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Annual Report 2019

ICAR-Central Coastal Agricultural Research Institute

भाकृअनुप - केंद्रीय तटीय कृषि अनुसंधान संस्थान

(Indian Council of Agricultural Research)

Old Goa - 403 402, Goa, India

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Distribution of agricultural inputs at the hands of Dr Pramod Sawant, Hon. Chief Minister, Goa

Visit of the 5th Quinquennial review team

World Soild Day and Agricultural Education Day celebrations

Workshop on scope of extending cashew plantations in non-traditional areas

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2019

भाकृअनुप
ICAR

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(भारतीय कृषि अनुसंधान परिषद)

ओल्ड गोवा- ४०३ ४०२, गोवा, भारत

ICAR-CENTRAL COASTAL AGRICULTURAL RESEARCH INSTITUTE

(Indian Council of Agricultural Research)

Old Goa - 403 402, India

ICAR-CCARI, Goa

Annual Report 2019

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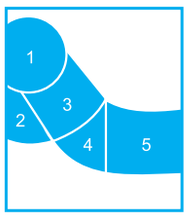


Cover page photos

1. Low-land integrated farming system
2. Fishing boats in estuary
3. Mitigation activities in Fani affected areas
4. Bush pepper cultivation
5. Agroecotourism unit

PREFACE

The ICAR - Central Coastal Agricultural Research Institute (ICAR-CCARI) is one of the research Institutes under Division Natural Resource Management (NRM) of the Indian Council of Agricultural Research (ICAR), New Delhi. The Institute is mandated to carry out the research and extension activities on the natural resource management, field and horticultural crops, livestock, and fisheries and Agro-ecotourism. Research activities are being undertaken through various research themes *viz*. conservation, utilization and management of natural resources, crop, livestock and fisheries, development of production technologies, post harvest management and agri- entrepreneurship. This is executed through five functional sections - Natural Resource Management, Crop Science, Horticulture Science, Animal Sciences and Fisheries Science. The annual report of the Institute documents the progress made in research and extension during the year 2019.

During the period, the Institute applied for the release of two bacterial wilt resistant brinjal varieties *viz.* Goa Brinjal-5 and Goa Brinjal-6 to the Goa State seed Sub-committee for Agriculture and Horticulture crops Govt. of Goa. Shwet Kapila cattle breed was registered with NBGAR, Karnal as the national breed for the coastal region (Goa state) known for its adaptability and milk production, which can be used for crossbreeding with local cattle. The two products *viz.* CCARI Bio 3: Value-added formulation of PGPB (*B. methylotrophicus* STC-4) for vegetables and CCARI Bio 4: Value-added formulation of PGPB (*B. methyllotrophicus* RCh6-2b) for vegetables were formulated and developed.

The Institute is a regular centre for AICRPs on cashew, integrated farming system, vegetable crops, palms, pig and animal disease monitoring and surveillance and voluntary centre for AICRP on rice and arid legumes. In addition to the Institute projects, research projects are also funded by ICAR through various network platforms and collaborations, Department of Science, Technology & Environment and Department of Biotechnology etc. to undertake research in the field of coastal agriculture. Extension and development projects are channeled through various development programmes like Scheduled Tribe Component (STC), Scheduled Caste Sub Plan (SCSP), NABARD, National Horticultural Mission, Rashtriya Krishi Vikas Yojana, NFDB, DASD and also through other developmental agencies.

To provide advisories in the field of agro-ecotourism, Institute has established an Agro-ecotourism centre. Six Automatic Weather Stations were established across Goa to monitor nine weather variables recorded at every three minutes. An exclusive web portal on agricultural information of Goa (www.agrigoaexpert.res.in) was hosted during 2019 for the benefit of farmers and other stakeholders.

A rice-based farming system model (crop-dairy-fish) has been standardized on 0.5 ha area for typical lowland situations of Goa. 16.5 q breeder seeds of the released salt-tolerant rice varieties *viz.*, Goa Dhan 1, Goa Dhan 2, Goa Dhan 3 and Goa Dhan 4, and Cowpea variety Goa Cowpea 3 were produced at the Institute farm. Truthfully labeled seeds of other important varieties Karjat 3, Jyothi and Jaya in paddy and TM 96-2 and IPR 2-14 in Moong were taken up at the Institute farm as well as in farmers' field through participatory seed production mode. Front Line Demonstration on high yielding upland rice variety 'Sahbhagi Dhan' was conducted in Gaodongrim village covering 10 ha area during the Kharif season. Under MIDH programmes, four FLDs on high-density planting of Grafted Bush pepper were established in farmers fields. Quality planting material of spice crops *viz,* Black pepper, Nutmeg, Cinnamon and turmeric were produced and supplied. Talc based formulation of Trichoderma was produced and was sold to farmers, used in various experiments and field trials of the Institute. Management interventions such as feed formulation (using medicinal herbs and vitamin plants), artificial insemination and disease surveillance were demonstrated for the backyard poultry units along Goa. A multi-disciplinary team of scientists visited the cyclone 'Fani' affected areas of Puri and Khordha district of Odisha to assess the impacts and organized animal health camps, for restoring the health of livestock and advised the farmers about the general animal health and nutrition management. Team also visited flood-affected area of Kolhapur, Maharashtra for assessing the impact of the flood on animal husbandry, and conducted animal health camps and also performed an advisory role in post-flood management of livestock and landslide affected area. The team of scientists also visited the Wayanad district of Kerela to study the impact of floods and landslides that occurred in 2019. The team assessed the causes of the disaster, losses incurred and the mitigation measures envisaged by each one of the bodies were deliberated upon. The steps to prevent further such disasters and the measures envisaged by the departments were reported.

As an output of these activities, 26 research articles, 21conference papers, five popular articles, three book chapters, two technical bulletins, three extension folders, two extension leaflets and two newsletters were published. The Institutes received the prestigious Green Maple Foundation Awards (GMF) – 2019 for outstanding contribution to research excellence. The insitute has disseminated technologies, products and services through trainings and awareness programmes (16), demonstrations (29) and seminars and workshops (4) through various schemes (institute activities, NABARD, SCSP, and STC).

I place on record my gratitude to Dr. Trilochan Mohapatra, Secretary, DARE and DG, ICAR, New Delhi, Dr. K. Alagsundaram, DDG (NRM), ICAR New Delhi and Dr. S. K. Choudhary, ADG (SWM) and Dr. S. Bhaskar, ADG (AF&CC) for the support, encouragement and guidance extended. I appreciate all the scientists and staff members of the Institute who contributed to the significant development of the Institute. I sincerely acknowledge the efforts made by the editor and the publication committee of the Annual Report for compilation and publication.

As a Director of the Institute, it is a great honour to present the Institute's Annual Report-2019 and I hope the report will be useful to researchers, policymakers, planners and extension personnel.

Chakurkar

(Eaknath B. Chakurkar)
DIRECTOR (A)

Place : Old Goa
Date : 24-11-2020

CONTENT

EXECUTIVE SUMMARY

ICAR- Central Coastal Agricultural Research Institute (ICAR-CCARI) conducts strategic and applied research under various research themes of conservation, management and utilization of natural and genetic resources, development of production technologies for crops, animals and fisheries, post-harvest technologies and agro-ecotourism. The research projects have been streamlined into five mega projects. The highlights of the research achievements for the year 2019 are presented below.

Conservation and management of natural resources of coastal region

- Long term seasonal and annual trends in streamflow of west flowing rivers of India was analysed using Mann-Kendall test, Spearman's rho test and linear regression.
- In Tapi to Tadri basin in the monsoon season, stream flow increased continuously at Collem, Durvesh, Gadat, Ganjim and Nanipalson. The stream flow showed increasing trend in four out of the nine gauging stations
- In Tadri to Kanyakumari basin in the monsoon season only two stations i.e Ambarapalayam and Pattazhy showed an increasing trend in the streamflow.
- The trends in daily maximum temperature, minimum temperature and rainfall derived different extreme climate indices for seven weather stations of coastal Maharashtra and Goa.
- Novel spectral indices, partial least square regression (PLSR)- and principal component analysis (PCA)-based machine learning models have been developed and evaluated for characterization of salinity tolerant rice genotypes.
- A package of practice of transplanting of 35-days Old Goa Bio 1 nursery treated seedling of an improved salt-tolerant rice variety with soil test based fertilizer recommendation or modified blanket fertilizer application has been identified to improve the productivity and income under coastal saline soils.
- Mid-infrared spectroscopy (2500-15000 nm) could be effectively employed for monitoring the soil salinity of the salt-affected soils as it is rapid, repeatable, reliable and cost-effective. A spectral algorithm of partial least square regression of Savitzky-Golay Standard Normal Variate of 10 nm averaged spectral data yielded an excellent accuracy to predict soil salinity.
- A rice based integrated farming system (IFS) model including crop-diary-fishery components has been standardised in 0.5 ha area for tropical low land situations. The crops, diary and fishery yielded highest shares to the net returns (1.39 lakhs) from the system. An employment of 339 man days were generated from the system. The upland IFS model including plantation crops, fruit crops, piggery, poultry and vermi-compost yielded a revenue of Rs. 1.73 lakh and a net profit of 1.18 lakhs. The piggery and cashew-pineapple system yielded the major shares towards the revenue.
- In the upland IFS, the gross return of the system was around Rs. 1.73 Lakhs and the net profit was Rs. 1.18 Lakhs. The highest contribution to net profit was from the piggery unit (42%) followed by cashew-pineapple system (25%).
- In rice based cropping systems, the different tillage management practices- puddled transplanted rice (PTR)-PTR, direct seeded rice (DSR)-DSR, rice-moong, rice-cowpea and rice-baby corn were followed. The higher yield was observed in PTR condition (5.18 t ha^{-1}) followed by direct seeded rice with brown manuring of Sesbania (5.11 t ha^{-1}).
- Furthermore, the different soil properties were not influenced by the tillage management practices. The higher soil organic carbon, available nitrogen (125 kg ha^{-1}), phosphorus (13 kg ha^{-1}) and potassium (135 kg ha^{-1}) were recorded in direct seeded rice with brown manuring of sesbania.

Conservation and utilization of genetic resources in the coastal region

- The rice germplasm from Goa, Uttara Kannada and Shimoga were characterized based on agro-morphological and 34 Simple Sequence Repeat (SSR) markers covering 12 linkage groups. Molecular characterization using SSR markers produced 148 alleles and cluster analysis grouped 153 rice genotypes into four different clusters with each clusters further divided into two sub-clusters.
- Phenotyping of 71 rice genotypes for salt stress at the seedling stage was carried out in micro-plot. Based on the reaction of genotypes to salt stress, ten genotypes *viz.*, Korgut, Kagga, GWR 005, CST 7-1, Panvel 1, KS 4, KS 19-2, Goa Dhan 2 (KS-17), GRS 1 and Pokkali were found to be tolerant (T) with Standard Evaluation System (SES) scoring of 3-4

similar to that of standard tolerant check varieties Pokkali and FL478. Haplo-typing of the genotypes using Saltol QTL linked markers revealed that three genotypes namely Goa Dhan 2, Panvel 1 and GWR 005 were found to be entirely different from FL478 in their allelic constitution.

- 16.5 q breeder seeds of the released salt-tolerant rice varieties *viz.,* Goa Dhan 1, Goa Dhan 2, Goa Dhan 3 and Goa Dhan 4, and Cowpea variety Goa Cowpea 3 were produced at the Institute farm. Truthfully labelled seeds of other important varieties Karjat 3, Jyothi and Jaya in paddy and TM 96-2 and IPR 2-14 in Moong were taken up at the Institute farm as well as in farmer's field through participatory seed production mode.
- Front Line Demonstration on high yielding upland rice variety 'Sahbhagi Dhan' was conducted in Gaodongrim village covering 10 ha area during the Kharif season. Sabhagi Dhan recorded on an average 4.0 - 4.5 t ha^{-1} of grain yield under upland condition compared to the existing varieties Jyothi and Karjat 3 which yielded 3.0 - 3.5 t ha^{-1}. Large scale demonstration of high-yielding salt-tolerant rice varieties Goa Dhan 3 and Goa Dhan 4 were conducted at the Durga farm of South Goa KVK during the rabi season under high salinity condition.
- Local mango varieties *viz.* Cardozo Mankurad, Costa, Bindao, Maxima and Cota showed regular bearing tendency, while fruit quality was par excellent in Cardozo Mankurad. Four variants of Mankurad and three variants of Hilario showed higher pulp contents and higher total soluble solids with attractive pulp and skin colour indicating the promising fruit quality. Germplasm collection of mango, being maintained in three blocks, consists of a total of 144 accessions/ varieties. Scion bank of Cardozo Mankurad and Hilario 2/18 and 3/18 was established. From among the nutmeg germplasm accessions, NMF-6, NMD-1 and NMD-2 continued to record promising yield performance. Tamsuli-1, a promising nutmeg genotype identified in farmer's field is shortlisted for variety proposal for its bold nut size, higher mace contents per fruit and higher yield.
- Coconut based multi-species cropping system of 0.5 ha area (10 crop components and poultry yielded a total income of 2.53 lakhs, where crops, poultry, and crop residues shared 53%, 33.8%, and 13.2% towards the total income. Production of planting material is also an added activity of the system that contributes to the total returns.
- A total of 97 cashew germplasm accessions, representing different groups comprising of jumbo nut types, bold nut types, cluster bearing types and high yielding genotypes, are being maintained in the field germplam bank. Tudal – 1 cashew accession recorded consistently promising performance, with 8.88 kg per tree nut yield, having 8.4 g nut weight, 28.1% shelling and mean apple weight of 88.6 g with 10.8 % degree brix. Similarly, HB-21/05 and 27/05have also recorded promising performance.
- Under MIDH programmes, four FLDs on High Density Planting of Grafted Bush pepper were established in farmers' fields. Quality planting material of spice crops *viz,* Black pepper, Nutmeg, Cinnamon and turmeric was produced and supplied.
- Extension activities were carried out under STC and SCSP programmes and a new FLD on improved cashew varieties was initiated in Satorlim vada of Goandongrim village in Canacona Zone. A training on Turmeric production, processing and marketing was imparted to Haryana farmers.
- The fish assemblage structure was analyzed and established the functional and ecological status of tropical estuaries; Zuari, Mandovi, Terekhol, Bheemuni, and Kali along the west coast of India. 245 taxa were identified from Zuari (184 taxa), Mandovi (159 taxa), Terekhol (142 taxa), Kali (144), Bheemuni (56) estuaries respectively. The dominant guilds consisted of marine species, both juveniles and seasonal migrants, and carnivores and omnivores.
- At Grande and Nethrani Islands, 52 and 67 fish species were recorded and the maximum taxonomic diversity and Shannon index were observed at mid shelf, followed by shallow and minimum in the deep zone. The pattern of diversity did not differ significantly between the Islands. Cubist model was the best performing machine learning model to predict fish abundance in Zuari estuary based on environmental descriptors- latitude, temperature, salinity, and dissolved oxygen.
- Distributed a total of 2000 ornamental fish seeds, 40 kg of fish feed, 50 kg of freshwater fish, 100 seedlings of aquatic plants to the farmers from Goa and Maharashtra.

Development and validation of production technologies of major crops of coastal region

- The proposal for release of two bacterial wilt resistant brinjal lines *viz.* Goa Brinjal 5 and Goa Brinjal 6 has been submitted to Goa State seed Sub-committee for Agriculture and Horticulture crops, Govt. of Goa. The data of three years indicated that bacterial wilt incidence was less than 4% in these two lines as against 90-100% wilt in susceptible lines. The above lines recorded fruit yield ranged from 17.5 to 28.3 t ha^{-1}.
- In chilli, the major viral disease confirmed symptomatically and by molecular diagnosis was ChiLCV. However, there was no significant difference

of vector population and virus disease symptoms among different management treatments. Higher yield was recorded from insecticide treatment alone and the treatment combined with spray of neem-based product. It was also recorded that the chilli crop is susceptible to viral disease incidence during the major planting season (Dec-Jan). Sequences of coat protein gene of ChiLCV from 18 samples representative of different seasons, different crops and location indicated that there is not significant difference in the viral coat protein sequence among the samples.

