Directorate of Women and Child Development, Govt. of Goa, was Chief Guest. Her remarks emphasized the need to establish Nutrition Garden at Anganwadi centres and informed that 180 Anganwadi centres will be provided with the Nutrition Unit. Dr EB Chakurkar, Director, ICAR – CCARI, Old Goa, mentioned a multi-ministerial convergence mission with a vision to address malnutrition in a targeted approach by 2022.Institute will provide all the technical know-how as and when required by the department. A field visit was arranged for the participants to Model Nutrition Garden at KVK Campus.

Scheduled Tribe Component (STC) and Schedule Caste Sub Plan (SCSP)

Training and agricultural inputs distribution under STC scheme to the integrated farming systems farmers of Goa

On June 26 2020, a training and agricultural inputs distribution programme for the beneficiary farmers of Priol, Ponda, Goa was organized. The fertilizer was distributed to the paddy, coconut, cashew growers, and dairy farmers of Priol and Veling villages of Goa. Dr Paramesha, V Scientist Agronomy, highlighted the importance of the integrated farming systems in Goa for sustainability and livelihood security of the small and marginal farmers. Dr. Monica Singh, SMS, KVK-ICAR North Goa, explained the importance of the integrated nutrient management approach using a balanced dose of fertilizers and organics to improve soil health and productivity.

Distribution-cum-awareness programme on nutrient and water management in coconut for tribal farmers of Canacona taluka

A distribution-cum-awareness program on nutrient and water management in coconut was organized for tribal farmers of the village-Bhupar and Badsare of Canacona taluka of South Goa on 3rdSeptember 2020. Three selected beneficiary farmers' groups, 1 from Bhupar and 2 from Badsare attended the programme. The farmers received soil health cards and organic and inorganic fertilizer inputs based on soil testing for the nutrient management related interventions. While the water management interventions included rainwater harvesting ponds, the gravity-based drip and fertigation system, and all associated accessories. The beneficiary farmers also received face masks and Institute made hand sanitizer (prepared as per WHO guidelines) as a preventive measure against Covid-19.

Distribution of improved variety of poultry germplasm and feed supplements to tribal farmers of Goa

A distribution programme was organized for 14 tribal farmers of Canacona, Salcette and Tiswadi talukas of Goa on 10th September2020. Various inputs like *Vanaraja* and *Grampriya* birds, feed supplements and litter material were distributed through STC funds. These interventions will add supplementary income to the farm family and improve the livelihood and nutritional security. Besides this, face masks and hand sanitizers were distributed to all the beneficiaries.

Field training and farm inputs distribution programme

A field training and farm inputs distribution programme was organized in Veling, Mardol, North Goa, on 30th September 2020. Shri Durgadas L. Gaude, Chairman, Goa State ST F&D corporation, was the Chief Guest of the programme. About fifteen farmers and youths actively participated in the training programme. Dr. Gokuldas PP, Scientist and Dr. Sanjay K Udharwar, SMS, KVK North Goa, acted as programme coordinators. During the event, participants were imparted technical knowledge on overall aspects of scientific dairy farming, including housing, feeding, reproductive and health management. Various farm supplies, veterinary preparations and feed supplements were also distributed during the programme.

Distribution of konkan Kanyal goats

Konkan Kanyal goats were distributed under SCSP and STC programs to farmers in Sawantwadi districts of Maharashtra and South Goa districts.

Distribution of Improved inputs for Post-harvest Management of Paddy

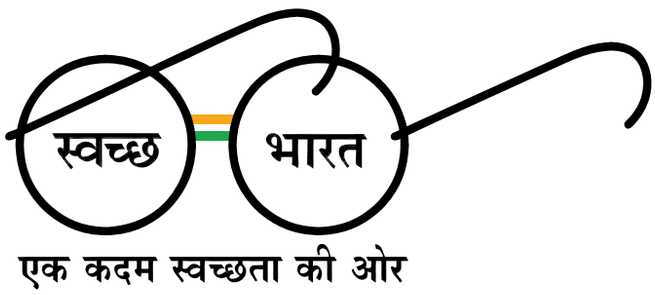
A distribution programme was organised on 17th November, 2020under STC and SCSP programme of the Institute.Inputs likemini parboiling unit (SS) and hermetic paddy storage bags were distributed to selected beneficiaries under the august presence of Smt. Usha Ramesh, GM & Officer I/c, NABARD, and Director(A), Dr EB Chakurkar. The programwas attended by 19 farmers from South and North Goa and Kudal of Maharashtra. Atraining manual on good postharvest management practices for field crops of west coastal ecosystem, four bilingual (English & Konkani) fliers on parboiling technology and modified Pusa bin for high rainfall regions (under NABARD FSDD funded project, "Popularising good post-harvest management for field crops of Goa"were released. Dr MJGupta co-ordinated the programme.

GLIMPSES OF INSTITUTE

- Swachh Bharat Abhiyan
- संस्थान के राजभाषा प्रकोष्ठ की गतिविधियां
- Implementation of PWD Act for the Persons with Disabilities
- Events
- Distinguished Visitors
- Committees and Meetings
- Personnel
- Budget

Intergrated cropping system in lowland IFS

Swachh Bharat Abhiyan



Under *Swachh Bharat Abhiyan*, Govt. of India, the Institute organized a series of events to emphasize the importance of cleanliness. Scientists, administrative, technical, supporting, SRF, RA, contractual staff of the Institute and Krishi Vigyan Kendra actively organized the cleanliness drives. The following events were organized as part of *Swachha Bharat Abhiyan*

Swachhta Pakhwada 16th -31st December, 2020

Date	Activities as per the theme
16-12-2020	Display of banner at prominent places Taking *Swachhta* pledge Stocktaking & briefing of the activities to be organized during the *Pakhwada* Plantation of trees
17-12-2020	Weeding out of old records
18-12-2020	Awareness programme on avoiding single-use plastic at Government Primary School, Nagargaon, adopted village
	Awareness programme on vermicompost production at adopted village
19-12-2020	Sanitation and SWM Cleanliness and sanitation drive within campuses and surroundings, including residential colonies and common market places. Stock taking of biodegradable and non-biodegradable waste disposal status and providing on the spot solutions.
20-12-2020	Stocktaking of waste management & other activities including utilization of organic wastes/ generation of wealth from waste, polythene free status, composting of kitchen and home waste materials. Promoting clean & green technologies and organic farming practices in kitchen gardens of residential colonies/one nearby village and providing on the spot technology solution.
21-12-2020	Awareness on recycling of wastewater, water harvesting for agriculture/horticulture application/kitchen gardens in residential colonies/1-2 nearby villages.
22-12-2020	Organizing workshops, exhibitions, technology demonstrations on agricultural technologies for conversion of waste to wealth, safe disposal of all kinds of wastes.
23-12-2020	Celebration of Kisan Divas - Farmers Day and felicitation of progressive farmers
24-12-2020	*Swachhta* awareness at local level (organizing Sanitation Campaigns involving and with the help of the farmers, farm women and village youth in new villages not adopted by any Institutes/Establishments.
25-12-2020	Cleaning of public places, community market places and/or nearby tourist spots.
26-12-2020	Fostering healthy competition: Organizing drawing competitions for school children.
27-12-2020	Awareness on waste management and other activities including utilization of organic waste/generation of wealth from waste, polythene free status, composting of kitchen and home waste materials, promoting clean and green technologies and organic farming practices in a new area.