- Evaluation of liquid formulation of RCh6-2b on brinjal and tomato indicated that per cent increase of growth parameters was higher in 1:100 (1%) and 1:500 (0.2%) dilutions when sprayed at 10 and 20 days after planting. Novel formulations like capsule and tablet of bacterial bio-agents was standardized. Results indicated that the population was above 9 Log CFU g^{-1} till 18 months. Field evaluation of talc formulation of bacterial bio-agents on chilli disease management revealed reduced soil borne disease incidence in the bio-agent applied plots. Application of talc formulation of bacterial bio-agents (RCh6-2b and STC-4) reduced the incidence of foot rot in black pepper.
- Talc based formulation of Trichoderma was produced and was sold to farmers, used in various experiments and field trials of the Institute. The formulation was used in experiments like black pepper foot rot, papaya evaluation, plants in protected cultivation, chilli root rot/ wilt and etc. Bacterial antagonists (150 kg of RCh6-2b & STC-4) were produced and given to farmer's demonstration plots to treat black pepper plants for management of foot rot and plant growth experiments of paddy.
- Damage incidence of an invasive insect pest Rugose Spiralling Whitefly (RSW) *Aleurodicus rugioperculatus* Martin was recorded in coconut plantations. Besides, coconut RSW infestation and its colonies was recorded on Banana, All spices, Triandra palm, Areca nut, Soar sop, Guava, Mango, Black pepper, Heliconia, Papaya, Citrus, Avocado, Chafa, Indian shot and Maize. The predominant natural enemies found feeding this white fly was predator *Mallada boninensis* Okamoto and parasitoid *Encarsia guadeloupae* Viggiani. Severe incidence of RSW was observed during the months of March – May. An average of 21.9 adults of whitefly was attracted to yellow stick trap.
- The damage incidence of fall armyworm in fodder maize varied from 43.33% to 76.66%. Predators like coccinellids, spiders, reduviid bug, rove beetle, earwig and wasps were found predating on various stages of fall armyworm. Egg parasitoids i.e., *Telenomus* spp and *Trichogramma* spp were found parasitizing the eggs. Average parasitization of 29.38 and 13.40 % was recorded by *Telenomus* spp and *Trichogramma* spp respectively. Number of larvae per plant varied from 0 to 3 and of egg masses per plant varied from 0 to 4. The fall armyworm completed its life cycle in 24.6 days on fodder maize.
- Integrated nutrient mixture improved the vegetative growth characters and induced early flowering in banana varieties, 'Grand Naine' and 'Velchi'. Drip fertigation with 100 % RDF (12:4:12 g NPK per plant per cycle) along with application of ethephon 25 ppm + urea (2 %) + sodium carbonate (0.04%) flower induction treatment produced 2.42 kg and 2.05 kg fruits in pineapple variety 'Giant Kew' main crop and ratoon crop of respectively.
- The coconut yield per palm in the intercropping system was 67 nuts per palm per year. The yield of papaya, heliconia, lemon fruit, pineapple, soursop, and crossandra were 96 kg ha^{-1}, 2240 stems ha^{-1}, 25.12 kg ha^{-1}, 1688.64 kg ha^{-1}, 320 kg ha^{-1}, and 49.92 kg ha^{-1} respectively. Nucleus seed garden of Hirehalli Dwarf (HD) variety of arecanut was established with 271 palms of which 72 are at reproductive stage. The foliar glucose content of the HD (855.26 µg mol^{-1}) was significantly higher than Mangala tall variety (564.43 µg mol^{-1}) and the foliar glucose content can be considered as a diagnostic biochemical assay for selecting the dwarf plants.
- The multi-location trials of brinjal, chilli, tomato and pumpkin are undertaken under this project. The highest fruit yield for brinjal (long), brinjal (round) and brinjal (bacterial wilt resistant) were recorded in 2018/BRLVAR-7 (291.04 q ha^{-1}), 2017/BRRVAR-8 (258.78 q ha^{-1}) and 2016/BRBW-8 (69.86 q ha^{-1}) respectively. While evaluating the entries of tomato hybrid and pumpkin, the highest fruit yield was recorded in 2016/TODHYB-7 (tomato) (339.07 q ha^{-1}) and 2016/PUMPVAR-7 (pumpkin) (305.64 q ha^{-1}) respectively.
- The fresh kokum seed can be fermented for maximum 3 days for better fat recovery (36 to 40%) when compared to 6 days (19 to 24%).
- In jackfruit, the non-edible waste compostion ranged from 50-70%. The total income when sold in form of fresh fruit is ₹ 68,200 (ripe fruits) and ₹ 27,280 (for unripe vegetable type). But, when converted into chips, there was four times increase in net profit, 1.66 times increase when converted into leather; 2.4 times increase, when converted into papad.
- Jackfruit Accessions, BT2, CT3, CT9, CT 12 and Canacona accession were best suitable for chips, in terms of taste, crispiness, size and thickness. Accessions BT 2 , BT 6, BT 7 and Canacona accessions were best suitable for papad, in terms of spreadability and taste.

- The matured jackfruit bulbs stored well for 9-12 months, in 20 to 40% brine solution under ambient conditions, with minimum microbial load of 27 CFU (10^{-1} dilution). The microbial load was almost zero in cold storage in all the treatments.
- A germplasm bank of 115 kokum grafts comprising 19 local accessions, along with two check varieties are being maintained. Accession Kasarpal-11 is showing a promising trend in high yield and fruit quality in the past two years. In 2019 season, the single graft. 4 years old, yielded 117 fruits of 4.78 kg
- Various pre-treatments for improving dehusking of kokum seeds were studied and dry roasting for 10 minutes was found to give the best results.

Development and validation of production technologies of livestock and fisheries

- To standardize the suitable long term cryopreservation protocol for boar semen, attributes of semen quality were experimented using indigenous extenders at different freezing protocols. Four boar cryo protocols (BCP) (BCP-I, BCP-II, BCP-III and BCP-IV (conventional vapour freezing)) were designed. Mean value of post-thaw progressive sperm motility was highest in BCP-III and BCP-II. Mean percentage of live sperms, and acrosome integrity were also found highest in BCP-III and BCP-II. These selected frozen-thawed samples were evaluated for in-vivo fertility status in breeding sows and revealed an overall conception rate of 42.1% and fallowing rate of 10.5% in the initial trials.
- Ovarian perfusion and morphometric data under Real-time B-mode ultrasound (RTU) and Colour Flow Mapping (CFM) modes were monitored and analysed in dairy buffaloes during different seasons using digital Colour Doppler Ultrasound imaging system. Significant difference in diameter of mature pre-ovulatory follicle was recorded between seasons which ranged from 9.9 to 12.4 mm (mean 11.2 ± 0.30) in summer and 16.1 to 18.4 mm (mean 17.42 ± 0.22) in winter. Significantly higher ($p<0.05$) pixel values corresponding to follicular vascularity were also recorded in winter during the mid to late stages of the estrus cycle in dairy buffaloes.
- The surveys and diagnosis in small and large diary units in Goa and Kerala for clinical mastitis and sub-clinical mastitis and further confirmation using CMT and PCR yielded the following Pathogens- *Staphylococcus aureus*, coagulase negative *Staphylococci* (CoNS), *E. coli*, *Bacillus* spp. etc. The antibiotics susceptibility of milk samples from Goa indicated susceptibility for cephalexin, cefotaxin, ceftizoxime, ceftriaxone, and enrofloxacin and resistance for methicillin, penicillin G and streptomycin.
- Swine blood samples from Dakshina Kannada district were collected and viral RNA was extracted and subjected to RT-PCR to detect the Japanese Encephalitis Virus (JEV) RNA. The samples were found negative for JEV RNA.
- Management interventions such as feed formulation (using medicinal herbs and vitamin plants), artificial insemination and disease surveillance were demonstrated for the backyard poultry units along Goa. The data collection on status, socio-economics, constraints and impacts on technological interventions in backyard poultry have been initiated.
- Epidemiological surveillance of pig diseases in Goa were carried out and seroprevalence of Classical Swine Fever (CSF) viruses, Porcine Reproductive Respiratory Syndrome Virus (PRPSV) were confirmed in sera samples. Also seroprevalence of Blue Tounge Virus (BTV) and PPR were confirmed in goat population in Goa. Phylogenetic analysis of ORF virus from goat based on B2 gene was carried out.

Improving livelihood security through post-harvest technologies and other agri- enterprises

- Segregating seedling banana progenies of Sugandhi along with suckers were planted in the field for evaluation. Promising mother plants of banana leaf type Rupa (BB) were sent to State Government Horticulture Farm, Kanyakumari Tamil Nadu for multiplication and distribution to farmers. Coconut populations of Goa state (Rivona, Calangute, Gaodongri, Canacona) were characterized for fruit component analysis, and fruit shape was quantified by the software. Betacyanin rich amaranth genetic stock Goa Arun (AtR 18) IC- 598190 was confirmed by four consecutive years of study.
- Physical, mechanical, and bio-chemical properties of banana pseudostem were studied and a process to make cups from banana pseudostem was standardized.
- Qualitative analysis of phytochemicals of Kirayate/ Kalmegh (*Andorgraphis paniculata*) and Kaala adusa (*Justicia jendarussa*) was carried out. Paper making process from cashew apple pomace the major by-product of the cashew feni industry was optimised.
- Under naturally ventilated conditions with insect nets over vents, the microclimate in single span greenhouse was above the optimum conditions required for a cucumber crop i.e. 32-15°C and 45-60% humidity respectively, except during July and August, when the temperature was in the optimum range and December to May when the day time humidity was in the optimum range.

कार्यकारी सारांश

भाकृअनुप – केन्द्रीय तटीय कृषि अनुसंधान संस्थान (ICAR - CCARI), 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; फसलोत्तर प्रौद्योगिकियां एवं कृषि इकोटूरिज्म के अंतर्गत रणनीतिपरक एवं प्रायोगिक अनुसंधान किया जाता है। अनुसंधान परियोजनाओं को पांच मेगा विषयों में बांटा गया है। वर्ष 2019 के लिए संस्थान की प्रमुख अनुसंधान उपलब्धियों को नीचे प्रस्तुत किया गया है :–

तटीय क्षेत्र के प्राकृतिक संसाधनों का संरक्षण एवं प्रबंधन

- मैन–केंडल (Mann-Kendall) जांच, स्पीयरमैन रो (Spearman's rho) जांच तथा रेखीय समाश्रयण का उपयोग करते हुए भारत में पश्चिम की ओर बहने वाली नदियों की जलधारा में दीर्घावधि मौसमी और वार्षिक रूझान का विश्लेषण किया गया।

- मानसून मौसम में तापी से ताद्री बेसिन में, कोलम, दुर्वेश, गडात, गंजम और नैनीपल्सन में जलधारा का प्रवाह निरन्तर बढ़ा। कुल नौ गॉजिंग स्टेशनों में से चार स्थानों में जलधारा के प्रवाह में बढ़ोतरी का रूझान देखने को मिला।

- मानसून मौसम के दौरान ताद्री से कन्याकुमारी बेसिन में केवल दो स्टेशनों यथा अम्बारपालयम और पटाझी में ही जलधारा के प्रवाह में बढ़ोतरी प्रदर्शित हुई ।

- तटवर्ती महाराष्ट्र और गोवा के कुल सात मौसम स्टेशनों के लिए विभिन्न प्रतिकूल जलवायु सूचकांकों से उत्पन्न दैनिक अधिकतम तापमान, न्यूनतम तापमान और वर्षा के रूझानों की गणना की गई।

- लवणता सहिष्णु चावल जीनप्ररूपों का लक्षणवर्णन करने के लिए नवीन स्पेक्ट्रल सूचकांकों, आंशिक न्यूनतम वर्गाकार समाश्रयण (PLSR) तथा प्रधान संघटक विश्लेषण (PCA) आधारित मशीन लर्निंग मॉडल विकसित किए गए और उनका मूल्यांकन किया गया।

- पैंतीस दिन पुरानी ओल्ड गोवा बायो 1 नर्सरी से उपचारित एक उन्नत लवण सहिष्णु चावल किस्म का पौधरोपण करने और मृदा की जांच पर आधारित उर्वरक संस्तुति अथवा संशोधित ब्लैन्केट उर्वरक प्रयोग को अपनाने वाले रीति पैकेज की पहचान तटवर्ती लवणीय मृदाओं के अंतर्गत उत्पादकता और आय को बढ़ाने हेतु की गई।

- मध्य इन्फ्रारेड़ स्पेक्ट्रोस्कोपी (2500-15000 nm) का प्रयोग लवण प्रभावित मृदाओं की लवणीयता की निगरानी करने में प्रभावी तरीके से किया जा सका क्योंकि यह एक त्वरित, दोहराये जाने योग्य, विश्वसनीय और सस्ती विधि है। 10 nm औसत के स्पेक्ट्रल डाटा के सैविटजकाई–गोलेय मानक सामान्य विचलन में आंशिक न्यूनतम वर्गाकार समाश्रयण की स्पेक्ट्रल कलनविधि अथवा एल्गोरिद्म द्वारा मृदा की लवणता का पता लगाने हेतु उत्कृष्ट सटीकता प्रदान की गई।

- फसल – डेयरी – मत्स्य पालन संघटकों को शामिल करते हुए चावल आधारित एकीकृत कृषि प्रणाली (IFS) मॉडल को उष्णकटिबंधीय निचली भूमि परिस्थितियों के लिए 0.5 हेक्टेयर क्षेत्रफल में मानकीकृत किया गया। फसलों, डेयरी पालन और मत्स्य पालन से शुद्ध लाभ में अधिकतम योगदान (रूपये 1.39 लाख) किया गया। इस प्रणाली के माध्यम से कुल 339 मानवदिवस का रोजगार उत्पन्न किया गया। रोपण फसलों, फलदार फसलों, सूअर पालन, कुक्कुट पालन और वर्मी कम्पोस्ट को शामिल करते हुए उच्च भूमि वाले एकीकृत कृषि प्रणाली मॉडल में रूपये 1.73 लाख का राजस्व और रूपये 1.18 लाख का शुद्ध लाभ हासिल किया गया। इस राजस्व में सूअर पालन और काजू–अनानास कृषि प्रणाली द्वारा प्रमुख योगदान दिया गया।

- उच्च भूमि परिस्थिति में एकीकृत कृषि प्रणाली (IFS) मॉडल में कुल रूपये 1.73 लाख का समग्र लाभ और रूपये 1.18 का शुद्ध लाभ हासिल किया गया। शुद्ध लाभ में सबसे अधिक योगदान सूअर पालन इकाई (42 प्रतिशत) का और उसके उपरान्त काजू–अनानास प्रणाली (25 प्रतिशत) का था।

- चावल आधारित फसलचक्र प्रणालियों में, विभिन्न प्रकार की जुताई प्रबंधन रीतियों यथा धान की पंकिल अथवा गीली रोपाई (PTR) – पीटीआर, धान की सीधी बीजाई (DSR) – डीएसआर, चावल–मूंग, चावल – लोबिया तथा चावल – बेबी कॉर्न को आजमाया गया। सबसे अधिक उपज को धान की पंकिल रोपाई (PTR) में हासिल किया गया जबकि इसके उपरान्त सेस्बेनिया (5.11 टन प्रति हेक्टेयर) की भूरी खाद के साथ धान की सीधी बीजाई विधि में हासिल किया गया।

- पुनः जुताई प्रबंधन रीतियों का मृदा की भिन्न विशेषताओं पर कोई प्रभाव नहीं पाया गया। उच्चतर मृदा जैविक कार्बन (मान), उपलब्ध नाइट्रोजन (125 किग्रा./हे.), फॉस्फोरस (13 किग्रा./हे.) और पोटेशियम (135 किग्रा./

हे.) को सेस्बेनिया की भूरी खाद के साथ धान की सीधी बीजाई करने पर हासिल किया गया।

तटवर्ती क्षेत्र में आनुवंषिक संसाधनों का संरक्षण एवं उपयोगिता

- गोवा, उत्तर कन्नड़ और शिमोगा से बारह लिंकेज समूह को शामिल करते हुए कृषि आकृतिविज्ञान और 34 सिम्पल सिक्वेंश रिपीट (SSR) मार्कर्रों के आधार पर चावल जननद्रव्य का लक्षणवर्णन किया गया। एसएसआर मार्कर्रों का उपयोग करके आणविक लक्षणवर्णन करने पर 148 युग्मविकल्पी उत्पन्न हुए और कलस्टर विश्लेषण द्वारा चार भिन्न कलस्टरों में कुल 153 चावल जीनप्ररूपों को एकत्रित किया गया और इसमें प्रत्येक कलस्टर को पुनः दो उप क्लस्टर में विभाजित किया गया।

- सूक्ष्म प्लॉट में पौद अवस्था में लवण दबाव के लिए कुल 71 चावल जीनप्ररूपों की फिनोटाइपिंग की गई। लवण दबाव के प्रति जीनप्ररूपों की प्रतिक्रिया के आधार पर, मानक सहिष्णु तुलनीय किस्मों पोक्काली और एफएल 47 के समान 3 – 4 की मानक मूल्यांकन प्रणाली (SES) स्कोरिंग के साथ दस जीनप्ररूप यथा कोरगुट, कग्गा, जीडब्ल्यूआर 005, सीएसटी 7–1, पनवेल 1, केएस 4, केएस 19–2, गोवा धान 2 (केएस 17), जीआरएस 1, पोक्काली सहिष्णु पाए गए। साल्टोल क्यूटीएल लिंक्ड मार्कर्रों का उपयोग करके जीनप्ररूपों की हैप्लो टाइपिंग करने से पता चला कि तीन जीनप्ररूप नामतः गोवा धान 2, पनवेल 1 और जीडब्ल्यूआर 005 अपने युग्मविकल्पी निर्माण में एफएल 478 से पूरी तरह से भिन्न पाए गए।

- जारी की गईं लवण सहिष्णु चावल किस्मों यथा गोवा धान 1, गोवा धान 2, गोवा धान 3 तथा गोवा धान 4 और लोबिया की किस्म गोवा काउपी 3 का कुल 16.5 प्रजनक बीज उत्पादन संस्थान के फार्म पर किया गया। संस्थान के फार्म पर और साथ ही भागीदारी बीज उत्पादन रीति के माध्यम से किसानों के खेतों पर धान में अन्य प्रमुख किस्मों यथा करजत 3, ज्योति और जया तथा मूंग में टीएम 96–2 एवं आईपीआर 2–14 का विश्वसनीय लेबल्ड बीज उत्पादन किया गया ।

- खरीफ मौसम के दौरान दस हेक्टेयर कृषि क्षेत्रफल को कवर करते हुए गोवाडोंगरिम गांव में उच्चभूमि परिस्थिति में चावल की अधिक पैदावार देने वाली किस्म 'सहभागी ध ाान' का अग्रिम पंक्ति प्रदर्शन लगाया गया। सहभागी धान किस्म में उच्चभूमि परिस्थिति के तहत औसतन 4.0 से 4.5 टन प्रति हेक्टेयर की दाना उपज हासिल की गई जबकि इसकी तुलना में मौजूदा किस्मों यथा ज्योति और करजत 3 में 3.0 से 3.5 टन प्रति हेक्टेयर की दाना उपज ही दर्ज की जा सकी। उच्च लवणीय परिस्थिति के तहत रबी मौसम के दौरान दक्षिणी गोवा कृषि विज्ञान केन्द्र के दुर्गा फार्म पर अधिक पैदावार देने वाली लवण सहिष्णु चावल किस्मों यथा गोवा धान 3 एवं गोवा धान 4 के व्यापक स्तरीय प्रदर्शन लगाए गए।

- आम की स्थानीय किस्मों नामतः कारदोजो मनकुराड, कोस्टा, बिन्दाओ, मैक्सिमा और कोटा में नियमित फलन प्रवृति देखने को मिली जबकि फल की गुणवत्ता कारदोजो मनकुराड में उत्कृष्ट के समतुल्य थी। मनकुराड के चार परिवर्त और हिलेरियो के तीन परिवर्त में आकर्षक गूदा और छिलका रंग के साथ उच्चतर गूदा मात्रा और उच्चतर कुल घुलनशील ठोस पदार्थ अंश पाया गया जिससे इनकी आशाजनक फल गुणवत्ता का पता चलता है। आम के जननद्रव्य संकलन जिनका रखरखाव तीन ब्लॉकों में किया जा रहा है, में कुल 144 प्राप्तियां/किस्में शामिल हैं। कारदोजो मनकुराड और हिलेरियो 2/18 तथा 3/18 के कलम बैंक की स्थापना की गई। जायफल जननद्रव्य प्राप्तियों में, एनएमएफ 6, एनएमडी 1 एवं एनएमडी 2 में आशाजनक उपज प्रदर्शन बना रहा। किसान के खेत में पहचाने गए जायफल के एक आशाजनक जीनप्ररूप नामतः तमसुली–1 को बड़े दाना आकार, प्रति फल उच्चतर जावित्री मात्रा और उच्चतर उपज प्रवृति के लिए किस्मीय प्रस्ताव हेतु छांटा गया।

- आधा (0.5) हेक्टेयर कृषि रकबे (दस फसल संघटक एवं कुक्कुट पालन) में नारियल आधारित बहु प्रजाति फसलचक्र प्रणाली में कुल 2.53 लाख रूपये की कुल आय उत्पन्न हुई । सृजित कुल आय में फसलों, कुक्कुट पालन तथा फसल अपशिष्ट की हिस्सेदारी क्रमशः 53 प्रतिशत, 33.8 प्रतिशत और 13.2 प्रतिशत थी। रोपण सामग्री का उत्पादन भी एक अतिरिक्त गतिविधि है जिसका कुल आय में योगदान रहता है।

- जम्बो गिरी टाइप, बड़े आकार की गिरी वाले, गुच्छे में फल धारण करने वाले और उच्च उपजशील जीनप्ररूपों को शामिल करके विभिन्न समूहों का प्रतिनिधित्व करने वाली काजू की कुल 97 जननद्रव्य प्राप्तियों का रखरखाव खेत जननद्रव्य बैंक में किया जा रहा है। काजू की प्राप्ति नामतः टुडाल–1 में लगातार अच्छा प्रदर्शन देखने को मिला जिसमें प्रति वृक्ष 8.88 किग्रा. गिरी उपज, 8.4 ग्राम गिरी भार, 28.1 प्रतिशत शेलिंग, 88.6 ग्राम का औसम फल भार एवं 10.8 प्रतिशत ब्रिक्स मान दर्ज किया गया। इसी प्रकार, एचबी–21/05 और 27/05 में भी आशाजनक अथवा अच्छा प्रदर्शन देखने को मिला।

- एमआईडीएच कार्यक्रम के अंतर्गत, किसानों के खेतों में कलमबंधन अथवा ग्राफिट्ड बुश पेपर के उच्च सघनता रोपण पर चार अग्रिम पंक्ति प्रदर्शन आयोजित किए गए। मसाला फसलों यथा काली मिर्च, जायफल, दालचीनी और हल्दी की गुणवत्ता रोपण सामग्री का उत्पादन किया गया और उसकी आपूर्ति की गई।

- एसटीसी तथा अनुसूचित जाति उप–योजना (SCSP)

कार्यक्रमों के अंतर्गत प्रसार गतिविधियां चलाईं गईं और कैनकोना जोन में गोवाडोंगरिम गांव के सैटारलीमवाडा में काजू की उन्नत किस्मों पर एक नया अग्रिम पंक्ति प्रदर्शन शुरू किया गया। हरियाणा राज्य के किसानों को हल्दी के उत्पादन, प्रसंस्करण तथा मार्केटिंग पर प्रशिक्षण प्रदान किया गया।

- मत्स्य एसेम्बलेज संरचना का विश्लेषण किया गया और चार उष्णकटिबंधीय मानसूनी नदीमुख यथा जुआरी, मान्डोवी, टेरेखोल, भीमुनी और भारत के पश्चिमी तट के साथ साथ काली की कार्यपरक और इकोलॉजिकल स्थिति को स्थापित किया गया। जुआरी (184 वर्ग), मान्डोवी (159 वर्ग), टेरेखोल (142 वर्ग), काली (144), भीमुनी (56) नदीमुख से कुल 245 मत्स्य वर्ग अथवा समूहों की पहचान की गई। प्रमुख गिल्ड में समुद्री प्रजातियां, दोनों किशोर एवं सीजनल प्रवासी, और मांसभक्षी तथा सर्वाहारी शामिल थीं।

- ग्रैण्ड तथा नेथरानी द्वीपसमूह में क्रमशः 52 एवं 67 मत्स्य प्रजातियों को रिकॉर्ड किया गया और अधिकतम वर्गीकरण विविधता एवं शैनन सूचकांक को मध्य शेल्फ में पाया गया जबकि तदुपरान्त उथले जोन में पाया गया । सबसे न्यूनतम को गहरे जोन में पाया गया। दोनों द्वीपसमूहों के बीच विविधता पैटर्न में कोई विशेष भिन्नता नहीं थी। पर्यावरणीय वर्णन यथा अक्षांश अथवा विस्तार, तापमान, लवणता तथा घुलनशील ऑक्सीजन के आधार पर जुआरी नदीमुख में मत्स्य की प्रचुरता का पूर्वानुमान करने हेतु सबसे अच्छा प्रदर्शन करने वाला मशीन लर्निंग मॉडल कुबिस्ट मॉडल था।

- गोवा एवं महाराष्ट्र राज्य के किसानों को 2000 अलंकारिक मत्स्य बीज, 40 किग्रा. मत्स्य आहार, 50 किग्रा. मीठाजल मत्स्य, जलीय पौधों की 100 पौद का वितरण किया गया।

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

- बैंगन के दो जीवाण्विक मुरझान प्रतिरोधी वंशक्रमों यथा गोवा ब्रिंजल 5 एवं गोवा ब्रिंजल 6 को जारी करने का प्रस्ताव कृषि एवं बागवानी फसलों के लिए गोवा राज्य बीज उप–समिति, गोवा सरकार को प्रस्तुत किया गया है। तीन वर्षों के आंकड़ों से पता चलता है कि इन दोनों वंशक्रमों में जीवाण्विक मुरझान प्रकोप 4 प्रतिशत से भी कम था जबकि इनके मुकाबले में संवेदनशील वंशक्रमों में यह 90 से 100 प्रतिशत था। उपरोक्त वंशक्रमों में प्रति हेक्टेयर 17.5 से 28.3 टन की फल उपज दर्ज की गई।

- मिर्च में, प्रमुख वायरल रोग द्वारा लक्षणों की पुष्टि की गई और आणविक निदान द्वारा पहचाना गया रोग ChiLCV था। हालांकि, विभिन्न प्रबंधन उपचारों के बीच वेक्टर संख्या तथा वायरस रोग लक्षणों में कोई उल्लेखनीय भिन्नता नहीं थी। अकेले कीटनाशक उपचार से और नीम आधारित उत्पाद के छिड़काव के साथ संयोजित उपचार से उच्चतर उपज दर्ज की गई। यह भी पाया गया कि प्रमुख रोपण सीजन (दिसम्बर से जनवरी) के दौरान, मिर्च की फसल वायरल रोग प्रकोप के प्रति संवेदनशील है। विभिन्न सीजन, विभिन्न फसलों तथा स्थानों के 18 नमूना प्रतिनिधियों से ChiLCV के आवरण प्रोटीन जीन के अनुक्रमों से पता चला कि नमूनों के बीच वायरल आवरण प्रोटीन अनुक्रम में कोई उल्लेखनीय भिन्नता नहीं है।

- बैंगन और टमाटर पर RCh 6 – 2 b के तरल फार्मुलेशन का मूल्यांकन करने पर पता चला कि रोपाई के उपरान्त जब 10 एवं 20 दिनों पर छिड़काव करने पर बढ़वार पैरामीटरों में प्रतिशत वृद्धि 1 : 100 (1 प्रतिशत) और 1 : 500 (0.2 प्रतिशत) विलयन में उच्चतर थी। जीवाण्विक जैव एजेन्टों के कैप्सूल और गोली अथवा गुटिका जैसे नवीन फार्मुलेशन का मानकीकरण किया गया। परिणामों से पता चला कि 18 माह तक जीवाणु की संख्या अथवा पापुलेशन 9 Log CFU/g से अधिक थी। मिर्च के रोग प्रबंधन पर जीवाण्विक जैव एजेन्टों के पाउडर फार्मुलेशन का खेत मूल्यांकन करने पर जैव एजेन्टों का प्रयोग करने वाले प्लॉटों में मृदाजनित रोग प्रकोप में कमी देखने को मिली। जीवाण्विक जैव एजेन्टों (RCh 6-2b तथा STC 4) के पाउडर फार्मुलेशन का प्रयोग करने पर काली मिर्च में पाद सड़न का प्रकोप कम हुआ।

- ट्राइकोडर्मा का पाउडर आधारित फार्मुलेशन उत्पन्न किया गया और उसे किसानों को बेचा गया। इसका उपयोग विभिन्न प्रयोगों में और संस्थान के खेत परीक्षणों में किया गया। इस फार्मुलेशन का उपयोग काली मिर्च के पाद सड़न, पपीता का मूल्यांकन, संरक्षित कृषि प्रणाली में पौधों, मिर्च के जड़ सड़न/मुरझान आदि जैसे प्रयोगों में किया गया। जीवाण्विक प्रतिरोधी (RCh6-2b एवं STC 4 का 150 किलोग्राम) उत्पन्न किया गया और उसे किसानों के प्रदर्शन प्लॉटों में प्रयोग करने के लिए प्रदान किया गया ताकि पाद सड़न के प्रबंधन हेतु काली मिर्च के पौधों का उपचार किया जा सके और धान के पादप बढ़वार परीक्षण ों में इनका उपयोग किया जा सके।

- नारियल के बगीचों में एक आक्रामक कीट नाशीजीव रूगोज स्पाइरैलिंग सफेद मक्खी (RSW) एल्यूरोडाइकस रूजियो पर्कुलेटस मार्टिन को रिकॉर्ड किया गया। इसके अलावा, इसका संक्रमण और इसकी बसावट अथवा कॉलोनी को केला, सभी प्रजातियों, ट्राइंडरा ताड़, सुपारी, सोर सोप, अमरूद, आम, काली मिर्च, हेलिकोनिया , पपीता, नींबूवर्गीय फसलों, एवोकैडो अथवा नाशपाती, चैफा, इंडियन शॉट और मक्का में रिकार्ड किया गया। इस सफेद मक्खी पर पलने वाले प्रबल प्राकृतिक शत्रु था परभक्षी मैलाडा बोनीनेन्सिस ओकामोटो और परजीव्याभ इनकार्सिया ग्वाडेलॉपी विगियानी । मार्च से मई माह के दौरान रूगोज स्पाइरैलिंग सफेद मक्खी (RSW) एल्यूरोडाइकस रूजियो पर्कुलेटस मार्टिन का गंभीर प्रकोप दर्ज किया

गया। सफेद मक्खी के औसतन 21.9 वयस्क पीले चिपचिपे ट्रैप में फंसे।

- चारा मक्का की फसल में फॉल आर्मीवर्म के कारण होने वाले नुकसान प्रकोप में 43.33 से 76.66 प्रतिशत की भिन्नता देखने को मिली। फॉल आर्मीवर्म की विभिन्न अवस्थाओं पर कॉक्सीनेलिड्स, मकड़ी, रेडुविड बग, रोव भृंग, इयरविग तथा भिड़ अथवा वास्प जैसे परभक्षी पाए गए। अण्डा परजीव्याभ यथा टेलेनोमस प्रजातियां एवं ट्राइकोग्रामा प्रजातियां अण्ड़ों पर परजीवी पाई गईं। टेलेनोमस प्रजातियों एवं ट्राइकोग्रामा प्रजातियों द्वारा औसतन क्रमशः 29.38 एवं 13.40 प्रतिशत की परजीविता दर्ज की गई। प्रति पौधा लार्वा की संख्या में 0 से 3 तक और प्रति पौधा अण्डा द्रव्यमान में 0 से 4 की भिन्नता थी। फॉल आर्मीवर्मी द्वारा चारा मक्का की फसल पर 24.6 दिनों में अपना जीवनचक्र पूरा किया गया।

- केले की किस्मों यथा 'ग्रैण्ड नैने' तथा 'वेल्ची' में एकीकृत पोषक तत्व मिश्रण का प्रयोग करने पर शाकीय वृद्धि गुणों में सुधार देखने को मिला और साथ ही अगेती पुष्पन हुआ। इथेफॉन 25 पीपीएम + यूरिया (2 प्रतिशत) + सोडियम कार्बोनेट (0.04 प्रतिशत) के पुष्प उत्प्रेरण उपचार का प्रयोग करने के साथ 100 प्रतिशत आरडीएफ (12 : 4 : 12 ग्राम नाइट्रोजन, फॉस्फोरस, पोटेशियम/पौधा/चक्र) के साथ ड्रिप उर्वरीकरण करने पर अनानास की किस्म 'जिआंट कीव' मुख्य फसल और रैटून फसल में क्रमशः 2.42 किलोग्राम और 2.05 किलोग्राम फल उत्पादन हुआ।

- अंतर फसलचक्र प्रणाली में प्रति ताड़ नारियल की उपज प्रति वर्ष प्रति ताड़ 67 फल दर्ज की गई। पपीता, हेलिकोनिया , लेमन फल, अनानास, सोरसोप तथा क्रासैण्ड्रा की उपज प्रति हेक्टेयर क्रमशः 96 किलोग्राम, 2240 तने, 25.12 किलोग्राम, 1788.64 किलोग्राम, 320 किलोग्राम एवं 49.92 किलोग्राम दर्ज की गई। सुपारी किस्म हिरेहल्ली डवार्फ (HD) के केन्द्रक बीज बगीचे की स्थापना कुल 271 ताड़ पौधों के साथ की गई जिसमें से 72 पौधे पुनर्जनन अवस्था में हैं। हिरेहल्ली डवार्फ में पर्णीय ग्लूकोज मात्रा (855.26 µg mol-1) मंगला टॉल किस्म (564.43 µg mol-1) की तुलना में उल्लेखनीय रूप से कहीं ज्यादा थी । ग्लूकोज की मात्रा पर बौने पौधों का चयन करने के लिए एक नैदानिक जैव रासायनिक आमाप के रूप में विचार किया जा सकता है।

- इस परियोजना के अंतर्गत, बैंगन, मिर्च, टमाटर और कद्दू के बहु स्थानिक परीक्षण किए गए। बैंगन (लंबा), बैंगन (गोल) तथा बैंगन (जीवाण्विक मुरझान प्रतिरोधी) के लिए सबसे अधिक फल उपज क्रमशः 2018/BRLVAR-7 (291.04 क्विंटल/हेक्टेयर), 2017/BRRVAR-8 (258.78 क्विंटल/हेक्टेयर) तथा 2016/BRBW-8 (69.86 क्विंटल/हेक्टेयर) में दर्ज की गई। जबकि संकर टमाटर और कद्दू की किस्मों का मूल्यांकन करते समय, अधिकतम फल उपज को 2016/TODHYB-7 (टमाटर) (339.07 क्विंटल/हेक्टेयर) एवं 2016/PUMPVAR-7 (कद्दू) (305.64 क्विंटल/हेक्टेयर) में दर्ज किया गया।

- छः दिनों तक किण्वित किए जाने की तुलना में वसा की वसूली (36 से 40 प्रतिशत) के लिए अधिकतम तीन दिनों तक कोकुम के ताजा बीजों को किण्वित किया जा सकता है ।

- कटहल में, गैर खाने योग्य अपशिष्ट प्रतिशत की सीमा 50 से 70 प्रतिशत थी। ताजा फल के रूप में बेचने पर कुल आमदनी रूपये 68,200/– (पके हुए फल) तथा रूपये 27,280/– (कच्चे सब्जी टाइप फल) है। लेकिन जब इनकी चिप्स बनाईं गईं तब शुद्ध लाभ में चार गुणा तक, चमड़ा तैयार करने पर 1.66 गुणा तक और पापड़ बनाने पर 2.4 गुणा तक बढ़ोतरी हुई ।

- स्वाद, कुरकुरापन, आकार और मोटाई के संबंध में कटहल प्राप्तियां यथा बीटी 2, सीटी 3, सीटी 9, सीटी 12 एवं कैनाकोना प्राप्ति चिप्स बनाने के लिए सबसे अच्छी थीं। विस्तार क्षमता एवं स्वाद के मामले में पापड़ बनाने के लिए प्राप्तियां बीटी 2, बीटी 6, बीटी 7 एवं कैनाकोना प्राप्तियां सबसे अधिक उपयुक्त पाई गईं।

- परिवेशी परिस्थितियों के तहत 20 से 40 प्रतिशत ब्राइन घोल में परिपक्व कटहल कंदों को 9 से 12 माह तक भण्डारित किया गया जिनमें 27 CFU (10^{-1} विलयन) का न्यूनतम सूक्ष्मजीव भार था। सभी उपचारों में शीत भण्डार में सूक्ष्मजीव भार लगभग शून्य था।

- दो तुलनीय किस्मों के साथ कुल 19 स्थानीय प्राप्तियों को शामिल करते हुए 115 कोकुम ग्राफ्टस के एक जननद्रव्य बैंक का रखरखाव किया जा रहा है। प्राप्ति कासरपल–11 में पिछले दो वर्षों में उच्च उपज एवं फल गुणवत्ता में आशाजनक रूझान प्रदर्शित हो रहा है। वर्ष 2019 के सीजन में, चार वर्ष पुरानी एकल ग्राफ्ट अथवा कलम में 4.78 किलोग्राम के कुल 117 फल उत्पन्न हुए।

- कोकुम बीजों से छिलका हटाने में सुधार लाने के लिए अनेक पूर्व–उपचारों का अध्ययन किया गया और दस मिनट तक सूखा भूनने वाले उपचार से सबसे अच्छे परिणाम मिले।

पषुधन एवं मात्स्यिकी की उत्पादन प्रौद्योगिकियों का विकास एवं प्रमाणन

- सूअर अथवा वराह के वीर्य के लिए उपयुक्त दीर्घावधि हिम परिरक्षण प्रोटोकॉल का मानकीकरण करने के लिए विभिन्न फ्रीजिंग प्रोटोकॉल पर स्वदेशी एक्सटेंडर्स का उपयोग करते हुए वीर्य गुणवत्ता विशेषताओं पर प्रयोग किए गए। इस कार्य के लिए चार सूअर क्रायो प्रोटोकॉल (BCP)