28-12-2020	Campaign on cleaning of sewerage and water lines, awareness on recycling of wastewater, water harvesting for agriculture/horticulture application/kitchen gardens in residential colonies/outside campus, nearby villages with the involvement of local/village communities.
29-12-2020	Visits of community waste disposal sites/compost pits, cleaning and creating awareness on treatment & safe disposal of bio-degradable/non-biodegradable wastes by involving civil/farming community.
30-12-2020	Involvement of VIP/VVIPs in the Swachhta activities, Involvement of print and electronic media may be ensured so that adequate publicity is given to the Swachhta Pakhwada.
31-12-2020	Highlighting the activities of Swachh Bharat Pakhwada by involving all stakeholders, including farmers

Swatchta pledge

Tree planting campaign

Demonstration of clean milk production

Cleanliness drive and awareness program

Demonstration on waste to wealth

Cleanliness drive in KVL campus

संस्थान के राजभाषा प्रकोष्ठ की गतिविधियां

संस्थान में राजभाषा के, प्रचार - प्रसार तथा भारत सरकार की राजभाषा नीतियों का अनुकरण व प्रसार हेतु राजभाषा प्रकोष्ठ की स्थापना की गयी है। हिन्दी के प्रयोग तथा प्रधानता के आधार पर राजभाषा विभाग, भारत सरकार द्वारा विभक्त किए गए तीन भौगोलीक क्षेत्रों में से संस्थान 'ग' क्षेत्र में स्थित है तथा इसे राजभाषा अधिनियम की धारा 10 (4) के अंतर्गत केन्द्रीय गज़ट में अधिसूचित किया जा चुका है।

राजभाषा अधिनियम व राजभाषा नियम के अनुसार संस्थान में राजभाषा-संबंधी कार्यों की समीक्षा तथा राजभाषा के प्रयोग को गति प्रदान करने हेतु संस्थान के निदेशक की अध्यक्षतामें राजभाषा कार्यान्वयन समिति गठित की गयी है। इसमे विभिन्न अनुभागों के वैज्ञानिकों, तकनीकी कर्मचारियों तथा प्रशासनिक कर्मचारियों को शामिल किया गया है। राजभाषा कार्यान्वयन समिति की त्रैमासिक बैठक आहूत की जाती है, जिसमे राजभाषा संबंधी कार्य -कलापों की समीक्षा की जाती है तथा राजभाषा कार्यान्वयन में आने वाली बाधाएँ एवं उनके निदान के उपायों पर चर्चा की जाती है। राजभाषा कार्यान्वयन समिति राजभाषा विभाग, भारत सरकार के वार्षिक कार्यक्रम में निर्धारित लक्ष्यों की प्राप्ति हेतु समुचित प्रयास सुनिश्चित करती है तथा समय -समय पर किए गए प्रयासों की समीक्षा भी करती है।

हिन्दी पखवाड़ा

भाकृअनुप- केन्द्रीय तटीय कृषि अनुसंधान संस्थान, एला, ओल्ड गोवा में सितम्बर 14-28, 2020 के दौरान हिन्दी पखवाड़े का आयोजन सुनिष्टित रूप से ऑनलाइन मोड में किया गया। सितम्बर 14, 2020 को पखवाड़े का उद्घाटन करते हुए निदेशक डॉ ई भा चाकुरकर ने सभी कार्मिकों को पखवाड़े के दौरान आयोजित होने वाले विभिन्न कार्यक्रमों में प्रतिभाग के लिए प्रेरित किया । श्रीमति मदीना सोलापूरी, प्रभारी राजभाषा ने हिन्दी पखवाड़े के दौरान आयोजित होने वाले विभिन्न कार्यक्रमों की रूपरेखा के बारे में सभी कर्मियों को अवगत कराया। पखवाड़े में आयोजित किये गए विभिन्न कार्यक्रम निम्नलिखित है:

क्र.	प्रतियोगिता का नाम	दिनांक
1.	सुलेख प्रतियोगिता - सभी कर्मचारियों तथा संविदा कर्मचारियों के लिए।	17.09.2020
2.	हिन्दी टिप्पण एवं प्रारूप लेखन प्रतियोगिता - सभी कर्मचारियों तथा संविदा कर्मचारियों के लिए।	19.09.2020
3.	आशुभाषण प्रतियोगिता - सभी कर्मचारियों तथा संविदा कर्मचारियों के लिए।	22 .09.2020
4.	हिन्दी काव्य पाठ प्रतियोगिता - सभी कर्मचारियों तथा संविदा कर्मचारियों के लिए।	24.09.2020
5.	बच्चों के लिए विभिन्न प्रतियोगिताएँ: चित्रकला एवं प्रतिभा दर्शन	28.09.2020

पखवाड़े के दौरान अनेक प्रतियोगिताओं का आयोजन ऑन-लाइन मोड में किया गया। इस पखवाड़े में आयोजित कार्यक्रम ज़्यादा से ज़्यादा लोगों को सरकारी काम-काज में हिन्दी का अधिक प्रयोग करने के लिए प्रेरित करने वाले थे। संस्थान में कार्यरत कर्मियों तथा संविदा कर्मियों के बच्चों के लिए विभिन्न प्रतियोगिताओं का आयोजन किया गया। कोरोना महामारी से बचाव के लिए सभी निर्देशों का पालन करते हुए हिन्दी पखवाड़ा बहुत उत्साह के साथ मनाया गया।

हिन्दी पखवाड़े का समापन सभी विजयी प्रतियोगियों को पुरस्कार वितरण समारोह के साथ सपंन्न हुआ।

राष्ट्रभाषा के बिना राष्ट्र गूंगा है।

Implementation of PWD Act for the Persons with Disabilities

The following actions have been taken by this Institute for effective implementation of the Persons with Disabilities (Equal Opportunities, Protection of Rights and Full Participation), PWD Act 1995.

- A ramp has been built at entrance of building for accessible approach.
- Reserved parking near the entrance of the Office Building has been made.
- The Pathway to the entrance of the building has been made accessible.
- The Corridors of the building are made accessible.
- Reception has been placed on the ground floor of the building, so as to be accessible.
- Accessible toilets have been constructed on the Ground Floor of the building.
- The Staircases of the building are equipped with handrails.
- Auditory and visual signage.
- Drinking water provision has been made on the ground floor of the Building.
- Tactile path has been installed in the new building (Farmers Exhibition Hall).
- Durable railings along the staircase have been provided.
- Transport Allowance is being paid at double rate than the normal charges.
- Enhanced number of casual leave.
- Income Tax Act, 1961 provides deduction u/s.80 in pursuance of which an individual (Indian citizen and foreign national) who is resident of India, and who suffers from not less than 40 per cent of any disability is eligible for deduction to the extent of Rs. 75,000/- and in case of severe disability to the extent of Rs.100,000/-.
- Age relaxation for Direct Recruitees.
- Exemption of payment of examination and application fees for direct recruitment
- Guidelines are being followed as per the Rules of Govt. of India issued from time to time.