(BCP-I, BCP-II, BCP-III तथा BCP-IV (पारम्परिक वास्प फ्रीजिंग) की डिजाइन तैयार की गई। BCP-III तथा BCP-II में पिघलने के उपरांत (post thaw) प्रगतिशील शुक्राणु मृत्युदर का औसत मान सबसे अधिक पाया गया। सजीव शुक्राणु का औसत प्रतिशत और एक्रोसम अखण्डता भी BCP-III तथा BCP-II में सबसे अधिक पाई गई। इन चुने गए फ्रोजन थॉव्ड नमूनों का मूल्यांकन प्रजनक मादा सूअर में स्वः जीवे उर्वरता स्थिति के लिए किया गया और प्रारंभिक परीक्षणों में 42.1 प्रतिशत की समग्र गर्भधारण दर तथा तदुपरान्त 10.53 प्रतिशत की दर दर्ज की गई।

- विभिन्न मौसमों के दौरान डेयरी भैंस पशुओं में यथार्थ समय B - मोड अल्ट्रासाउण्ड (RTU) तथा कलर फ्लो मैपिंग (CFM) मोड के तहत डिम्बग्रंथि विस्तार एवं आकारिकी डाटा की निगरानी की गई और उनका विश्लेषण किया गया तथा इस कार्य में डिजिटल कलर डॉपलर अल्ट्रासाउण्ड इमेजिंग प्रणाली का उपयोग किया गया। भिन्न सीजन के बीच परिपक्व पूर्व–अंडाकार कूप अथवा फॉलीकल के व्यास में उल्लेखनीय भिन्नता देखने को मिली जो कि गर्मियों में 9.9 से 12.4 मिमी. (माध्य 11.2 $\pm$ 0.30) तथा सर्दियों में 16.1 से 18.4 मिमी. (माध्य 17.42 $\pm$ 0.22) की सीमा में थी। डेयरी भैंस में मदकाल चक्र की मध्य से पछेती अवस्था के दौरान सर्दी के मौसम में फॉलीकुलर वस्कुलेरिटी के सादृश्य उल्लेखनीय उच्चतर ($p<0.05$) पिक्सल मान भी दर्ज किए गए।

- क्लीनिकल थनैला अथवा स्तनशोथ और उप क्लीनिकल थनैला के लिए एवं साथ ही सीएमटी एवं पीसीआर का उपयोग करते हुए पुनः पुष्टि करने के लिए गोवा व केरल राज्य में लघु एवं बड़ी डेयरी इकाइयों में सर्वे और रोग का पता लगाने का कार्य किया गया जिसमें निम्नलिखित रोगजनकों यथा स्टेफाइलोकोकस ऑरियस , कॉगुलेज निगेटिव स्टेफाइलोकॉक्सी (CoNS), ई. कोलाई , बैसिलस प्रजातियां आदि का पता चला। गोवा राज्य से दूध नमूनों की प्रति–जैविक संवेदनशीलता से सिफालेक्सिन, सिफोटैक्सिन, सेफ्टीजोक्साइम, सेफिट्रयाक्सोन, तथा इनरोफ्लोक्सासिन के प्रति संवेदनशीलता तथा मेथीसिलिन, पेन्सीलिन जी एवं स्ट्रेप्टोमायसिन के प्रति प्रतिरोधिता का पता चला।

- दक्षिण कन्नड़ जिले से स्वाइन रक्त नमूनों को संकलित किया गया और जैपनीज इन्सेफैलाइटिस वायरस (JEV) आरएनए का पता लगाने हेतु आरटी–पीसीआर करके वायरल आरएनए को अलग किया गया। जैपनीज इन्सेफैलाइटिस वायरस (JEV) आरएनए के लिए नमूने निगेटिव पाए गए।

- गोवा राज्य में अहाता कुक्कुट पालन इकाइयों के लिए प्रदर्शन प्रयोजन हेतु आहार फार्मुलेशन (औषधीय जड़ी–बूटियों एवं विटामिन पौधों का उपयोग करके), कृत्रिम निषेचन तथा रोग निगरानी जैसे प्रबंधन हस्तक्षेप किए गए। अहाता कुक्कुट पालन में प्रौद्योगिकीय हस्तक्षेपों के स्तर, सामाजिक–आर्थिक स्थिति, बाधाओं और प्रभावों पर आंकड़ों को संकलित करने की पहल की गई।

- गोवा राज्य में सूअर रोग का महामारीविज्ञान सर्विलांस किया गया और सेरा नमूनों में क्लासिकल स्वाइन फीवर (CSF) वायरस , पार्सिन रिप्रोडक्टिव रेसपाइरेटरी सिन्ड्रोम वायरस (PRPSV) की सेरो मौजूदगी की पुष्टि की गई। इसके साथ ही, गोवा राज्य में बकरी संख्या में ब्लू टंग वायरस (BTV) तथा पीपीआर की सेरो मौजूदगी की पुष्टि भी की गई। बी–2 जीन के आधार पर बकरी से ओआरएफ वायरस का जातिवृतीय विश्लेषण किया गया।

फसलोत्तर प्रौद्योगिकियों एवं अन्य कृशि उद्यमों के माध्यम से आजीविका सुरक्षा में सुधार करना

- मूल्यांकन प्रयोजन के लिए सकर्स के साथ सुगन्धि की अलग की गईं केला संततियों की पौद को रोपा गया। राज्य सरकार बागवानी फार्म, कन्याकुमारी, तमिल नाडु को केला पत्ती टाइप रूपा (BB) के आशाजनक मातृ पौधों को भेजा गया ताकि इनका गुणनीकरण करके उसका वितरण किसानों को किया जा सके। गोवा राज्य की नारियल संख्या (रिवोना, कैलान्गुट, गोवाडोंगरी, कैनाकोना) का लक्षणवर्णन फल संघटक विश्लेषण के लिए किया गया और सॉफ्टवेयर द्वारा फल आकृति का परिमाणन किया गया। चार वर्ष तक लगातार अध्ययन के माध्यम से बीटासायनिन से भरपूर चौलाई अथवा एमरन्थ आनुवंशिक स्टॉक गोवा अरूण (AtR 18) आईसी–598190 की पुष्टि की गई।

- केला स्यूडोस्टेम अथवा विभज्योतक की भौतिक, मैकेनिकल एवं जैव रासायनिक विशेषताओं का अध्ययन किया गया और केला स्यूडोस्टेम से कप बनाने की प्रकिया का मानकीकरण किया गया।

- किरायटे/कालमेघ (एण्डोग्राफिस पैनिकुलेटा) तथा काला अडुसा (जस्टीसिया जेन्डारूसा) के पादप रसायनों का गुणात्मक विश्लेषण किया गया। काजू फेनी उद्योग से निकलने वाले प्रमुख उपोत्पाद काजू फल गूदे से पेपर बनाने की प्रकिया को अनुकूल बनाया गया।

- खीरावर्गीय फसलों के लिए वेन्ट्स की तुलना में कीटरोधी नेट अथवा जाल वाली प्राकृतिक रूप से हवादार परिस्थितियों के तहत, ग्रीनहाउस की अकेली अवधि में सूक्ष्म जलवायु के लिए वांछित अनुकूल परिस्थितियों में तापमान 32 – 15^0 सेल्सियस तथा आपेक्षिक आर्द्रता 45 से 60 प्रतिशत थी । ऐसा केवल जुलाई और अगस्त में नहीं था जब तापमान अनुकूल सीमा में था और दिसम्बर से मई के दौरान जब दिन के समय आर्द्रता अपनी अनुकूल सीमा में थी।

INTRODUCTION

The ICAR Research Complex for Goa was estabilshed in April 1976. After a short spell working as a part of ICAR Research Complex for North East Hill Region, the institute was brought under the administrative and technical control of the ICAR-Central Plantation Crops Research Institute (ICAR-CPCRI), Kasaragod, Kerala. After functioning at different Government agricultural farm sites in Goa, the location was finally shifted to Ela, Old Goa in 1982. To intensify the transfer of technology and to impart grass-root level vocational training, a Krishi Vigyan Kendra was also established at the Research Complex in 1983. 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 the state of Goa.

The total length of the coastline of India is 7516.6 km, of which 5422.6 km is with the mainland and 2094 km is for the Island. There is a total of 67 coastal districts in mainland states, 7 districts in mainland union territories, 3 districts in Andaman and Nicobar Islands, and 1 district in Lakshadweep. The total population of the coastal districts of India is 171 million, which is 14.2% of the total population of India. The major activities in the coastal region include agriculture and allied sectors, tourism, mining, industries, shipping transport, etc. The research activities of the Institute were earlier confined to the agriculture needs of Goa, and now the Institute has been further upgraded to ICAR- Central Coastal Agricultural Research Institute since 2014 to cater the 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 natural resource base for sustainable productivity, to develop climate-resilient land use and farming systems and agro-ecotourism.

The Institute is headed by the Director, who is supported by 20 Scientists, 18 Technical, 21 Administrative and 28 Skilled supporting staff, making the total staff strength of the Institute to 88.

The important areas of research of the Institute are 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; dissemination of PFZ advisories and validation of advisories; modelling the ecological dynamics of estuaries and fisheries assessment and fish diversity of coastal ecosystems. The Institute is also engaged in the transfer of technology through FLD's, trainings, awareness camps, demonstrations, and 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.

Mission

- Introduction and improvement of all potential crops and various species/breeds of livestock and scientific exploitation of various aquatic resources for improving fish production.

Mandate

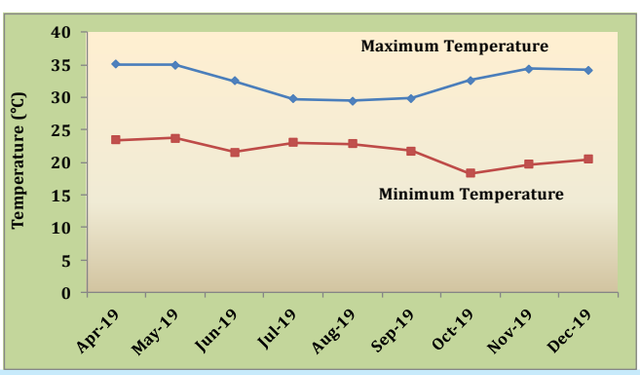
- Researches on the field and horticultural crops, livestock, and fisheries relevant to the natural resource base of coastal India for sustainable productivity.
- Develop climate-resilient land use and farming systems for improved and sustainable livelihood through coastal agriculture.
- Act as a centre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

WEATHER REPORT

Information on the weather parameters is of a great importance for agricultural production. Weather data is being continuously recorded by the Institute since 2002. Observations made during April 2019 to December 2019 are discussed here.

Air temperature

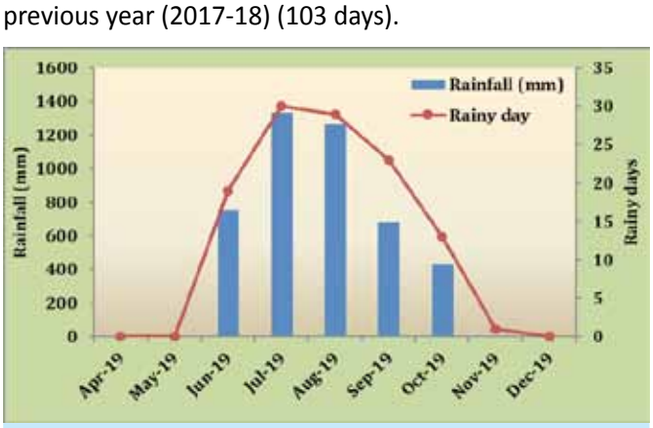
Mean monthly maximum temperature during April 2019 to December 2019 varied from 29.4 °C (August 2019) to 35.0 °C (April and May 2019), whereas mean minimum temperature varied from 18.3 °C (October 2019) to 23.7 °C (May 2019).



Mean maximum and minimum air temperature during April to December 2019

Rainfall and rainy days

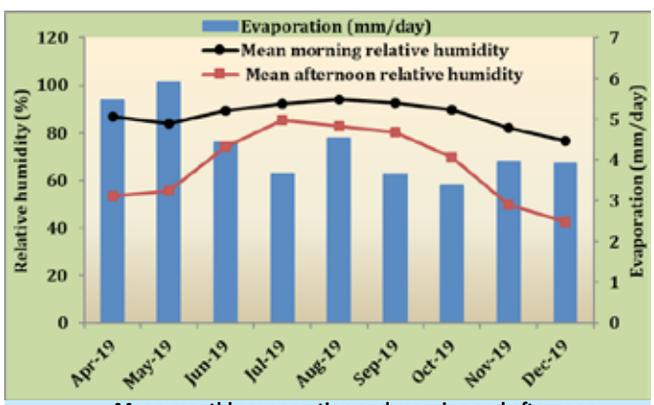
The total rainfall received during April to December 2019 was 4470.6 mm. Total rainfall of 4035.4 mm was received during kharif (June to September 2019). The annual rainfall for this year was 1697.6 mm higher than that of 2018-19 (2773.0 mm). The number of rainy days observed were 115 which was higher compared to previous year (2017-18) (103 days).



Trend of mean monthly rainfall and number of rainy days

Evaporation and relative humidity

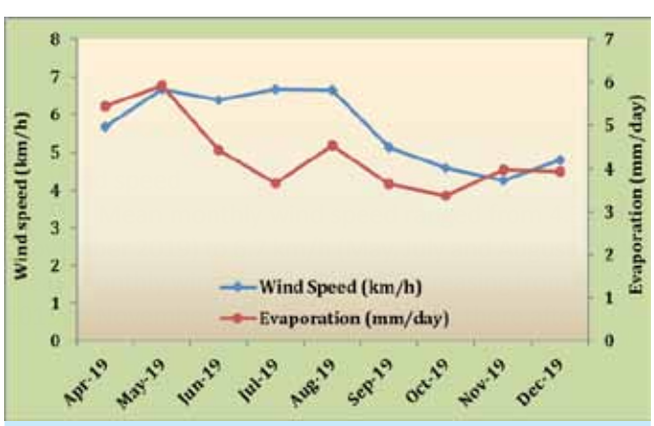
The total water evaporated from April to December 2019 was 1097 mm. The highest morning and afternoon relative humidity was observed during August and July 2019, respectively, whereas the corresponding lowest was recorded during December 2019.



Mean monthly evaporation and morning and afternoon relative humidity

Wind speed

Mean monthly wind speed ranged from 4.3 km h^{-1} (November 2019) to 6.7 km h^{-1} (May, July and August 2019). Mean monthly wind speed showed decreasing from August 2019 to November 2019 and it increased there after.



Mean monthly wind speed and evaporation

Sunshine hours

The mean monthly sunshine hour recorded ranged from 1.1 h (July 2019) to 8.8 h (November 2019). As expected, mean monthly sunshine hours were lower during rainy season compared to rest of the year.

Soil temperature

The ranges of mean monthly soil temperature recorded in morning hours at 5, 10 and 20 cm depths were 26.0-32.8 °C, 26.1-34.0 °C and 27.1-35.1 °C, respectively, whereas the corresponding ranges for afternoon observation were 30.3-47.5 °C, 29.4-43.7 °C and 27.7-37.2 °C.

Mean monthly weather parameters recorded at ICAR-CCARI from April to December 2019.

Month	Temperature (°C)		Relative Humidity (%)		Wind Speed (km h^{-1})	Sunshine (h day^{-1})	Evaporation (mm day^{-1})	Rainfall (mm)	Rainy day	Cloudiness (h)	
	Maximum	Minimum	07.34 AM	2.34 PM						07.34 AM	2.34 PM
April	35.0	23.4	86.7	53.3	5.7	7.7	5.5	0.0	0	1.6	0.3
May	35.0	23 .7	83.8	55.5	6.7	7.5	5.9	0.4	0	2.9	1.4
June	32.5	21.6	89.1	74.2	6.4	2.9	4.4	752.2	19	4.7	4.1
July	29.7	23.0	92.1	85.3	6.7	1.1	3.7	1335.4	30	4.8	4.9
August	29.4	22.8	94.1	82.8	6.7	2.3	4.5	1266.0	29	4.8	4.5
September	29.9	21.7	92.7	80.2	5.1	2.5	3.6	681.8	23	4.4	4.4
October	32.6	18.3	89.6	69.8	4.6	5.6	3.4	430.2	13	3.5	4.2
November	34.3	19.7	82.1	49.8	4.3	8.8	4.0	4.6	1	2.0	1.3
December	34.1	20.4	76.7	42.6	4.8	7.6	3.9	0.0	0	1.9	1.3

Important dates of observations during April to December 2019 with the highest and lowest values of weather parameters

Particular of weather parameter	Value	Date
Maximum temperature	37.8 °C	18/04/2019
Minimum temperature	15 °C	25/10/2019
Highest rainfall	169.3 mm	06/08/2019
Highest evaporation	8 mm	16/08/2019
Highest wind speed	13 km h^{-1}	12/06/2019
Maximum sunshine hours	10.7 h	23/04/2019

Meteorological Observatory at ICAR-CCARI
Photo Courtesy: Bappa Das

RESEARCH ACHIEVEMENTS

- Conservation and management of natural resources
- Conservation and utilization of genetic resources
- 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

Integrated farming systems for lowland situations
Photo Courtesy: Paramesha V

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

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

Sujeet Desai

Streamflow trend analysis of west flowing rivers

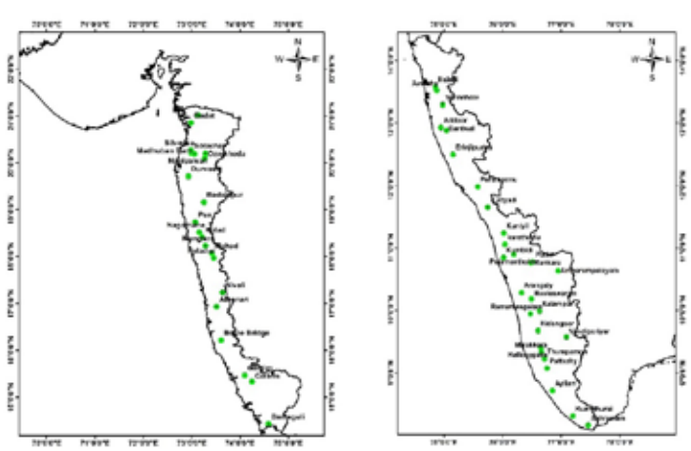
A study was carried out to assess the long-term trends in seasonal and annual streamflow of west flowing rivers of coastal India. The streamflow data required for the study was collected from the India WRIS website. The west flowing rivers are divided into two basins by the Central Water Commission (CWC) (1) Tapi to Tadri, covering rivers from Gujarat to Karnataka and (2) Tadri to Kanyakumari, covering the rivers from Karnataka to Kerala. The gauging station time series data from 1986-2015 (30 years) was used to analyse the spatio-temporal trends of streamflow. The different statistical tests such as Mann-Kendall test, Spearman's rho test and linear regression were used to analyse the trend in time series. All the tests were considered statistically significant at $p<0.01$ and $p<0.05$ significance level.