Events

Seminars and workshops organized

National Seminar on Spices: Emerging trends in production, processing and marketing

National Seminar on Spices: Emerging trends in production, processing and marketing was held at ICAR- CCARI, Old Goa, during 21-22 January 2020. Dr. S.D. Sawant, Vice-Chancellor, Dr. BSKKV, Dapoli was the Chief Guest, Dr. J.C. Katyal, Ex DDG (Education), ICAR, New Delhi, was the Guest of Honour. The seminar was graced by Dr. K. Nirmal Babu, Director, ICAR-IISR, Kozhikode, Dr. Gopal Lal, Director, ICAR-NRC for Seed Spices, Ajmer, Shri Madhav Kelkar, Director, Directorate of Agriculture, Government of Goa, Dr. Homey Cheriyan, Director, DASD, Kozhikode and Dr. EB Chakurkar, Director (A), ICAR-CCARI.

Conference on Weed Management for Enhancing Farmers' Income and Food Security

Conference on Weed Management for Enhancing Farmers' Income and Food Security was held at ICAR - Central Coastal Agricultural Research Institute, Goa by ICAR - Directorate of Weed Research (DWR), Jabalpur on 5th February 2020. Adv. Narendra Sawaikar, Commissioner, NRI Affairs, inaugurated the conference along with Dr. P.K. Singh, Director of ICAR-DWR. The valedictory function was graced by Dr. Narendra Pratap Singh, Ex-Director, ICAR-NIASM, Baramati, and Dr. E.B. Chakurkar, Director (A), ICAR-CCARI, Old Goa.

Webinar on Coconut Production and Value Addition

Webinar on coconut production & value addition was organized on 2nd September 2020. Dr. E.B. Chakurkar, Director (A), ICAR–CCARI, Goa, in his inaugural speech, urged the coconut growers to increase the state's coconut area, production, and productivity. Shri E. Aravazhi, Director, Coconut Development Board, Bangalore, explained the Board's schemes. Eighty-one participants were connected in this meet.

Capacity Development Programme for Anganwadi Workers and Farm Women on Poshan

ICAR–KVK, North Goa, ICAR–CCARI, Goa, organized a capacity development programme for Anganwadi Workers and Farm Women on Poshan on 17th September 2020. Smt. Janita Madkaikar, Sarpanch, Old Goa, the Chief Guest of the function and stressed the role of women in agriculture. Smt. Sangeeta Porab, Joint Director, ICDS, Govt. of Goa, was guest of honour and spoke on the role of Anganwadi workers to develop Nutri-Smart Villages. Dr. E. B. Chakurkar, Director (A), ICAR- CCARI, Goa, stressed the importance of dairy products in the human diet. One hundred participants attended the programme.

Days Celebrated

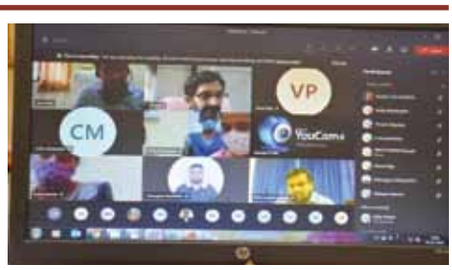
International Women's Day

International Women's Day was celebrated at the Institute on 8th March 2020 by showcasing the achievements of women in the field of agriculture and related areas. A programme in collaboration with Green Growth Institute, Sangolda, Goa, was conducted at this Institute. A total of 130 women participated, including women farmers, scientists, teachers, technical, administrative, supportive and contractual staff. Smt. Jennifer Miranda, Chairperson 'Ami Goenkar', an NGO, gave a talk on women empowerment. The other dignitaries who participated in the programme were Smt Sultana D'Souza, *Mrs. Goa 2019*, Smt. Swati Kerkar, Smt. Avita, Sports Women & Smt. Rahila Khan, HOD, Fashion Design, Government Polytechnic, Panaji.

Vigilance awareness week

The Institute observed the vigilance awareness week from 27th October to 2nd November 2020. The focus of Vigilance Awareness Week, of the year was "*Satark Bharat, Samriddh Bharat*" (Vigilant India, Prosperous India). In this connection, the online integrity pledge was administered to all the staff members on 27th October, 2020.

Agriculture Education Day



The Institute celebrated 'Agricultural Education Day' on 4th December 2020 through the virtual platform. Dr. E.B. Chakurkar, Director, ICAR-CCARI, Old Goa, welcomed the chief guest and the participants and apprised about the importance of celebrating Agricultural Education Day. Prof. Suhas Godse, President of Vighyan Parishad, Goa and Associate Professor at Dhempe College (Retd.), Goa was the Chief Guest for the function. He appealed to the students to see agricultural education as an opportunity for education, career and entrepreneurship.

World Soil Day

ICAR-CCARI and ICAR-Krishi Vigyan Kendra (KVK) North Goa celebrated 'World Soil Day' on 5th December 2020. The Chief Guest, Shri Shripad Yesso Naik, Hon'ble Union Minister of State and Ministry of AYUSH and Ministry of Defence, in his address said that "We should worship and work with soil for food, health and better environment". He appealed and emphasized the importance of organic farming for producing safe food for good health. Shri Nevil Alphonso, Director, Directorate of Agriculture, Goa, was the Guest of Honour. On this occasion, the Chief Guest launched the Fertilizer Calculator New' app. A total of 60 farmers and farm women from different villages of North Goa attended the programme. During the programme, around 300 Soil Health Cards were distributed, and five extension folders were released. Vegetable seed kits were also distributed to farmers to promote vegetable farming based on nutrient management through soil health cards.

Participation in exhibitions

AQUABE-2020

The Institute participated in second Aqua Goa Mega Fish Festival-2020 organized by Directorate of Fisheries, Govt. of Goa in collaboration with the National Fisheries Development Board, Hyderabad at Panjim during 13-15 February 2020. Dr. Pramod Sawant, Hon. Chief Minister of Goa inaugurated the three days event. The Hon. Chief Minister and Minister of Fisheries, Govt, of Goa, visited the institute stall. They appreciated the efforts of ICAR-CCARI in developing and disseminating the technologies for fishery resource enhancement in the state.

Distinguished Visitors

Date	Name of Visitor	Designation/ Institute/ Place
21-01-2020	Dr. S D Sawant	Vice Chancellor, Dr. BSKKV, Dapoli
21-01-2020	Dr. J C Katyal	Ex DDG (Education), ICAR, New Delhi
21-01-2020	Dr. K. Nirmal Babu	Director, ICAR-IISR, Kozhikode
21-01-2020	Dr. Gopal Lal	Director, ICAR-NRC for Seed Spices, Ajmer
21-01-2020	Shri Madhav Kelkar	Director, Directorate of Agriculture, Government of Goa
21-01-2020	Dr. Homey Cheriyan	Director, DASD, Kozhikode
05-02-2020	Adv. Narendra Sawaikar	Commissioner, NRI Affairs, Government of Goa
05-02-2020	Dr. PK. Singh	Director, ICAR- DWR, Jabalpur
17-09-2020	Smt. Janita Madkaikar	Sarpanch Old Goa Panchayat
09-11-2020	Mrs. Deepali Naik	Director, Directorate of Women & Child Development, Govt. of Goa
02-12-2020	Dr. Pramod Sawant	Honourable Chief Minister, Government of Goa
02-12-2020	Shri Chandrakant (Babu) Kavlekar	Honourable Dy. Chief Minister and Minister for Agriculture, Government of Goa
02-12-2020	Shri Kuldeep Singh Gangar IAS	Secretary (Agriculture), Government of Goa
02-12-2020	Shri Kunal, IAS	Secretary (Environment), Government of Goa
02-12-2020	Shri J. Ashok Kumar, IAS	Secretary (Industries), Government of Goa
02-12-2020 05-12-2020	Mr. Nevil Alphonso	Director, Directorate of Agriculture, Government of Goa
02-12-2020	Dr. Santosh Desai	Director, Department of AH&VS, Government of Goa
02-12-2020	Dr. Shamila Monteiro	Director, Directorate of Fisheries, Government of Goa
05-12-2020	Shri Shripad Yesso Naik	Hon'ble Union Minister of State and Ministry of AYUSH and Ministry of Defence