Streamflow trend of Tapi to Tadri basin gauging stations

During monsoon season, significant increasing streamflow trend ($p<0.05$) were exhibited by Collem, Durvesh, Gadat, Ganjim and Nanipalson gauging stations. In post-monsoon season, only Durvesh and Nanipalson stations showed a significant ($p<0.05$) increasing trend. During winter season (JF), Badalapur ($p<0.01$) and Mangaon ($p<0.05$) showed significant increasing trend in streamflow. Four out of nine stations showed negative streamflow trend in the winter season but the trend was non-significant. In the pre-monsoon season, Badalapur station exhibit significant increasing trend in streamflow, whereas Collem and Ganjim stations exhibited significant decreasing trend in streamflow at $p<0.01$ by all tests. Annually, four (Durvesh, Gadat, Ganjim and Nanipalson) out of nine gauging stations exhibited a significant ($p<0.05$) increasing trend, except for Collem station which showed significant decreasing streamflow trend.

Streamflow trend of Tadri to Kanyakumari basin gauging stations

In the monsoon season, out of 20 stations, only two stations i.e Ambarapalayam and Pattazhy showed significant ($p<0.05$) increasing trend. Annually, the streamflow trends at the gauging stations were similar to that of Monsoon season. In the post-monsoon season, out of 20 stations, 8 showed increasing trend and 12 stations showed decreasing trend but were in-significant. During the winter season, Arangaly and Bantwal stations exhibited significant ($p<0.01$) decreasing trend in streamflow whereas Kalampur and Karathodu showed decreasing trend at $p<0.05$. Haladi and Pattazhy stations showed significant increasing streamflow trend in the winter season at $p<0.05$. In the pre-monsoon season (MAM), Haladi, Pattazhy and Neeleshwaram showed significant increasing trend in streamflow, whereas Arangaly and Karathodu showed significant decreasing trend. The trend in remaining 15 stations was not significant in pre-monsoon season.



(a) (b)

Location of streamflow gauging stations of west flowing rivers a) Tapi to Tadri basin and b) Tadri to Kanyakumari basin

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

Crop establishment and nutrient management practices in rice to improve the productivity and economics under the salt-affected soils of the coastal region

The effect of the crop establishment methods and nutrient management practices in the salt-tolerant rice varieties (Goa Dhan 1, Goa Dhan 2 and Goa Dhan 3) was evaluted with a split-split-plot design. The nutrient management strategy was assigned as main plot, crop establishment method as sub-plot and variety as sub-sub-plot. The effect nutrient management strategy, crop establishment methods and variety was significant on the grain yield, straw yield, net income and benefit to cost ratio. A nutrient management strategy of soil test based fertilizer recommendation or modified blanket recommendation (120-30-00 kg $N:P_2O_5$, K_2O ha^{-1}) recorded the significantly higher grain yield, straw yield, net income and benefit to cost ratio compared to the control (without nutrient management) and farmers' fertilizer practice. The least values were observed in the control. Significantly higher grain (2.87 t ha^{-1}), straw yield (4.52 t ha^{-1}), net income (₹ 33427 ha^{-1}) and benefit to cost ratio (2.04) was achieved with the transplanting 35-days old Goa Bio-1 nursery treated seedling than the broadcasting (2.44 t ha^{-1}, 3.11 t ha^{-1}, ₹ 27679 ha^{-1} and 1.98). The variety, Goa Dhan 3, outperformed Goa Dhan 1 and Goa Dhan 2 with highest grain yield (3.51 t ha^{-1}), net income (₹ 48727 ha^{-1}) and benefit to cost ratio (2.56). The performance with respect to the net income and benefit to cost ratio the order was observed as Goa Dhan 3 > Goa Dhan 2 > Goa Dhan 1. Thus, package of practice of transplanting of 35-days old Goa Bio - 1 nursery treated seedling of an improved salt-tolerant rice variety with soil test - based fertilizer recommendation or modified blanket fertilizer application has been identified to improve the productivity and income for paddy cultivation under salt affected soils of coastal region.

Evaluation of organic and chemical amendments under paddy cultivation on salt-affected soils of coastal region

A salt-tolerant rice variety, CSR-27, was evaluated under different organic and chemical amendments on salt-affected soils of the coastal region. Significantly highest grain and straw yield was obtained with use of organic manure with recommended dose of fertilizer (OM-RDF) (4.03 and 6.29 t ha^{-1}) and rockphosphate with RDF (3.97 and 6.93 t ha^{-1}). The use of the chemical amendment gypsum was not as effective as OM-RDF, glyricidia with RDF and rockphosphate with RDF with respect to improvement in grain yield, income and benefit to cost ratio. The net income of the OM-RDF, glyricidia-RDF and rockphosphate-RDF was significantly higher than the unammended control and at par with each other. The highest net income of ₹ 58416 ha^{-1} was achieved with application of rockphosphate-RDF. It was ₹ 39864 ha^{-1} with RDF alone. The soil biological activity trended similar to the trend of grain and straw yield and income. The results indicated salinity stress alleviating effect on plants by the amendments. Thus, it could be concluded that a conjunctive use of organic and chemical ammendments is an effective nutrient management strategy to improve the yield and income from rice cultivation under coastal saline soils.

Using mid-infrared spectroscopy to predict the salinity of salt-affected soils in west coast region

The study aims to estimate salinity of the salt-affected soils of the coastal region using mid-infrared (2500-15000 nm) reflectance spectroscopy (MIRS). The spectral reflectance of processed soil samples (2 mm sieved, n=402) was recorded using Fourier Transform Infrared Spectrometer (Shimadzu IRTracer-100). A 10 nm averaged raw (RS_{10nm}) and Savitzky-Golay standard normal variate processed spectral reflectance ($SG\text{-}SNV_{10nm}$) was used for analysis. The data was divided into two sets, one as train data (70% of total) to develop the calibration model and other as test data (30% of total) to evaluate the performance of the calibrated model. Partial least-squares regression (PLSR) and principal component regression (PCR) were implemented to construct calibration models, which were independently validated for soil salinity prediction (electrical conductivity, EC) from the soil spectral data. Prediction accuracy of the model improved when $SG\text{-}SNV_{10nm}$ was used compared to RS_{10nm} and PLSR performed better than PCR. An excellent prediction accuracy was achieved using PLSR with $SGSNV_{10nm}$ pre-processing (R^2=0.79, r=0.89, RMSE=2.21 dSm^{-1}, ratio of performance to deviation=2.15). Thus, it may be concluded that the mid-infrared spectroscopy data could be employed for monitoring the soil salinity of the salt-affected soils as it is rapid, repeatable, reliable and cost-effective.

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

PI: Bappa Das

Using the dataset obtained from India Meteorological Department, Pune for the period of 1983-2015, different extreme climate indices were calculated based on daily maximum, minimum temperature and rainfall for 7 weather stations of coastal Maharashtra and Goa. These indices are proposed by Expert Team on Climate Change

Detection and Indices. The trend in the climatic parameters and extreme weather indices have been calculated using linear (Z_L), Mann–Kendall (Z_D) and Spearman's rho (Z_S) test. For all the stations, mean annual maximum temperature showed significantly increasing trend except for Colaba station according to Z_D and Z_S while negative trends were recorded for mean annual minimum temperature (TMIN) except for Colaba and Alibag stations. Maximum Tmin (TNx) and Minimum Tmin (TNn) also followed the same trend as that of TMIN. Likewise, significant positive trends were observed for diurnal temperature range (DTR) except for Alibag station while Colaba station showed insignificant negative trend. Warm spell duration indicator (WSDI) revealed positive trend for all the stations which is in accordance with the IPCC findings. The trends for warm nights (TN90p) were found to be negative for almost all the stations except for Colaba and Alibag stations. The positive trends of TN90p for Colaba and Alibag stations may be due to anthropogenic activities as these stations are more urbanized. All the stations showed significantly increasing trend for warm days (TX90p) with decreasing trend for cool days (TX10p). The trends for cool nights (TN10p) were found to be positive except for Colaba and Alibag stations. Tropical nights (TR20) showed significant decreasing trend for Panjim, Mormugao and Harnai stations while increasing trends were recorded in Alibag, Colaba and Dahanu stations.

Interestingly the number of days with daily maximum temperature >35°C (TR35) revealed increasing trend for all the stations. As the growing season length (GSL) for all the stations were more than 364 days per year, the trends were non-significant. None of the stations experienced frost days (FD) or ice days (ID) during the study period. All the stations showed negative trends for consecutive dry days (CDD) with rainfall less than 1 mm while nonsignificant trends were recorded for consecutive wet days (CWD) except for Harnai, Panjim and Mormugao stations. It is worth-noting that, two neighbouring stations (Panjim and Mormugao) showed opposite trends in CWD. Among the seven stations under the present study, four stations showed weak negative trends or no trend for annual total wet days precipitation (PRCPTOT), though linear trend for all the stations revealed significant decreasing tendency. Only two stations namely Harnai and Alibag experienced significant negative trends for PRCPTOT. Panjim, Harnai, Alibag stations had a significant decreasing trend for maximum 1-day, 5-day precipitation (RX1day and RX5day) and very wet days (R95p) while rest of the stations experienced non-significant negative trends. The highest negative trend for extremely wet days (R99p) was found in Alibag station. Significant negative trends were observed in Alibag and Harnai stations for simple daily intensity index (SDII) i.e. annual total precipitation divided by the number of wet days (days with rainfall ≥ 1.0 mm) in that year. The trends for number of days with precipitation ≥10 (R10) and ≥20 mm (R20) were insignificant except for Mormugao station and for days with precipitation ≥64.5 mm (R64.5), only Alibag and Harnai showed significant negative trend at $p < 0.05$ level.

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

Paramesha V

The objective of the study was development of the suitable conservation agricultural (CA) practices for improved grain yield, aboveground 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 cropping system included puddled transplanted rice (PTR)-PTR, direct seeded rice (DSR)-DSR, rice-moong, rice-cowpea and rice-baby corn. The yield data from *Kharif* did not show significant difference between tillage methods. However, the higher yield was observed in PTR (5.18 t ha^{-1}) followed by DSR with brown manuring of *Sesbania* (5.11 t ha^{-1}). Soil properties were not influenced by different tillage management practices. The soil organic carbon ranged from 1.1% to 1.35% with the highest being in the DSR with brown manuring of *Sesbania*. After rice harvest, the higher available nitrogen (125 kg ha^{-1}), phosphorus (13 kg ha^{-1}) and potassium (135 kg ha^{-1}) was observed in DSR with brown manuring of *Sesbania*. Under DSR saving of labor (198 MJ), fuel (235 MJ) and machinery (356 MJ) energy was observed over PTR.

Field view of expriment on conservation agriculture

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

Project: Breeding high yielding salt tolerant rice varieties for coastal saline soils

Manohara KK

Agro-morphological and molecular characterization of rice germplasm collections

The rice germplasm collections from Goa State and from two districts of Karnataka State *viz.,* Uttara Kannada and Shimoga were characterized for various agro-morphological characters along with yield and its contributing characters. The germplasm accessions were also characterized using 34 Simple Sequence Repeat (SSR) markers covering all the 12 linkage groups.

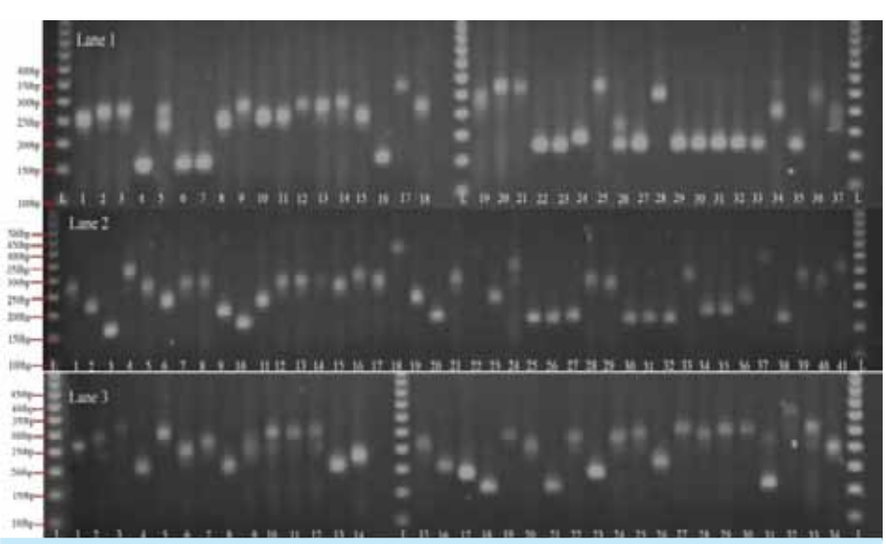
Agro-morphological characterization: Descriptive statistics

Days to maturity ranged from 119 days (Bharani) to 179 (Kempadaddi marthlgya). Genotype Bharani was the shortest (80 cm) and genotype Kari Jaddu bhatta was the tallest (208.33 cm). Panicle length ranged from 17.20 cm (GWR 013) to 36.67 cm (Mara bhatta). Wild rice GWR 013 had the lowest number of filled grains per panicle (19.67) whereas genotype kannatumba (344) had highest grains per panicle. Genotype Shahiram had the lowest 100 seed weight (1.45 g) whereas the genotype Adnen kelthi had the highest 100 seed weight (3.27 g). Grain yield was highest in the genotype Giddu bhatta (28.54 g per plant) followed by Mysore sanna and Kannur whereas lowest grain yield of 2.55 g per plant was recorded in wild rice GWR 002-1. The heritability estimates ranged from 61.1% in flag leaf width to 99.0% in days to maturity. The range of genetic advance as per cent of mean was 18.1% to 76.9% in flag leaf width to straw yield, respectively.

PCV and GCV values were highest for grains per panicle followed by grain yield and harvest index. Highest heritability was observed in days to maturity (99.0%) followed by test weight (98.5%) and days to 50% flowering (98.3%). Heritability and genetic advance as per cent mean values were highest for grains per panicle, grain yield and test weight, suggesting that these characters are governed by additive gene action.

Molecular characterization using SSR markers

Thirty four SSR markers covering all the 12 linkage groups were utilized for studying the diversity of 153 rice accessions. Except for four markers all other markers were found to be polymorphic. Marker RM10871 produced maximum alleles (19) followed by RM474 (10) and RM3867, RM333 and RM 180 with eight alleles each. PIC was highest in RM10871 (0.92) followed by RM474 (0.83) and RM206 (0.82). The dendrogram was constructed using the information generated from the SSR marker set. 153 genotypes were clustered into four groups with each group further divided into two sub-clusters.



Gel image showing allelic pattern for the marker RM10871

Dendogram depicting the diversity in collected rice germplasm

IC number allotment to Institutes rice germplasm collections

The rice landrace collections from Goa State and few of the breeding lines developed at the Institute were sent to National Bureau of Plant Genetic Resources (NBPGR), New Delhi, for obtaining IC numbers. The details of the IC numbers allotted by the NBPGR are furnished below.

No	IC Number	Cultivar Name
1	IC-632714	Damgo
2	IC-632715	Mudgo
3	IC-632716	Belo
4	IC-632717	Kalobelo
5	IC-632718	Walayo
6	IC-632719	Kendal
7	IC-632720	Red Kochri
8	IC-632721	White Kochri
9	IC-632722	Saalsi
10	IC-632723	Kolyo
11	IC-632724	Panyo
12	IC-632725	Shidde
13	IC-632726	Xitto
14	IC-632727	Babri
15	IC-632728	Patni-I
16	IC-632729	Patni-II
17	IC-632730	Asgo
18	IC-632731	Dodgi
19	IC-632732	Sal
20	IC-632733	KS-4
21	IC-632734	KS-16-1
22	IC-632735	KS-19-2
23	IC-632736	JK-58

Hybridization and generation advancement

The following new set of crosses were initiated in Kharif season of 2019 to develop populations from different genetic background.

Female parents	Male parents
Goa Dhan 1	CSR 27, Karjat 3, Jaya, Mysore sanna, Guddadani bhatta, Kalame, Chirang sub1, Swarna sub1
Goa Dhan 3	Swarna sub 1
Goa Dhan 4	CSR 27, Jaya, Cherang sub 1, Swarna sub 1
CSR 27	Goa Dhan 4, Jaya, Pusa 44
Pusa 44	CSR 27, KS 19-2
Jaya	CSR 27, Goa Dhan 4, Kalame, Mysore sanna, Guddadhani bhatta
Mysore sanna	CSR 27, Goa Dhan 4, Jaya
Guddadhani bhatta	CSR 27, Goa Dhan 4, Jyothi

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

AR Desai

Collection and maintenance of Mango germplasm

Mango germplasm bank , consisting of a total of 144 collections are currently maintained in three germplasm blocks and comprises to represent the following groups:

94 collections : Local varieties (including MKD, Hilario & others),
13 collections : Local Pickling types
15 collections : Introduced hybrids,
12 collections : Introduced varieties
04 collections : Pusa Varieties
06 collections : Exotic/ coloured varieties

Cardozo Mankurad, Costa, Bindao, Maxima and Cota mango varieties showed regular bearing tendency, while fruit quality was par excellent in Cardozo Mankurad.

Newly identified four Mankurad variants (MKD Chorao

Cardozo Mankurad

Fruit of Cota

Fruits of Costa

1/1-18, MKD Neura 1/3-18 MKD Pilar-1/4-18 and MKD Khotode (Valpoi) 1/5-18) and three Hilario variants (Hilar Raia 1/6-18, Hilar 2/18 –Mandrem and Hilar 3/18-Bicholim) were collected clonally and added to the germplasm during the year.

Analysis of the fruits of these variants revealed that fruit weight was in the range of 233.3 to 255 g with 69.3 to 72.5% pulp contents in Mankurad Khotode -1/5-18 and Mankurad Chorao 1/1-18 with higher total soluble solids of 20.6 and 19.67 ^{O}B respectively.

In case of Hilario variants , fruit size varied from 272.4 g (Hilar Mandrem-2/18) to 302 g (Hilar Bicholim 3/18) with 74.32 % and 70.38% fibre free pulp contents having total soluble solids of 23.2 and 23.4^{O}B in Hilar Mandrem -2/18 and Hilar Bicholim-3/18 respectively. Hilaro Mandrem-2/18 had attractive light orange skin colour besides excellent fruit quality.

Evaluation of mango hybrids

Among the introduced hybrids, Amrapali, Hb-56 and Neelgoa followed by Ratna consistently recorded the higher mean fruit yield of 56.8 kg per tree, 49.6 kg per tree, 42.6 kg per tree and 38.4 kg per tree respectively with corresponding mean fruit weight of 295.6 g and 307.6 g, 285.2 g and 258.6 g. Fruit quality of Amrapali (23.2 ^{O}B & 0.18% total acids) and Ratna (21.8^{O}B & 0.21% total acids) in terms of total soluble solids was far superior compared to fruit quality of Neelgoa (16.2^{O}B & 0.28% total acids). Fruits of Neelgoa (12 days) and Ratna (8 days) had better shelf life. Other late bearing hybrids such as HB-87 and K x B also recorded higher fruit yield of 26 kg and 28 kg per tree, the latter of which had excellent shelf life of 10 days with yellowish, firm pulp contents of 20.2 % total soluble solids and 0.185 % total acids.

Fruits of Amrapali

Evaluation of Mankurad genotypes

Mankurad variants collected from different locations in Goa are under evaluation for short listing the best types. Twelve variants consecutively flowered during the last two years. Due to delayed flowering-initiation from

MKD-1: Fruits of MKd-1 with attractive skin and pulp colour

2nd fortnight of January, 2019 instead of normal flowering during Nov-Dec, 2018, fruit maturity in different Mankurad variants was also delayed by almost a month's period and fruits were matured for harvesting only after 15 May 2019 unlike the normal fruit maturity in March in case of Mankurad variety. This even resulted in the infestation of fruits with fruit fly which was not common in Mankurad variety. Mankurad genotypes namely, MKD-1, MKD-6 and MKD-19, showed regular flowering and fruiting, though sparse in the current season 2019-20.

Flowering and development in MKD-2 : Fruits attained maturity in 2nd fortnight of May 2019 due to delayed flowering during Jan 2019

Fruit yield trend in Mankurad genotypes - 2018 & 2019 (4th season)

Genotypes	2018		2019	
	No. of fruits per tree	Fruit yied (kg per tree)	No. of fruits per tree	Fruit yied (kg per tree)
MKD -1	31	8.90	95	21.5
MKD-2	28	5.82	12	3.2
MKD-5	34	7.75	41	10.6
MKD-6	33	8.84	38	12.4
MKD-11	26	5.87	18	4.2
MKD-12	39	8.29	22	5.1
MKD-15	-	-	45	10.0
MKD-16	28	6.60	18	4.2
MKD-17	14	3.88	51	10.4
MKD-18	33	7.78	14	3.8
MKD-19	30	6.8	28	6.2
MKD-20	-	-	22	4.1
MKD-28	36	8.92	18	4.4
MKD-36	22	4.81	17	3.7
MKD-40	36	8.64	08	2.6
SEm	6.12	3.42	5.14	2.88
C. D (5%)	18.24	10.60	15.62	8.92

Establishment of new blocks

High density planting of mango varieties namely, Cardozo Mankurad and Hilario was established in Farm B. Sweet corn & hybrid maize, Sunflower hybrids and Ajwain seed spice (Var. AA2.) were intercropped successfully in the first year.

Maize and Ajwain as intercrops in HDP plot of mango

Establishment of pickling mango germplasm bank

A germplasm block of 14 pickling mango accessions, comprising of three collections *viz.* Karel-1/16 , Santhoma-1/16 and Mayem-1/16, suitable for matured fruit pickling; 9 local collections *viz*, Para Bicholim -1/16, Pissurlem-1/17, PM ICAR /16, Kudka PM/17, G.dongry-2 /17, S.Verem PM/16, S. Dargal, PM/17, Narvem PM/16, G.dongry-3/17 and two collections from Sirsi, Karnataka, *viz.* Appemidi and Jeeragi Mau, suitable for immature whole fruit pickling was established in Farm C along with collection of 6 coloured exotic mango varieties.

Production of quality mango grafts

Two thousand two hundred eighty five quality mango grafts of Cardozo Mankurad, Mankurad, Amrapali, Kesar, Ratna, Hilario and other Local varieties were produced and supplied to farmers.

Mango graft production in nursery

Characterization of Nutmeg genotypes: 1st Group (20 years)

First set of 28 genotypes of 20 years age group is being maintained as intercrop in coconut plantation, of which 26 genotypes are monoecious with varied level of male and female flowering dominance and two genotypes are pure male types. Monoecious genotypes *viz.* NMF-6, NMD-1 and NMD-2 recorded promising yield performance

Second group (4 to 6 years) is comprising of 18 - monoecious / dioecious genotypes, of which the genotype NMI-1 has shown precocious bearing with bold nut characters.

A Selection from Tamsurli – 1

A promising genotype located in farmer's field in Tamsurli wada, has been under observation for the last three years for its yield performance which recorded 1.7 kg/tree mean dry seed yield (at 7th year) and with dry mace yield of 0.86 kg per tree with mean dry seed weight of 8.86 g and dry Mace/seed 4.6 g respectively.

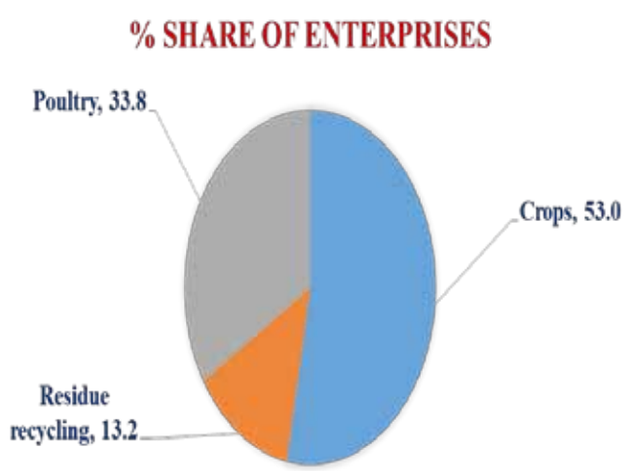
Tamsurli-1

Economics of Coconut based multi-species cropping system:

An area of 0.5 ha under this system has more than 10 crop components along with poultry component contributing to the total returns from system at different intervals thereby imparting continuous flow of income from the system. Production of planting material is also an added activity of the system that contributes to the total returns. Besides this, the entire system would supply the nutritive and protective food to the family.

Component	Production Quantity (kg)	Gross income (₹)	% Share in income
Banana	289.5	8150	3.21
Nutmeg Seed	64	38400	29.43
Nutmeg Mace	8	6400	
Nutmeg Taffy	5	25000	
Mouth freshner	12	4800	
Black Pepper	7	3500	1.38
Drumstick, Papaya	70	1350	0.53
Coconut	3730	9800	3.86
Elephant Foot Yam	193	9650	3.81
Other spices + Birds Chilli	69 pkts +1.4kg	1250	0.49
Planting Material &Crop Residue	-	67814	26.75
Poultry (CARI Nirbik)	-	76035	29.99
Total		253479	99.59
Cost of cultivation (COC)		151488	
Net Returns		101991	

Gross income from the above system was ₹ 2,53479/- against the total cost of cultivation (COC) of ₹ 151488/- resulting in the net income of ₹ 101991/- during 2019-20.



Percentage contribution of enterprises in Coconut based multi-species cropping system

Crops and crop residues contributed 53.0 and 13.2% of income while poultry component contributed 33.8% to the total income.

New spices introduced

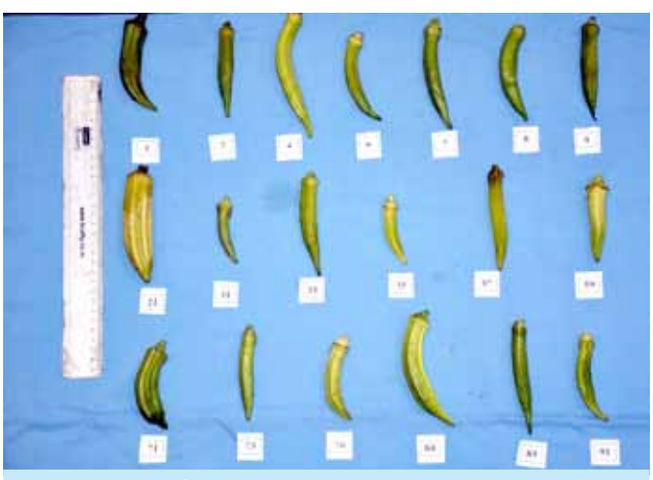
Salem variety of turmeric was introduced for evaluation. Seed spice namely Ajwain (Var. AA2) was introduced and preliminary observations indicated good scope for its cultivation in Goan agroclimatic conditions thereby indicating the possibility of cultivation of this seed spice in rabi season in other coastal regions.

Project: Augmentation, morphological and molecular characterization and evaluation of Okra and Amaranth genetic resources of West Coast India for sustainable utilization

M Thangam

Evaluation of okra germplasm during kharif 2019

Okra accessions received from NBPGR Thrissur were evaluated during Kharif season 2019 for morphological and yield traits. Morphological traits *viz.,* plant height, intermodal length, no. of branches and yield traits *viz.,* no. of fruits per plant, fruit length and diameter and individual fruit weight showed wide variability. Plant height ranged from 41.33 cm (EC930081-14) to 129.67 cm (EC930100-05), Internodal length varied from 14.55 cm in EC930102-03 to 26.25 cm in IC506048-04. No. of fruits per plant ranged from 3.55 in IC506048-04 to 22.55 in VRO-6-26. Individual fruit weight varied from 9.34 g in EC930102-03 to 20.22 g in IC506048-04. In general, the incidence of Yellow Vein Mosaic (YVM) disease noticed in majority of the accessions.



View of okra germplasm evaluated during 2019

Amaranthus accessions received from NBPGR Thrissur were evaluated during Rabi season 2019-20 for morphological and yield traits. Wide variability was recorded for various morphological and yield characters. The whole plant weight ranged from 2.57 g in TCR-46 to 23.86 g in TCR-69. No. of leaves per plant ranged from 8.25 (TCR-134, TCR-117 and TCR-46) to 33.25 in TCR-69. Among the accessions evaluated, the following were promising for yield *viz*., TCR-69, TCR-8 and TCR-106.

Estimation of Beta-cyanine content in Amaranthus germplasm

Betacyanin content was estimated in four amaranthus accessions AMR-2- New Dulapi, AMR-6-New Arlem, AMR-13 Manora and AMR -1- New Taligao recording 179.7, 180.3, 220.9, and 140.7 micro gram per g fresh weight of betacyanin respectively.

220.91 µg g^{-1} in Amar-13 (Goa Tambdi Bhaji-1)

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

Sreekanth GB

Assessment of fisheries status estuaries in west coast of India

The fish assemblage structure was analysed and established the functional and ecological status of four tropical monsoonal estuaries; Zuari, Mandovi, Terekhol, Bheemuni, and Kali along the west coast of India. 245 taxa were identified from Zuari (184 taxa), Mandovi (159 taxa), Terekhol (142 taxa), Kali (144), Bheemuni (56) estuaries respectively. The overall fish diversity and species richness were high in Zuari estuary and low in Bheemuni estuary. The composition of fish guilds was similar for the four estuaries but varied with the season and the location (gradient). The dominant guilds consisted of marine species, both juveniles and seasonal migrants, and carnivores and omnivores.

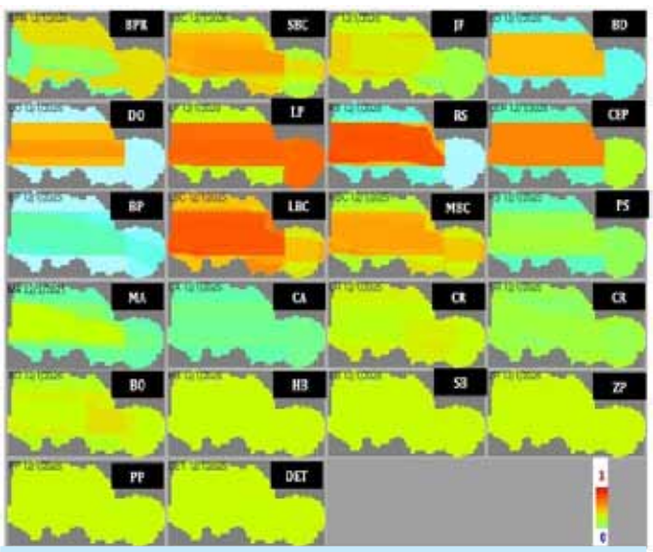
Fish assemblage structure of Grande Island, Goa and Nethrani Island, Karnataka

At Grande Island, in total, 1855 fish individuals are observed, which belongs to 52 species from 24 families in 5 underwater visual censuses during 2019 to 2020. In total, 4,228 fish individuals were observed at Nethrani Island, which belongs to 67 species and 24 families. Based on diversity indices, the maximum taxonomic diversity and Shannon index were observed at mid shelf and minimum in the deep zone. The pattern of diversity was similar in both the Islands. Fish abundance is Maximum at the mid shelf followed by shallow zone and then to deep zone, in which maximum fishes are from the size ranging in <10cm.

Fish species observed at the Islands (Snapper, Surgeon fish, Trigger fish)

Spatial dynamic simulation model for prediction of fish biomass and fish catch for tropical estuarine system

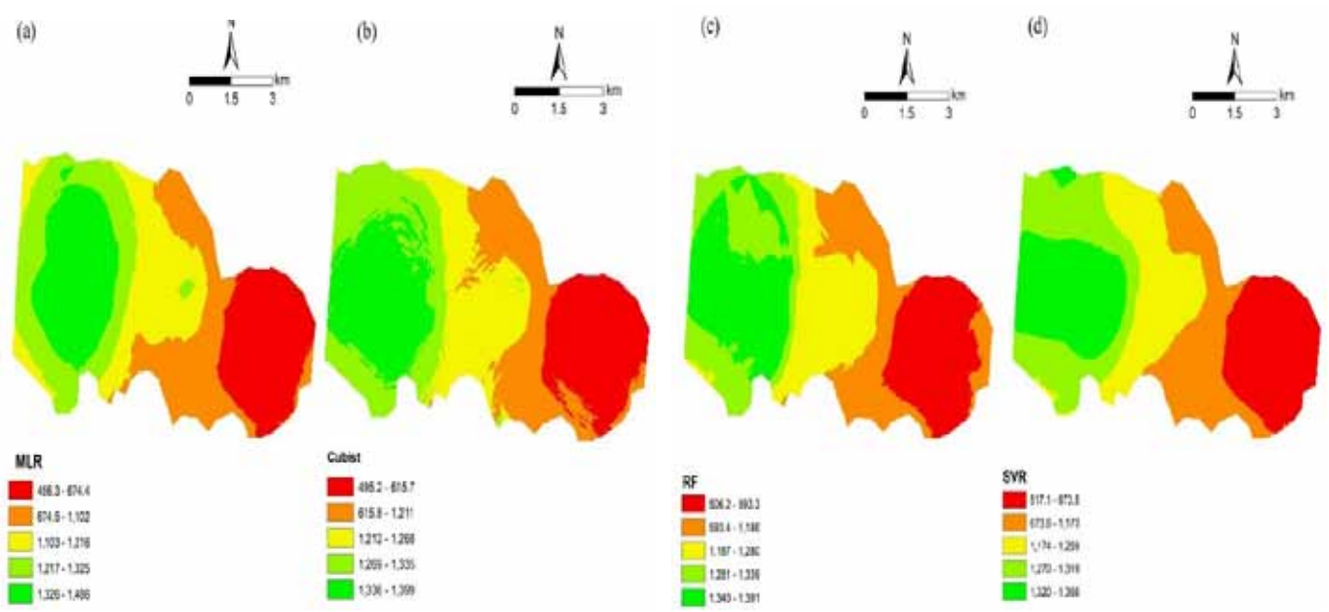
Ecospace model was developed for the period from 2016-2025 for Zuari estuary. Spatial simulations were also carried out to distinguish the regions with ecological significance proposed for rigorous spatial management. The relative biomass, mean trophic level, and relative catch were used to provide the fisheries authorities with a set of guidelines to report the potential impacts and to ensure fisheries and ecosystem conservation objectives in the ecosystem based fisheries management. A complete ban on indiscriminate fishing and increase in gillnetting (to a level of 75% from current) was found sustainable for the ecosystem.



Spatial biomass plot for various functional groups identified in Zuari estuary

Application of deterministic and stochastic geo-statistical tools for analysing spatial patterns of fish density in a tropical monsoonal estuary

The efficiency of advanced deterministic and stochastic geo-statistical techniques to predict spatial patterns of fish density in Zuari, Fish abundance and environmental data were subjected to different geo-statistical tools. Cubist model was the best performing model based on prediction accuracy in development phase and prediction consistency in the validation phase. Latitude, temperature, salinity, and DO had positive influence on fish abundance, while longitude and transparency showed negative impacts.



Digital maps of fish abundance in arid western India prepared using (a) MLR, (b) Cubist, (c) RF, (d) SVR

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

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

R Ramesh

Development of bacterial wilt tolerant brinjal lines

Based on the two years field evaluation data, two bacterial wilt resistant brinjal lines viz. 27-7-2 (Goa Brinjal-5) and 42-7-1 (Goa Brinjal-6) were selected. The variety release proposal was submitted to Goa Government for the release of the above varieties in the State of Goa.

Major characteristics of the varieties

Particulars	Goa Brinjal-5 (27 – 7 – 2)	Goa Brinjal-6 (42 – 7 – 1)
Fruit Colour	Purple	Purple
Fruit Shape	Oblong	Oblong
Fruit Size (length x breadth in cm)	7.5 x 5.0	8.1 x 6.7
No. of fruits per plant	8-9	7-8
Consumer preference	High	High

Goa Brinjal-5

Goa Brinjal-6

Field evaluation of bacterial wilt tolerant varieties and proposed bacterial wilt tolerant lines

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 42-7-2) were evaluated along with susceptible local cultivars (Agassaim and Taligao) in the field for further validation. Wilt incidence was less than 5% in all the released varieties and proposed lines. However, in susceptible lines wilt was 90-100%. Mean number of fruits and yield (kg/plant) was higher in lines 27-7-2, 42-7-1 and Goa Brinjal-2. Further, seeds of the released varieties were provided to the farmers for cultivation.