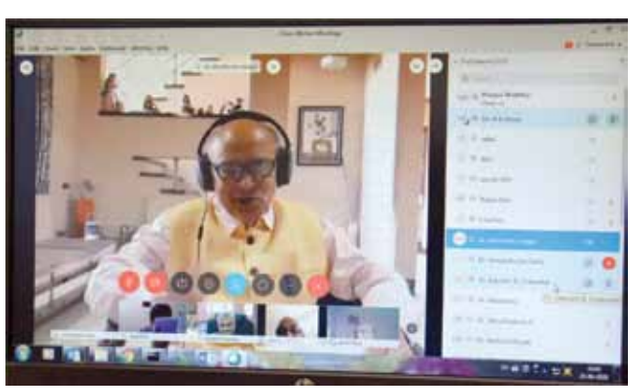
Committees and Meetings

Research Advisory Committee

The VIII Research Advisory Committee (RAC) for ICAR- Central Coastal Agricultural Research Institute for three years from 11-08-2017 to 10-08-2020. The composition of RAC is as follows:

Name and address	Role
Dr. SS Magar Ex-Vice Chancellor, Dr BSKKV, Dapoli, Runabandh Housing Society, Near Kotibagi Hospital, Aundh, Pune, Maharashtra – 411 008	Chairman
Dr. BB Deshpande Ex-Dean, College of Veterinary & Animal Sciences, Parbhani, Flat No 2, Raviraj Apartment, Umaji Colony, Bansilal Nagar, Aurangabad, Maharashtra - 431 001	Member
Dr. PN Jagdev Dean of Research, Orissa University of Agriculture & Technology, Plot No. MIG-141, Phase-1, Khandagiri Housing Board Colony, Kolathia, Bhubaneshwar, Odisha-751 030	Member
Dr. AM Gosawami Former Head, Division of Horticulture, IARI, 40/7 (Pocket 40, House No 07), C R Park, New Delhi - 110 019	Member
Dr. SD Singh Former ADG (Inland Fisheries), ICAR, 5/85, Viram Khand, Gomti Nagar, Lucknow, Uttar Pradesh - 226 010	Member
Shri Babu Narhari Komarpant Near Dhavlikar Hospital, Devbag, Palolem, Canacona, Goa - 403 702	Member
Shri Shrirang Venktesh Jamble Sawai, P. O. Verem, Ponda, Goa - 403 401	Member
Dr. S Bhaskar Assistant Director General (Agronomy/ Agroforestry), NRM, ICAR, KAB-II, Pusa, New Delhi - 110 019	Member
Dr. EB Chakurkar, Director (A), ICAR-CCARI, Old Goa, Goa - 403 402	Member
Dr. R Ramesh Principal Scientist, ICAR-CCARI, Old Goa, Goa - 403 402	Member Secretary

The Third meeting of VIII RAC was held on 25th June 2020 via video conferencing mode. The meeting was chaired by Dr SS Magar, Chairman, and attended by the following members Dr AM Goswami, Dr SD Singh, Dr PN Jagdev, Dr Adlul Islam, Dr EB Chakurkar and Dr. R Ramesh, Member Secretary, along with Scientists of the Institute and Programme Co-ordinator KVK, North Goa. At the outset, Dr EB Chakurkar, Director (A) of the Institute, welcomed and briefed the house about the Institute, status of Coastal agriculture, ongoing research projects and the research achievements. The action taken report for the last year's RAC recommendations was presented by Dr. R Ramesh, Principal Scientist and Member Secretary and reviewed by the committee. The Sectional in-charges made presentations on the research accomplishments of their research projects. The chairman and members of RAC appreciated the achievements made with the scientific and technical staff.



The approved RAC recommendations are as follows:

1. Coastal area database to be developed for optimal use of coastal resources. Coastal vulnerability index and map may be created considering the sea level rise and other vulnerabilities of the coastal region.
2. Soil and water conservation practices should focus on organic carbon loss, loss of soil nutrients and runoff and measures to reduce the loss need to be addressed.
3. The component of vegetables and pulses needs to be studied under the rice-based cropping system creating water resources by constructing *Vasant Bandhara* (cement) or *Vanarai Bandhara* (sand-soil empty cement bags) and diversion channel under the desired direction command areas.
4. Productivity of crops in coastal regions may be improved by adopting a multidisciplinary research approach, including doubling cropping intensity, precision farming and high-density planting.
5. ICAR-CCARI should develop approaches to improve the lactation milk yield in local cattle breeds.
6. Cage culture in fisheries should be tried in freshwater fisheries and mariculture.

The IX Research Advisory Committee (RAC) for ICAR- Central Coastal Agricultural Research Institute was constituted for three years, from 14-08-2020 to 13-08-2023. The composition of RAC is given below.

Name and address	Role
Dr. Tapas Bhattacharya Ex- Vice-Chancellor, Dr BSKKV, Dapoli, Bunglow No. 11, Jayanti Nagari 2, BESA Nagpur, Maharashtra – 440 031	Chairman
Dr. MA Shankar Ex-Director of Research, UAS, Bengaluru, 1st Main Road, HGH layout, Ganganagar, Bengaluru, Karnataka - 560 032	Member
Dr. V. L. Deopurkar Ex-Director of Research, MAFSU, Om Bangla, Plot No-88, Sangam Society, Bibvewadi, Pune, Maharashtra – 411 037	Member
Dr. Dilip Dora Ex-Professor, Horticulture, & Ex Dean (PG), OUAT, Bhubaneshwar, Tala Sahi, P.O- Khordha, Orissa – 752 055	Member
Dr. Baban Ingole Visiting Scientist, ESSO-National Centre for Polar & Ocean Research, Vasco, Goa - 403 804	Member
Dr. Anupam Mishra Vice-Chancellor, CAU, Imphal West, Manipur - 795 004	Member
Shri Dattaprasad P Kholkar H.No 245-A/9, Ganeshpuri, Housing Board Colony, Mapusa, Goa - 403 507	Member
Shri Prabhakar Gaonkar H. No. 21, Bendurden, Balli via Cuncolim, Salcette Goa - 403 703	Member
Dr. Adlul Islam Assistant Director General (SWM), NRM, ICAR, KAB-II, Pusa, New Delhi - 110 012	Member
Dr. EB Chakurkar Director (A), ICAR-CCARI, Old Goa, Goa - 403 402	Member
Dr. Shivasharanappa N Senior Scientist (Veterinary Pathology) ICAR- CCARI, Old Goa, Goa - 403 402	Member Secretary

The first meeting of IX RAC was held on 21st December 2020 via video conferencing mode. The meeting was chaired by Dr Tapas Bhattacharyya, Chairman, and attended by the following members Dr MA Shankar, Dr VL Deopurkar, Dr Dilip Dora, Dr Baban Ingole, Dr Anupam Mishra, Dr Adlul Islam, Dr EB Chakurkar, Shri Prabhakar Gaonkar and Dr Shivasharanappa N, Member secretary, along with scientists of the Institute and programme co-ordinator and subject matter specialists, KVK, North Goa. At the outset, Dr

EB Chakurkar, Director (A) of the Institute, welcomed the dignitaries and briefed the committee about the ongoing research projects and research achievements of the past year. The member secretary, RAC, presented the action taken report on the recommendations of the VIII RAC, followed by the presentation of the research achievements and detailed action taken report by In-charges of sections. The chairman and members of RAC appreciated the achievements made with the scientific and technical staff.

The approved RAC recommendations are as follows

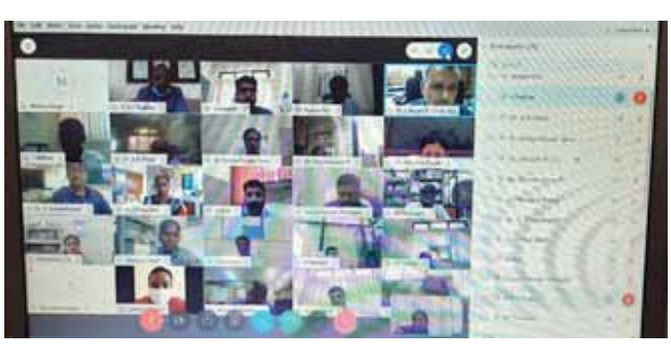
1. Development of coastal agricultural information system and sensitization through brainstorming sessions with different stakeholders may be carried out. Studies on the diversity of natural and genetic resources and assessment of the vulnerability of coastal regions should be initiated.
2. Research and development on secondary agriculture in horticulture needs to be focused on. Suitability evaluation of avocado cultivation in the coastal region may be initiated.
3. A systematic evaluation of high-density planting in cashew suitable to farmers' land holdings needs to be carried out.
4. Studies on different approaches for enhancing milk yield and quality in dairy cattle should be emphasized to backyard poultry research in the coastal region.
5. Studies on freshwater aquaculture in small water bodies and efforts to conserve coral and oyster reefs may be initiated.

Institute Research Council Meeting

The 31st Annual Institute Research Council meeting of the Institute was held from 12 – 16 May 2020 via video conferencing mode. Dr EB Chakurkar, Director (A) of the Institute, chaired the meeting. He welcomed all the scientists and highlighted the importance of this meeting. He suggested incorporating the RAC recommendations in the existing ongoing projects or new project proposals if any. He also requested the scientists to take up need-based research projects as per the requirements of the coastal ecosystem. The scientists deliberated on the recommendations of the last IRC meeting and research activities carried out during the previous year. The chairman reviewed all the projects thoroughly and made critical comments for the further improvement of projects.

The IRC reviewed the progress made under various research projects for the year 2019-20 and finalized the technical programmes of the ongoing research projects for the year 2020-21. The details of IRC are as follows.

Name and address	Role
Dr. EB Chakurkar Director (A), ICAR - CCARI Old Goa - 403 402	Chairman
All Project Leaders	Members
Dr. Manohara, KK Senior Scientist (Genetics & Plant Breeding) ICAR – CCARI, Old Goa - 403 402	Member Secretary



Institute Management Committee

The Institute Management Committee (IMC) is constituted for the financial and administrative guidance of the Institute by the council for three years, from 22-06-2020 to 21-06-2023. The composition of IMC is as follows.

Name and address	Role
Dr. EB Chakurkar Director (A), ICAR - CCARI, Old Goa, Goa - 403402	Chairman
Shri Nevil Alphonso Director of Agriculture, Directorate of Agriculture, Government of Goa, Krishi Bhavan, Tonca, Goa - 403002	Member
Dr. BN Sawant Associate Director of Research, RFRS, Vengurla, Maharashtra - 416516	Member
Dr. PC Haldvanekar Associate Dean, College of Horticulture, Dr BSKKV, Dapoli, Maharashtra - 415713	Member
Dr. Jagdish Rane In-charge, Head, School of Drought Stress Management ICAR-NIASM, Malegaon, Baramati, Maharashtra - 413 115	Member
Dr. J Loka Principal Scientist & I/c., Karwar Research Centre of CMFRI, Karwar, Karnataka - 581301	Member
Dr. Ravi Bhat Acting Head, Division of Crop production, ICAR-CPCRI, Kudlu P.O Kasargod, Kerala - 671121	Member
Dr. KN Bhilegaonkar I/c IVRI regional Station, Agriculture College Campus, Shivajinagar, Pune, Maharashtra - 411005	Member
Shri Dattaprasad P Kholkar H.No 245-A/9, Ganeshpuri, Housing Board Colony, Mapusa, Goa - 403507	Member
Shri Prabhakar Gaonkar H.No.21, Bendurden Balli Via Cuncolim, Salcete, Goa - 403703	Member
ADG (S&WM) NRM Division, ICAR, New Delhi - 110012	Member
Shri Saurabh Muni Sr. Finance & Accounts Officer, IARI, New Delhi - 110012	Member
Shri Somnath Administrative Officer, ICAR- CCARI, Old Goa, Goa - 403402	Member Secretary

The 50th meeting of the IMC was held at the Institute on 5th November 2020 via video conference mode.

Pre-*Kharif* Interface Meeting between ICAR-CCARI, Old Goa and Directorate of Agriculture, Government of Goa

The Pre-*Kharif* interface meeting between ICAR-CCARI, Old Goa and Directorate of Agriculture, Government of Goa, was held on Tuesday 28th May 2020 via video conferencing mode. Dr EB Chakurkar, Director (A), ICAR-CCARI, chaired the meeting along with Shri Nevil Alphonso, Director of Agriculture, Government of Goa. The meeting was attended by Scientists of ICAR-CCARI, Deputy Directors, Assistant Directors, Officers of the Directorate of Agriculture, Government of Goa and Subject Matter Specialists of Krishi Vigyan Kendra, North Goa. Different agenda points highlighted by the Directorate of Agriculture were discussed at length. Scientists of the Institute presented and informed the participants about the technologies and information available in response to the agenda points.

A one-day stakeholder meets to develop a roadmap for agriculture and allied sectors to make Goa self-sufficient

A one-day stakeholder meeting was held at ICAR-CCARI on 2nd December 2020 to develop a roadmap for agriculture and allied sectors for the State of Goa. The following were present.