Field evaluation of bacterial wilt tolerant varieties/ lines (2019-20)

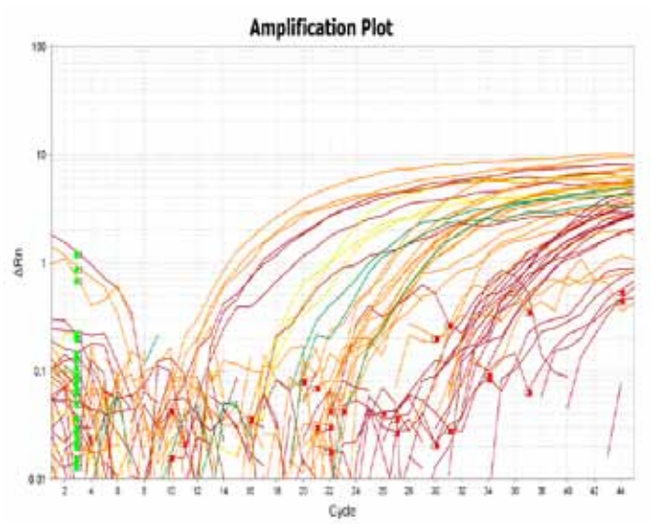
Varieties/ lines	% wilt (90 DAP)	Mean no. of fruits per plant	Yield kg per plant	yield (t ha^{-1})
Goa Brinjal-1	2.22	9.33	0.86	25.78
Goa Brinjal-2	0.00	10.89	1.01	30.18
Goa Brinjal-3	4.44	8.42	0.77	22.99
Goa Brinjal-4	0.00	9.49	0.98	29.46
27-7-2 (Goa Brinjal-5)	0.00	14.80	1.16	34.80
42-7-1 (Goa Brinjal-6)	4.44	11.36	1.07	32.13
Agassaim	91.11	0.11	0.04	1.26
Taleigao	100.00	0.00	0.00	0.00
CD (0.05)	12.32	3.51	0.33	
CD (0.01)	17.1	4.87	0.45	

Mean of three years data of all the 6 bacterial wilt resistant varieties/lines indicated that bacterial wilt incidence was less than 4.0 % 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 17.5t ha^{-1} to 28.3 t ha^{-1}.

Field evaluation of bacterial wilt tolerant brinjal

Viral disease complex in chilli

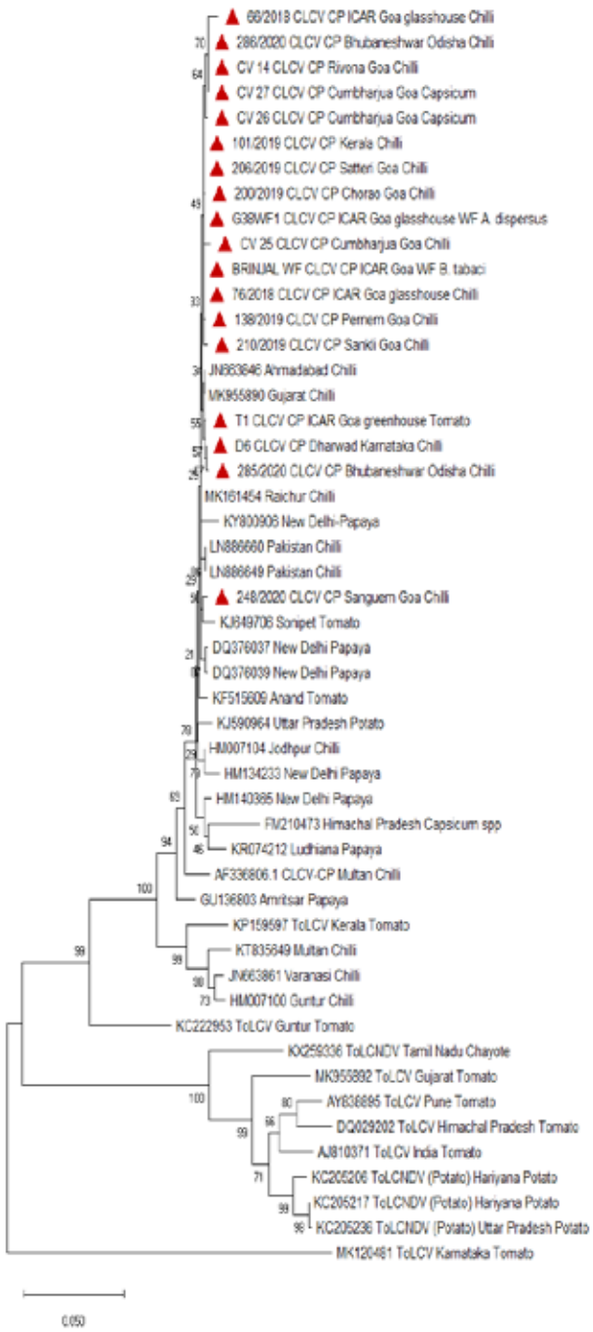
Symptoms associated with viral disease complex in chilli were studied in glass house (Kharif, 2019) and in the open field condition (Rabi, 2019). Observations in the entire crop period on four varieties (G-4, VNR, Aldona local and Nisha) indicated various types of symptoms *viz.,* curling of leaves, reduced leaf size, mosaic, leaf distortion, puckering, yellowing, bronzing of leaves, vein necrosis, and malformation of flower buds etc. Insect vectors *viz.,* whitefly, aphids and thrips were also present at different time periods. Samples from plants exhibiting different symptoms were taken for further diagnosis using PCR and qPCR analysis. Results suggested that the major virus associated is Chilli leaf curl virus (ChiLCV).



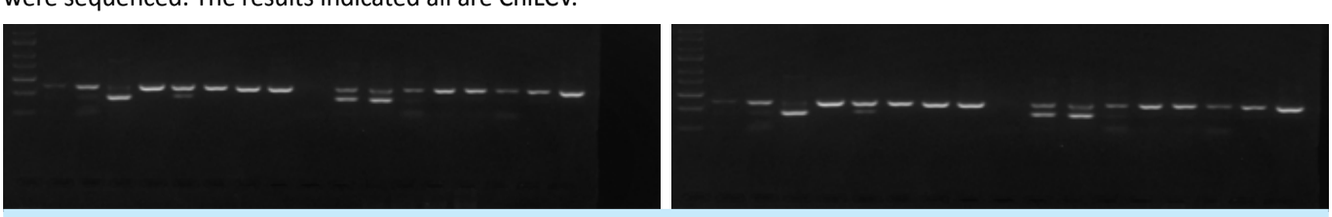
Amplification of ChiLCV in qPCR

To further confirm the test results, PCR amplicons of the 11 samples representative of two different seasons (2017-18) and (2018-19) and from different crops and location were sequenced. The results indicated all are ChiLCV.

A new set of primer (CLCV CP-F1 /CLCV CP-R1; 946 bp) was designed to amplify the entire coat protein (771bp) region. 18 samples representative of different seasons, different crops and location were sequenced. The results indicated all are ChiLCV and there is not significant difference in the viral coat protein sequence among the samples.



Phylogenetic analysis of ChiLCV CP gene of ChiLCV strains of coastal region



Amplification of 376 bp of ChiLCV

Screening of samples for Potyvirus infection

Aphid infestation was observed in the chilli field frequently during 2018 and 2019. None of the samples showed any amplification in PCR and qPCR.

Screening of samples for Tospovirus infection

Moderate to severe thrips infestation was observed in the field at some point of time and hence the thrips infested samples were screened for Tospo virus specific primers. None of the other samples tested showed any amplification in PCR.

Field evaluation of different methods for the management of chilli viral disease complex

A field experiment at ICAR-CCARI (Block B) was conducted with different treatments. The treatments include seed treatment, nursery treatment, insecticide sprays (15, 30, 45 and 60 Days After Planting), bio-formulation and neem based insecticide sprays (15, 30, 45 and 60 DAP) and barrier crop in the borders. Hybrid VNR was used in the experiment.

Observations indicated that the crop in all the treatments was infested with insect vectors and exhibited viral disease symptoms. The major viral disease confirmed symptomatically and by molecular diagnosis was ChiLCV. Though symptoms of aphid and thrips were severe in the later stage of the crop, the presence of viruses were not found as evidenced by the molecular diagnosis.

Effect of date of planting of chilli on the incidence of viral diseases

Seeds of chilli (Aldona local, G4, Nisha and VNR) were sown on staggered dates in such a way that planting was taken up from Mid of Dec 2018 to end of January 2019 at 10-15 days intervals.

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

Field trial is being conducted with microbial insecticide, antagonistic bacterium, entomophagous fungus and resistant inducing chemicals on chilli virus disease complex. Treatments were given from nursery stage and continued till 60 days of planting and the trial is in progress.

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

Talc based formulation of Trichoderma (210 kg) was produced and was sold to farmers, used in various experiments and field trials of the Institute. Some of the experiments where the products used are black pepper foot rot, papaya evaluation, plants in protected cultivation, chilli root rot/ wilt and etc. Bacterial antagonists (150 kg of RCh6-2b &STC-4) was produced and distributed to farmer's demonstration plots to treat black pepper plants for management of foot rot and plant growth experiments of paddy.

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

Maruthadurai R

Status of rugose spiraling whitefly, host range and their natural enemies

Field studies were carried in different coconut plantations of Goa to record the status of an invasive insect pest Rugose Spiralling Whitefly (RSW), *Aleurodicus rugioperculatus*, host range and their natural enemies. Moderate to severe incidence of RSW was recorded on coconut plantations in areas of Sakhali, Sattari, Ponda, Mapusa and Tiswadi. Large number of nymphs and adults were found under surfaces of the leaflets to suck the sap. Extensive feeding of the insect leads to the excretion of honey dew resulted in sooty mould growth on the upper surface of the leaves. Besides, coconut RSW infestation and its colonies were recorded on banana, All spices, triandra palm, areca nut, sour sop, guava, mango, black pepper, heliconia, papaya, citrus, avocado, chafa, indian shot and maize. The predominant natural enemies found feeding this white fly was predator *Mallada boninensis* and parasitoid *Encarsia guadeloupae*.

Whitefly affected leaf

Parasitoid Encarsia guadeloupae

Monitoring of rugose spiraling whitefly with yellow sticky traps

Widespread infestation of rugose spiraling whitefly was recorded in coconut plantations. In order to monitor and manage the RSW, yellow sticky traps were installed on the coconut trunk. Attracted whitefly adults were counted in the yellow sticky traps. Severe incidence of RSW was observed during March to May. An average of 21.9 adults of whitefly was attracted per trap.

Damage potential, biology and natural enemies of fall armyworm

A field trail was undertaken to study the damage potential, biology and natural enemies of fall armyworm on fodder maize. The damage incidence varied from 43.33 to 76.66 % was recorded on fodder maize. Number of larvae per plant varied from 0 to 3. Number of egg masses per plant varied from 0 to 4. The fall armyworm completed its life cycle in 24.6 days on fodder maize. Predators like coccinellids, spiders, reduviid bug, rove beetle, earwig and wasps predated on various stages of fall armyworm. Egg parasitoids i.e., *Telenomus* spp and *Trichogramma* spp were also found to parasite the eggs. An average of 29.38% and 13.40% parasitization was recorded by *Telenomus* spp and *Trichogramma* spp respectively. Natural infection of fall armyworm larvae by entomopathogenic fungus and bacteria was also recorded.

Telenomus spp

Evaluation of roosting plants with food baited traps for the management of cucurbit fruit fly, Zeugodacus cucurbitae

The aim of this study was to evaluate the roosting plants with food baited traps for the management of cucurbit fruit fly, *Zeugodacus cucurbitae* in cucumber. The roosting plants *viz.*, maize, sorghum, castor, red gram, amaranth, tulsi, and tapioca were raised in plastic pots and kept in all the borders of cucumber. Banana and jaggery based food baited traps were prepared and kept at the center of the each roosting plants. Attracted fruit flies were collected at weekly interval. Food bait was changed weekly once. Among the treatments, tapioca + food bait attracted maximum number of fruit flies (7.51 adult flies per trap per week). Control treatment without roosting plant could attract only 2.62 adult flies per trap per week. In all the treatments more females were attracted compared to the males.

Roasting plants with food baited traps

Project: Development of good agricultural practices through integrated nutrient management for sustainable fruit crop production in coastal regions of India

Maneesha SR

The effect of integrated nutrient mixture was tested in two commercially important varieties, Velchi (V1) and Grand Naine (V2). Four different nutrient management practices namely, absolute control (T1), recommended dose of fertilizers (RDF: 400:200:200 g NPK/ plant/ year) (T2), RDF+ integrated nutrient mixture (T3), RDF + commercially available nutrient mixture (T4) and organic cultivation practices (T5) were applied to the plants. Among the different treatments, T3 registered the highest plant height (181.78 cm), stem girth (32.97 cm), leaf length (105.39 cm) and leaf width (39.79 cm) at vegetative stage (5 months after planting). Among the varieties, the highest number of leaves (14.53), leaf length (96.14 cm) and leaf

Early flowering and fruiting in T2V3 treatment at banana plot

width (37.40 cm) were recorded in V2. The interaction effect showed that, Grand Naine variety treated with RDF+ integrated nutrient mixture (V2T3) had the highest number of leaves (14.80), leaf length (114.75 cm) and leaf width (43.41 cm) during vegetative stage.

The least number of days taken for flowering was recorded in Grand Naine variety (250.50 days). Among the nutrient management treatments, RDF + integrated nutrient mixture recorded the least number of days taken for flowering (243.47 days), the highest plant height (202.80 cm), stem girth (52.87 cm), leaf length (160.97 cm) and leaf width (62.53 cm). The interaction effect showed that, V2T3 had the least number of days taken for flowering (229.93 days). The highest plant height and stem girth was recorded in V2T2 (241.47 cm and 56.13 cm, respectively). The highest leaf length (167.53 cm) was recorded in V1T3.

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

S Priya Devi

Standardization of extraction of butter from kokum seeds

Dried kokum seed is a good source of butter, which possesses industrial applications. An experiment conducted using different extraction methods showed that fermentation method was the best among all the other methods tried. With this background, further studies were conducted on fermentation aspects. The fresh seeds along with encompassing pulp were kept for fermentation for a week. The samples were drawn daily and tested for fat content. The results showed that there was a constant increase in fat content up to third day (45%) and it declined on following days (to a minimum of 25%). In a different study, fermentation was aided manually to dried kokum seeds. The fat percentage increased from 11% on the 1st day to 17.7 % on the third day. However, there was a decrease in the following to 5-6 %.

Storage of mature jack fruit bulbs in brine solution

Mature jackfruit bulbs were stored in brine solution of varying concentrations, *viz.,* 10, 15, 20, 25, 30 and 40 %. The treatments were kept under refrigerated (6-8°C) and ambient conditions in May, 2019. The microbial load in the brine solution and the bulb pieces were analysed six months after storage. The load was almost zero in all treatments under refrigerated conditions. The bulb pieces also recorded minimum microbial load of 27 CFU (10^{-1} dilution) in 25 to 40 % brine solution. However, the microbial load in solution was less than that of the bulb pieces.

Estimation of losses, economics of fruits, chips of jackfruit

All the jackfruit trees in the Institute were considered in this analysis. The yield data was recorded and the bio-waste after removal of bulbs and seeds was also calculated. Out of the 19 trees, nine were firm type and ten were soft fleshed. The total no. of fruits were 617 (101 in firm, 516 in soft type). The percentage of bulbs was 21-30 (without seeds), of seeds was 10-19 and of waste (skin, inner core, rags etc) almost 50.

Economics/ net income was calculated based on the Institute and market rates. The total income when sold in the form of fresh fruit is ₹ 87,000 (ripe fruits) and ₹ 30,000 (for unripe vegetable type). If the ripe fruits are converted in to leather, the income would be ₹ 66,000 (@ ₹ 200/ kg). When processed into chips, the income would be ₹ 2,35,000 (@ Rs. 800 /kg). All the rates were calculated after considering labour charges and other required inputs.

Kokum

Kokum seeds physical, mechanical properties as affected by thermal treatment to design a decorticator for kokum butter extraction were studied.

Effect of heat treatment on brittleness of kokum seed coat

No.	Treatment	Time (s)	Force required to pucture seed coat ($x10^5$) (kgf m^2)
1.	Hot air oven at 40°C	600	(6.02 ± 0.47)
2.	Hot air oven at 40°C	1200	(6.07 ± 0.30)
3.	Hot air oven at 50°C	600	(5.62 ± 0.74)
4.	Hot air oven at 50°C	1200	(5.39 ± 0.50)
5.	Dry Roasting	600	(4.02 ± 0.70)
6.	Dry Roasting	1200	(2.86 ± 0.72)

Angle of repose of Kokum seeds and kernels

Trial No.	Angle of repose of whole seed	Angle of repose of kernel
1	56.71	49.95
2	53.47	50.65
3	54.84	51.56

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

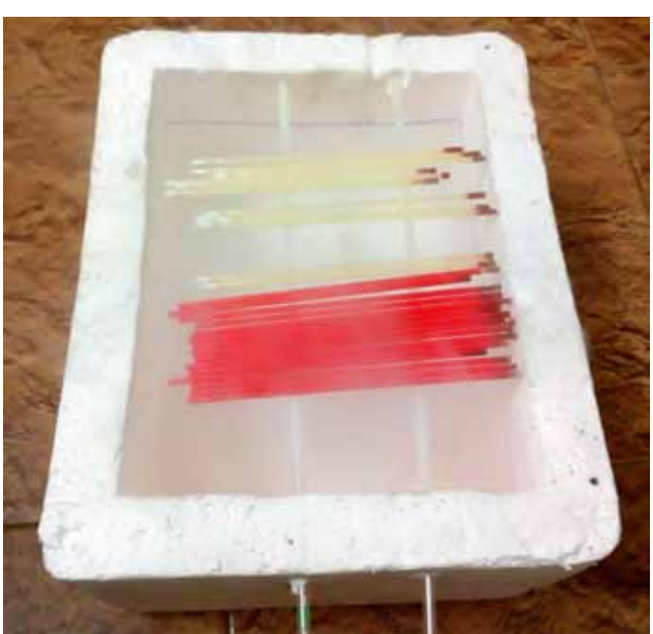
Project: Standardization of protocols for cryopreservation of boar semen

EB Chakurkar

This project was undertaken to standardize and evaluate suitable cryopreservation protocols for long-term preservation of boar semen. Efficiency of cryopreservation of pig semen was evaluated for long-term preservation using indigenous boar semen extenders with different controlled-rate freezing protocols and conventional vapour freezing. Screening of suitable boars for semen collection and freezing trials were carried out during the period. Cold-shock resistance test was performed to select suitable ejaculate samples for semen freezing trials. Cryopreservation extenders containing reduced levels of egg yolk and modified concentrations of glycerol as cryoprotectant were used. Selected protocols for controlled-rate freezing using programmable freezer (Planer Kryo®560) were compared for post-thaw quality and viability. Selected samples were also subjected to conventional vapour freezing method in which straws were horizontally arranged in static nitrogen vapour at recommended level of 4 cm above liquid nitrogen surface and exposed for 10 minutes before plunging into liquid nitrogen (-196°C). Pre-freezing and post-thaw sperm viability were assessed using Eosin Nigrosin staining, hypotonic swelling test and acrosome integrity at different time intervals were evaluated with modified Eosin-Nigrosin Giemsa staining.