Dr. Pramod Sawant	Hon'ble Chief Minister, Goa
Shri Chandrakant (Babu) Kavlekar	Deputy Chief Minister and Minister of Agriculture
Shri Kuldeep Singh Gangar IAS	Secretary (Agriculture), Govt. of Goa
Shri Kunal IAS	Secretary (Environment), Govt. of Goa
Shri J Ashok Kumar IAS	Secretary (Industries), Govt. of Goa
Dr EB Chakurkar	Director (A), ICAR-CCARI
Mr. Nevil Alphonso	Director, Directorate of Agriculture
Dr. Santosh Desai	Director, Directorate of Animal Husbandry
Dr. Shamila Monteiro	Director, Directorate of Fisheries
Shri Rohan J. Kaskar	Dy. Director (Adm)
Shri Prashant Kamat	Functional Manager (DIC), Directorate of Industries
Shri Suraj Amre	District Rural Development Agency
Shri Sandeep Faldesai	Managing Director, Goa State Horticulture Corporation Ltd. Govt. of Goa
Shri Chandrahas Desai	Programme Coordinator, KVK, South Goa
Dr. BL Kashinath	Programme Coordinator, KVK, North Goa
Scientist experts	ICAR-CCARI

Hon'ble Chief Minister of Goa chaired the valedictory function of the one-day stakeholders meeting and gave his concluding remarks on the roadmap and strategies developed through deliberations to develop agriculture and allied sectors in the state of Goa to make the state self-sufficient. Shri Chandrakant (Babu) Kavlekar, Deputy Chief Minister and Minister of Agriculture, also attended the function and expressed his views. A five-point strategy draft for the development of agriculture and allied sectors for the state was formulated.

Personnel

ICAR-CCARI - Old Goa

1. Dr. EB Chakurkar, Director (A), Section in-charge Animal and Fishery Sciences

Scientific Staff

2. Dr. SK Singh, Principal Scientist (Soil Science)
3. Dr. V Arunachalam, Principal Scientist (Horticulture)
4. Dr. AR Desai, Principal Scientist (Horticulture), Section in-charge Horticultural Sciences
5. Dr. R Ramesh, Principal Scientist (Plant Pathology), Section in-charge Crop Sciences, Cordinator AKMU, member secretary RAC
6. Dr. Mathala Juliet Gupta, Senior Scientist (Agricultural Structures and Process Engineering), Cordinator TSP
7. Dr. Manohara KK, Senior Scientist (Plant Breeding), member secretary IRC
8. Dr. Shivasharanappa N, Senior Scientist (Veterinary Pathology)
9. Dr. R Solomon Rajkumar, Scientist (Livestock Products Technology), On Study Leave
10. Dr. Maruthadurai R, Scientist (Agricultural Entomology), Cordinator Library
11. Dr. Gokuldas PP, Scientist (Animal Reproduction and Gynaecology), Cordinator IPR
12. Dr. Mahajan GR, Scientist (Soil Science), NRM Section, PME/ PIMS
13. Dr. Shripad Bhat, Scientist (Agricultural Economics)
14. Dr. Susitha Rajkumar, Scientist (Veterinary Pathology)
15. Dr. Sreekanth GB, Scientist (Fisheries Resource Management)
16. Mr. Trivesh S Mayekar, Scientist (Fish Genetics and Breeding)
17. Dr. Uthappa AR, Scientist (Agroforestry)
18. Dr. Maneesha SR, Scientist (Fruit Science)
19. Dr. Paramesha V, Scientist (Agronomy)
20. Dr. Bappa Das, Scientist (Agricultural Meteorology), Cordinator HRD, ISO
21. Dr. Sujeet Desai, Scientist (Land and Water Management Engineering)
22. Dr. Nibedita Nayak, Scientist (Poultry Science)
23. Dr. Amiya Ranjan Sahu, Scientist (Animal Genetics and Breeding)

Technical Staff

1. Ms. Madina Sollapuri, Assistant Chief Technical Officer (Estate)
2. Mr. Vinod Ubarhande, Farm Superintendent
3. Mr. Rahul Kulkarni, Senior Technical Officer (Agronomy)
4. Mr. Sidharth K Marathe, Senior Technical Officer (PME Cell), PRO -I
5. Mr. Edward Crasto, Technical Officer (Stockman), PRO -II
6. Ms. Pranjali Wadekar, Technical Officer (AKMU)
7. Mr. Yoganand Gaude, Technical Officer (Electrical)
8. Mr. Suresh M Gomes, Senior Technical Assistant (Tractor Driver)
9. Mr. Omar Illroy Francisco De Ursula, Sr. Technical Assistant
10. Mr. Prakash Parwar, Sr. Technician
11. Mr. Gokuldas Gawas, Sr. Technician
12 Mr. Datta Velip, Sr. Technician
13. Mr. Laxman Naik, Sr. Technician

Administrative and Accounts Staff

1. Mr. Somnath, Administrative Officer
2. Ms. Lizette Maria Carmel Noronha, Private Secretary
3. Ms. Montia Rita D'Silva, Assistant Administrative Officer, Estt./ Bills
4. Ms. Sneha Arlekar, Assistant Administrative Officer, Works
5. Ms. Pratibha Sawant, Assistant Administrative Officer
6. Ms. Sohini Sawant, Assistant
7. Ms. Tarika Ussapkar, Personal Assistant
8. Mr. Vinod Pagi, Assistant
9. Ms. Bushra Ansari, Stenographer Grade. III
10. Ms. Chitra Kankonkar, UDC
13. Mr. Vyas Hiren Kumar, UDC
14. Ms. Sujatha S. Kamble, LDC
15. Ms. Swati Khandeparkar, LDC
16. Ms. Kushmala Chalawadi, LDC
17. Ms. Sarita Shelko, LDC

Skilled Supporting Staff

1. Mr. Subhash Melekar
2. Mr. Dhaku Kankonkar
3 Mr. Ashok Gadekar
4. Mr. Chimmnu Tivrekar
5. Mr. Anil Khandeparkar
6. Ms. Maria S Dias
7. Mr. Giri Madkaikar
8. Mr. Umesh Marcelkar
9. Ms. Prafulla Khandeparkar
10. Ms. Rekha U Naik
11. Ms. Lalitha Naik
12. Ms. Partibha Folkar
13. Mr. Ravi S Kadam
14. Mr. Vilas P Gaonkar
15. Mr. Prabhakar Goankar
16. Mr. Sitaram Kuncolikar
17. Ms. Janika S Shirodkar
18. Mr. Shanu G Velip
19. Mr. Nitin J Naik
20. Mr. Prallhad Zambaulikar

KVK - North Goa

Technical Staff

1 Dr. BL Kashinath, Principal Scientist (Soil Science) and Head KVK, Programme Co-ordinator
2. Mr. HRC Prabhu, Subject Matter Specialist T-9 (Plant Protection)
3. Ms. Sunetra Talaulikar, Subject Matter Specialist T-9 (Home Science)
4. Dr. Sanjay Kumar Udharwar, Subject Matter Specialist T-6 (Animal Science)
5. Dr. Monica Singh, Subject Matter Specialist T-6 (Agricultural Extension)
6. Mr. Shashi Vishwakarma, Technical Officer
7. Mr. Vishwajeet Prajapati, Technical Officer
8. Mr. Dilkush Velip, Driver T-2

Administrative Staff

1. Mr. Vishwas Sharma, Assistant
2. Ms. Shreya C. Barve, Stenographer Grade. III

Skilled Supporting Staff

1. Mr. Payak J Padkar

STAFF ACTIVITIES

Appointments / Joining

Name	Post	Date of Joining
Dr. Surendra Kumar Singh	Principal Scientist (Soil Science)	06-01-2020
Dr. BL Kashinath,	Principal Scientist (Soil Science) and Head KVK	01-06-2020
Dr. Shripad Bhat	Scientist (Agricultural Economics)	03-08-2020
Dr. Uthappa AR	Scientist (Agroforestry)	08-10-2020
Ms. Kushmala I. Chalawadi	Lower Divisional Clerk	03-10-2020

Promotions

Name/designation of the Officials	Promoted/ Granted higher Grade Pay in the Pay band/level	Date of promotion
Dr. BL Kasinath, Senior Scientist (Soil Science) and Head, KVK	Principal Scientist in the Pay Level 14	07-09-2018
Smt. Madina S. Sollapuri, Senior Technical Officer	Assistant Chief Technical Officer	20-11-2017
Shri Vyas Hiren Kumar, LDC	Upper Division Clerk	30-06-2020
Smt. Swati Khandeparkar, Skilled Support Staff	Lower Division Clerk	30-06-2020
Smt. Sarita Kedo Shelko, Skilled Support Staff	Lower Division Clerk	21-11-2020

Transfer

Name	Post held	Transfer to	Date of transfer
Dr. M Thangam	Principal Scientist (Vegetable Science)	ICAR-IIHR, Bengaluru	19-08-2020
Dr. S Priya Devi	Principal Scientist (Fruit Science)	ICAR-IIHR, Bengaluru	19-08-2020
Dr. Chethan Kumar, HB	Scientist (Veterinary Public Health)	ICAR-NIVEDI, Bengaluru	19-08-2020

Superannuation

Name	Post held	Date of Retirement
Shri Gokuldas Kaskar	Skilled Support Staff	31-05-2020
Shri Dugu Khandeparkar	Skilled Support Staff	30-06-2020

Demise

Name	Post held	Date of Demise
Irappa M Chalawadi	Driver-cum-Mechanic	20-05-2020

ICAR-CCARI in Print Media

SEMINAR ON SPICES UNDERWAY

Spice farming in Goa organic by default: agri director

Rues spice farmers losing out due to lack of certification

NT NETWORK
Panaji

While cultivation of spices in the state is organic by default, local farmers are losing out on the organic market due to lack of certification, revealed Madhav Kelkar, director of agriculture on Tuesday.

Speaking at the inaugural session of the National Seminar on Spices: Emerging Trends in Production, Processing and Marketing on Tuesday, Kelkar said that local farmers need to be educated on organic farming based on standards although in comparison to other states they use very less of fertilizers and plant protection chemicals and are therefore organic by default.

Black pepper, areca nut and green chilli are the three main spices cultivated in the state. Kelkar said that farmers in Goa are unaware about certification, and lack technical knowhow in maintaining the organic protocol.

Urging experts attending the seminar to deliberate on difficulties faced by the state in making spice cultivation organic, the director pointed out that the conversion period of three years to achieve organic standards is considered too high by Goan farmers.

The two-day national seminar at Old Goa is being hosted by ICAR- Central Coastal Agricultural Research Institute (CCARI) and Directorate of Areca Nut and Spices Development (DASD), Kozhikode.

"The seminar will focus on ways of increasing spice exports and production," said Eli Chakuriac, director, ICAR-CCARI, Goa.

It is attended by battery of speakers including Dr JC Katyal, former deputy director general (education), ICAR, Delhi; Dr K Nirmal Babu, director, ICAR-Indian Institute of Spices Research, Kerala; Dr SD Sawant, Vice Chancellor of Konkan Krishi Vidyapeeth, Dapoli; Dr Hirmoy Cherian, director, DASD and Dr Gopal Lal, director, ICAR- National Research Centre on Seed Spices, Ajmer.

Heads of prominent agriculture research institutes in the country, agri-scientists, spice farmers, graduates of agricultural colleges and spice industry stakeholders have arrived in the state to attend the seminar.

Speakers revealed that spices are 'low volume high value produce' and have the potential to be a major foreign exchange earner to the country by way of exports. Foreign exchange earnings from spices are expected to touch 135 $ six million in 2019-20. The volume of cultivation is estimated at about 10 lakh tonne of which exports comprise about 10-15 per cent of the total cultivation.

"Domestic as well as global consumption of spices is increasing and there is an urgent need for production to be taken up in a much competitive way," said Cherian, adding that chillies and turmeric are the top spices being exported.

India has maximum genetic varieties of spices with over 1,500 varieties of black pepper being grown in the country, it was revealed.

HERALD

GI tag brings cheer to Khola's chilli farmers

The GI tagging of Caracoma chilli has opened up a huge revenue earning opportunity to the farmers of Khola and other villages in constituency

गोव्याच्या 'श्वेतकपिले'ला राष्ट्रीय ओळख

देशातील ५५ गायींच्या प्रजातीमध्ये समावेश : 'आयसीएआर'च्या प्रयत्नांना यश

गोमन्तक अंकुर

केवळ गोव्यात

ICAR sees potential in local cow breed Shweta kapila

पूरक उद्योगांमुळे उत्पन्न दुप्पट

कृषी संशोधन केंद्राचे संचालक डॉ. एकनाथ चाकुरकर यांची माहिती

शेतकऱ्यांचे उत्पन्न वाढीसाठी कृषी अनुसंधान परिषद

'मानकुराद'च्या निर्यातीसाठी संशोधन सुरू

किनारी कृषी संशोधन केंद्राचे मुख्य संशोधक डॉ. ए. आर. देसाई यांची माहिती

शेतकऱ्यांचे उत्पन्न दुप्पट होणे शक्य

आयसीएआरला विश्वास : कृषी समितीच्या सूचनांची अंमलबजावणी आवश्यक

गोव्यातील देशी गायींचे 'श्वेतकपिला' नामकरण

राष्ट्रीय ॲनिमल जेनेटिक रिसर्च संस्थेकडून गोव्यातील गायींचे नामकरण

वैशिष्ट्यपूर्ण पिकाला राष्ट्रीय 'ब्रँड' बनवा

मुख्यमंत्री डॉ. प्रमोद सावंत : शेतकऱ्यांचे उत्पन्न दुप्पट करण्याचे लक्ष्य; चार खात्यांचा संयुक्त प्रयत्न

प्रक्रिया उद्योगांवर भर : राज्य सरकारचे 'लक्ष्य'

कृषी उत्पादनांचे नवे ब्रँड करणार विकसित

प्रतिनिधी । गोवन वार्ता

- पुढील काळात गोव्यातील कृषी उत्पादनांचे ब्रँडिंग होईल. पर्यायाने उत्पादनांना बाजारपेठ मिळवून देण्यात येईल. त्यासाठी प्रक्रिया उद्योग उभारण्यात येतील.
- सौंदीय शेती तसेच तंत्रज्ञानाचा अधिकाधिक वापर होण्यासाठी शेतकऱ्यांना प्रशिक्षण देण्यात येईल.
- केंद्राच्या विविध योजना असून, त्याचा अधिकाधिक लाभ घेता यावा, यासाठी मार्गदर्शन केले जाईल. * राष्ट्रीय काजू, नारळ संशोधन संस्थांच्या माध्यमातूनही सहकार्य करण्यात येईल.
- राज्यात नारळ मोठ्या प्रमाणात होत असले तरी शहाळी मिळत नाहीत. शहाळी ही अन्य राज्यांतून आणावी लागतात. म्हणूनच खास जात विकसित करण्यात येणार आहे.

पणजी : काजू, फेणी, भात तसेच अन्य कृषी उत्पादनांचे नवे ब्रँड विकसित करण्यासाठी प्रक्रिया उद्योग उभारण्यावर भर देण्याचे राज्य सरकारने ठरवले आहे. यापूर्वी २०२२पर्यंत शेतकऱ्यांचे उत्पन्न दुप्पट करावे, त्यासाठी भारतीय कृषी संशोधन संस्थेने आखून तयार केला असून, त्या आधीचे पुढील अंमलबजावणी होणार आहे.

मुख्यमंत्री डॉ. प्रमोद सावंत यांनी कृषकांचे मार्गदर्शनासाठी जुने गोवे येथील कृषी विज्ञान केंद्राला भेट देऊन तेथे सुरू असलेल्या विविध योजनांची, शेतकऱ्यांचे उत्पन्न दुप्पट करावे यासाठी भारतीय कृषी संशोधन संस्थेने आखलेल्या कार्यक्रमाची माहिती जाणून घेतली. या प्रसंगी कृषी संशोधन संस्थेचे अध्यक्ष डॉ. ए. के. चतुर्वेदी, कृषिमंत्री चंद्रकांत कवळेकर व अन्य अधिकारी उपस्थित होते.

Govt aiming at doubling farmers' income by 2022 & becoming self-sufficient in agri produce

WHAT ARE THE STEPS BEING TAKEN?

- The State government is focusing on promoting an integrated Farming System
- This is aimed at increasing the farmers' income by producing field crops along with other farm activities like dairy and poultry
- Farmer Producer Organisations (FPOs) will be set up across all 12 talukas, with a minimum of 100 farmer members
- The farmers would be trained in processing, packing, marketing, branding, etc, which will help them to grow
- The Government is also proposing to set up Rice Clusters, each in North and South, along with Food and Agro processing units
- Under the Rice Cluster, Goan rice variaties would be produced and marketed under the Goa brand. A plant using advanced technology will also be set up for the purpose
- The Indian Council of Agriculture Research (ICAR) has prepared a road map for agriculture sector with the focus being on improving the agriculture produce
- For this, ICAR convened a stakeholder meeting, which was attended by the Department of Agriculture, Fisheries, Industries and Horticulture Corporation
- The government will also slowly phase out the practice of getting rices from other States for rearing in Goa

"The contribution of agriculture to GDP is less than 5% and as such, we are highly dependent on other States to meet our requirements of agriculture, horticulture, dairy, pottery, etc. The time has come to become self-sufficient and promote 'vocal for local'. The target is to ensure that net profit per annum is around Rs three lakhs to the farmers. Only then more farmers will get attracted

शेतकऱ्यांचे उत्पन्न वाढविण्यासाठी कृषी रोडमॅप : मुख्यमंत्री

जुने गोवे येथे पत्रकार परिषदेत मुख्यमंत्र्यांनी केले कृषी रोडमॅपचे अनावरण

Govt wants to double farmers' income in 2 years

Announces roadmap for agriculture sector

STAFF REPORTER
Panaji

कृषी उत्पन्न दुप्पट करण्यावर भर

मुख्यमंत्री : स्थानिक उत्पादने 'गोवा ब्रँण्ड' म्हणून विकसित करणार

परराज्यांतून गाई आणणे होणार बंद

प्रमोद सावंत : गोव्यातील तांदळाची परराज्यातही विक्री

गोधन हर्डस

२०२२ पर्यंत शेतकऱ्यांचे उत्पन्न दुप्पट; सरकारची मोहीम

Budget 2020-21 (Rs. in lakhs)

Heads	Total allocation 2020-21	TSP	SCSP	Other than NEH & TSP	Total expenditure 2020-21
Works					
A. Land	0.00	-	-	-	0.00
B. Building		-			
i. Office building	82.00		-	82.00	82.00
ii. Residential building	0.00	-	-	-	0.00
iii. Minor Works	0.00	-	-	-	0.00
Equipments	56.96	17.97	8.01	25.45	51.44
Information Technology	4.27	-	-	4.27	4.27
Library Books and Journals	0.21	-	-	0.21	0.21
Vehicles & Vessels	0.00	-	-	-	0.00
Livestock	0.05	-	-	0.05	0.50
Furniture & fixtures	0.74	-	-	0.74	0.74
Others	0.00	-	-	-	0.00
Total – Capital (Grants for creation of Capital Assets)	144.23	17.97	8.01	112.72	138.72
Establishment Charges	935.22	-	-	906.38	906.38
Wages	0.00	-	-	-	0.00
Overtime Allowance	0.00	-	-	-	0.00
Total – Establishment Expenses (Grant in Aid - Salaries)	93.52	0.00	0.00	906.38	906.38.00
Pension & Other Retirement Benefits	45.20	-	-	51.58	51.58
Traveling Allowance					
Domestic TA / Transfer TA	2.26	-	-	2.25	2.25
Foreign TA	0.00	-	-	-	0.00
Total – Traveling Allowance	*2.26*	0.00	0.00	2.25	2.25
Research & Operational Expenses	-	-	-	-	-
Research Expenses	114.43	-		116.83	116.83
Operational Expenses	259.59	-	-	259.50	259.50
Total - Research & Operational Expenses	374.02	0.00	0.00	376.33	376.33
Administrative Expenses					
A. Infrastructure	107.36	-	-	109.20	109.20
B. Communication	1.13	-	-	1.05	1.05
C. Repair & Maintenance	0.00	-	-	0.00	0.00
i. Equipments, Vehicles & Others	13.62	-	-	14.02	14.02
ii. Office building	0.00	-	-	0.00	0.00
iii. Residential building	0.00	-	-	0.00	0.00
iv. Minor Works	39.24	-	-	38.81	38.81
D. Others (excluding TA)	57.50	-	-	57.17	57.17
Total - Administrative Expenses	218.85	0.00	0.00	220.27	220.27
Miscellaneous Expenses					
A. HRD	1.36	-	-	1.35	1.35
B. Other Items (Fellowships, Scholarships etc.)	0.00	-	-	-	0.00
C. Publicity & Exhibitions	0.00	-	-	-	0.00
D. Guest House – Maintenance	12.52	-	-	12.51	12.51
E. Other Miscellaneous	73.38	21.93	30.03	1.99	53.96
Total - Miscellaneous Expenses	87.26	21.93	30.03	15.87	67.84
Total - Grants in Aid - General	727.59	21.93	30.03	66.63	71.82
Grand Total (Capital + Establishment+General)	1807.04	39.91	38.04	1685.42	1763.38

Jackfruit processing training programme, Mundugod

National seminar on spices

International Decade of Soils
2015 - 2024

स्वच्छ भारत
एक कदम स्वच्छता की ओर

FLD on cashew-based IFS plot in Ziltawadi, Canacona

Scan Me

भाकृअनुप
ICAR

हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद

Agrisearch with a human touch