Mean progressive sperm motility, live and dead percentage and acrosomal integrity of semen samples in liquid form before freezing and post-thaw states at different time intervals were recorded and compared. There were significant differences ($p < 0.05$) in post-freezing semen quality parameters associated with different cryopreservation protocols evaluated with major parameters showing higher values of sperm viability and sperm motility in boar cryo protocol-III (BCP-III). Mean post-thaw progressive sperm motility 24 hours post-freezing were 5.5%, 23.0%, 35.8% and 18.75% for protocols I, II, III and vapour freezing, respectively.

The mean percentage of live sperms in post-freezing samples were 17.7%, 51.0%, 56.3% and 36.2% for protocols I, II, III and vapour freezing. The acrosomal integrity as measured by percent intact acrosome in post-freezing samples were 11.0%, 29.6%, 36.0% and 21.5% for protocols I, II, III and vapour freezing, respectively. There was a gradual decline in live sperm percentage and acrosomal integrity percentage from day 1 to day 30 post-freezing in all protocols. Nevertheless, significantly higher values ($p < 0.05$) were recorded in BCP II and BCP III as compared to BCP I and conventional vapour freezing. Selected frozen-thawed samples were also evaluated for in-vivo fertility status in breeding sows using deep intra-uterine insemination procedure during the observed estrus. Overall conception rate of 42.1% and farrowing rate of 10.5% were recorded in the initial trials.



Controlled-rate freezer system

Conventional vapour freezing method

Project: Study on the virulence factors and antimicrobial resistance of important mastitis pathogens from coastal areas and exploration of indigenous herbals against clinical and subclinical mastitis

Susitha Rajkumar

Screening of dairy animals for mastitis and subclinical mastitis

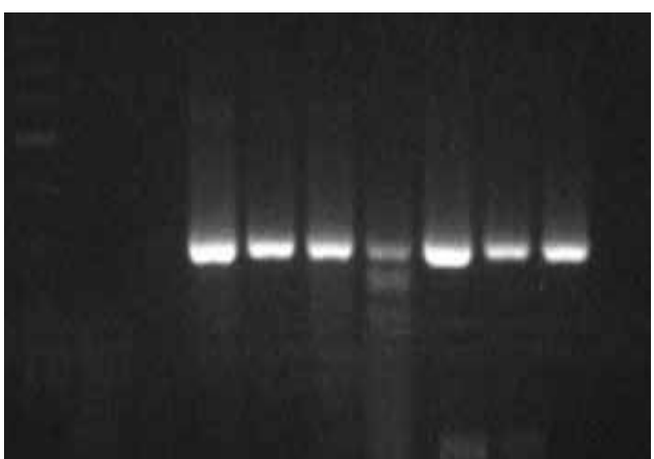
Mastitis including clinical and subclinical mastitis is an economically very important disease of dairy animals including cattle and buffalo. In order to study major bacterial pathogens and their pathotypes milk samples were collected from mastitis affected animals from small and large dairy units of Goa and Kerala. Initially animals were screened for clinical mastitis by presence of clinical signs and abnormal changes in milk and subclinical mastitis by using CMT. Milk samples were collected and subjected to bacterial isolation. Major mastitis pathogens isolated were *Staphylococcus aureus*, coagulase negative Staphylococci (CoNS), *E. coli*, *Bacillus* spp. etc. The *Staphylococcus* species were confirmed by PCR amplification of Gap gene. *Staphylococcus* aureus isolates were confirmed by PCR detection of nuc gene.

Screening of *Staphylococcus* spp. for biofilm formation

Ability to form biofilm is one of the virulence factors which helps the bacteria to persist in animal tissue and protect from antibiotic therapy. The *Staphylococcus* aureus and Cogulase negative *Staphylococci* isolated from clinical and subclinical mastitis were screened for biofilm formation phenotypically by growth in Congo Red Agar at 37°C. Out of the 48 isolates screened 5% showed positive by formation of black coloured colonies. The Staphylococci isolates were screened for presence of biofilm associated genes by PCR. Eno gene encoding for laminin binding protein was detected in 80% of the 48 isolates.

Antibiotic resistance pattern of Coagulase negative Staphylococci

A total of 114 coagulase negative Staphylococci from subclinical mastitis are screened for commonly used antibiotic in field. Highest susceptibility was found to be for enrofloxacin followed by amoxycillin clavulanate, ceftriaxone and methicillin. Least susceptibility was found to be for oxytetracyclin.



PCR amplified product of 300 bp sized eno gene

Project: Surveillance of Japanese encephalitis infection in pigs of selected JE endemic districts in west coast of India

Chethan Kumar HB

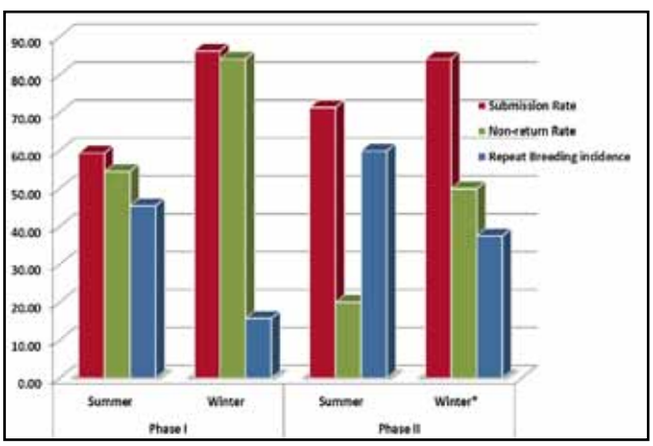
The project was initiated to identify the extent of pig population exposed to JEV in selected endemic districts of West coast of India. In the year 2019, thirty one pig blood samples have been collected from Dakshina Kannada district, Karnataka. The serum was separated and viral RNA was extracted from serum using QIAamp viral RNA mini kit (Qiagen). The viral RNA samples were subjected to reverse transcription polymerase chain reaction (RT-PCR) for the detection of JEV RNA. It was found that none of the samples were positive for JEV RNA by RT-PCR. The serum samples will be subjected to enzyme linked immunosorbent assay (ELISA) for the detection of anti JEV antibodies.

Pig farm visited for sampling in Dakshina Kaannada district during the study

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

Gokuldas PP

The impact of different bio-meteorological factors was studied in relation to overall reproductive performance in dairy buffaloes reared under coastal climatic conditions. In the first phase, effects of extended photoperiod on reproductive performance in buffaloes were assessed during different seasons. Two year data on different reproductive variables of buffaloes exposed to extended photoperiod were compared between summer and winter seasons. Under extended photoperiod, there existed a significant difference in major reproductive variables between the seasons with apparently favourable reproductive performance observed during winter months. Submission rate in a breeding herd was found to be significantly higher ($p<0.05$) in buffaloes bred during winter (59.4) than summer season (59.4% vs. 86.36%). Correspondingly, significantly higher conception rate was recorded in winter than summer. Overall calving rate in buffaloes reared under coastal climate was also significantly higher ($p<0.05$) in winter as compared to summer. Calf crop percentage is the proportion of calves born to total animals bred in a given period and this proportion was found to be significantly higher during winter (27.3% vs. 68.4%, $p<0.05$). Buffaloes calving in mid and late summer had apparently lower reproductive efficiency compared to those calving during winter. Animals calving during winter season had significantly shorter service period than other seasons. Significantly shorter ($p<0.05$) calving to estrus intervals were also recorded for those buffaloes calved in winter (10.4±1.04 weeks) than in summer (28.8±3.71 weeks). Similarly, significantly shorter inter-calving intervals were recorded for those buffaloes calved in winter months (56.7±1.6 weeks) in comparison to hot and humid summer season (82.8±6.4 weeks). In phase II with regular photoperiod, there was no significant difference in submission rate between seasons. Repeat breeding incidence was significantly higher ($p<0.05$) in summer when compared to winter.



Comparison of various reproductive variables in buffaloes in different seasons

Environmental factors like wind velocity and solar radiation can also influence thermal load on animals reared under sub-tropical climate. A newer approach using Heat Load Index (HLI) was thus applied for assessing correlation of environmental factors with reproductive variables *viz.* conception rate, calving rate and repeat breeding in different seasons. HLI consider additional environmental variables like Black Globe Temperature (BGT), Solar radiation (SR, W m^{-2}),

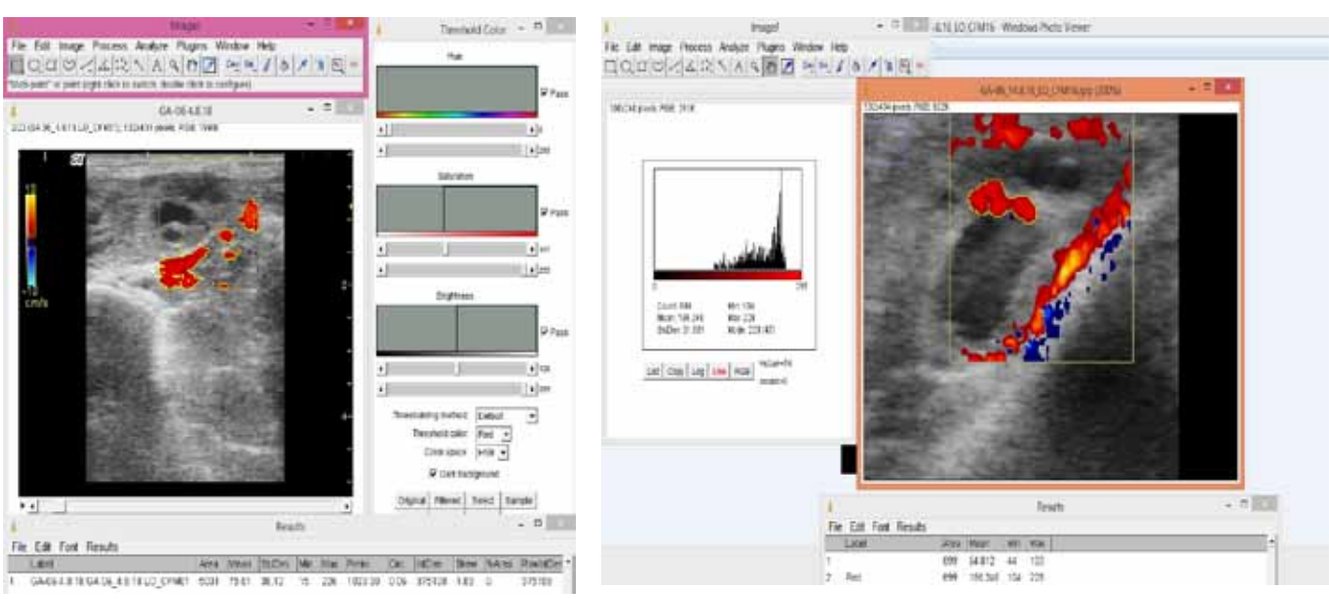
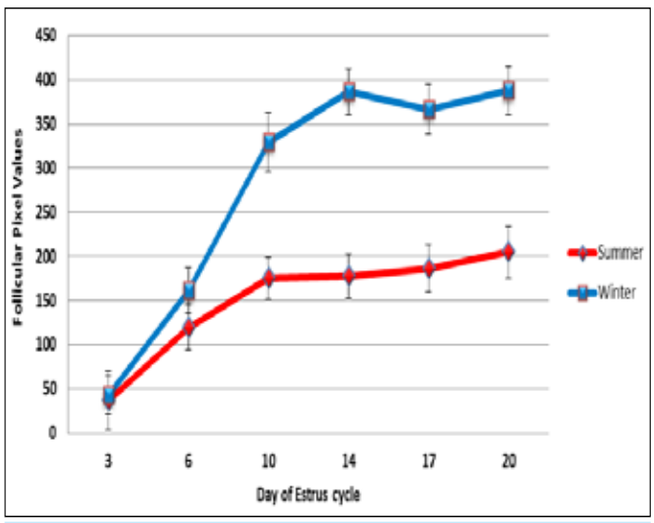


Image analysis of representative ultrasonograms (CFM mode)

Wind Speed (WS, m s^{-1}) and Relative humidity (RH %). The linear regression was established for HLI with the environmental variable HLI = (8.62) + 0.38 x RH + (1.55 x BGT) - (0.5 x WS) + e(-WS + 2.4). HLI was found to be negatively correlated (r = -0.97, p<0.05) with overall conception rate in winter and positively correlated (r = +0.90, p<0.05) with repeat breeding incidence in summer period.

Ovarian perfusion and morphometric data under Real-time B-mode ultrasound (RTU) and Colour Flow Mapping (CFM) modes were monitored and recorded during different seasons using digital Colour Doppler Ultrasound imaging system. Trans-rectal ultrasonography was performed using a battery operated multi-mode ultrasound scanner equipped with multi-frequency (6-10 MHz) linear-array transducer (LOGIQ® Book XP device, GE Healthcare) in buffaloes reared under coastal climate. Optimal scan and CFM images were frozen and recorded for analysis and interpretation. A total of 73 scanning sessions were carried out during the period. For analysis and interpretation image data, pixel values of saved and frozen CFM images were measured using computer-based ImageJ® image analysis software (Image J 1.51j8; NIH, MD, USA).

Image analysis is based on the number of coloured pixels which is expressed as pixel2 and corresponds to blood flow of the area scanned. Significantly higher (p<0.05) pixel values corresponding to follicular vascularity were recorded in winter during the mid to late stages of the estrus cycle. During summer, mean length and width of the ovary in buffaloes were 2.6±0.05 cm and 0.9±0.05 cm respectively, while significantly (p<0.05) higher corresponding values were recorded in winter (3.1±0.06 cm and 1.3±0.03 cm). Significant difference in diameter of mature preovulatory follicle (p<0.05) was also recorded between seasons which ranged from 9.9 to 12.4 mm (mean 11.2 ± 0.30) in summer and 16.1 to 18.4 mm (mean 17.42 ± 0.22) in winter.



Seasonal variation in follicular pixel values during different stages of estrous cycle in buffaloes

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

Nibedita Nayak

In this project, development of feed formulations using locally available ingredients and demonstration of artificial insemination techniques to farmers and collection, testing of samples from field for disease surveillance were carried out.

Baseline survey and constraint analysis of rural poultry farming in Goa

To study the present status, constraint analysis and impact evaluation of technological interventions of backyard poultry production in west coast, baseline survey of small scale poultry farmers atleast 75 was conducted initially.

Epidemiological surveillance of diseases in backyard poultry including duckery was carried out and 165 samples were collected from various clinical cases. Isolation and characterization of the organism was carried out in our laboratory.

To formulate a least cost balanced ration for early chick nutrition, inclusion of unique medicinal herbs and vitamin plants were taken into account.

Backyard poultry farm in Chorao, Goa

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

Project: Prospects and promotion of agro ecotourism in coastal region of India
EB Chakurkar

Maintenance of Dhanvantari garden

The medicinal and aromatic garden (Dhanvantari vatika) was maintained where around 100 plant species were added during this year. The garden was made informative to the visitors with display boards. Apart from maintenance, mass propagation and nursery activities are also in progress for most plants.

Demonstration for organic preparations and evaluation of their properties

A unit for preparing the organic preparations like Jeevamrut, Panchagavya, Waste decomposer, etc. was developed. Different combinations of the Jeevamrut preparation which included different amounts of ingredients, days of incubation (4, 7th and 10th days), etc. were evaluated. Based on the analysis of the chemical and biological properties, it was found that a combination use of 2 kg each of cattle dung, jaggery, gram flour, 2 liters of cow urine and 2 kg of fertile and biological active soils produces a Jeevamrut with higher number of the microorganisms (bacteria and fungi). The microbial population on 7th and 10th day in this combination was 8.3 and 9.5 log CFU mL^{-1} as and it was higher than other combination tested. Corresponding microbial population of the waste decomposer solution prepared as by the standard guideline of National Center on Organic Farming (NCOF) had 7.1 and 7.3 log CFU mL^{-1}. A Jeevamrut prepared using afore-mentioned combination except using the culture Goa Bio 1 (2 kg) (*Bacillus methylotrophicus* RCh6-2b) instead of fertile soil had 7.8 and 8.4 log CFU on 7th and 10th day. Consistent decrease in the pH of all the preparation with time was observed and all had acidic pH.

A structure for demonstration of azolla unit was established however the culturing of azolla for demonstrations is yet to be started.

Preparation of Jeevamrut in different combinations

Recycling of the biodegradable waste through vermicomposting

Through two cycles of vermicomposting, 6.3 tonnes of biodegradable waste was converted into 4.2 tonnes of vermi-compost. The conversion ratio was 0.65. The average time for composting for one cycle was 110 days. The gross and net income was ₹ 0.82 Lakhs and ₹ 0.59 Lakhs. The net income for one cycle of vermicomposting for converting 3.1 tonnes of biodegradable waste in 110 days was ₹ 0.29 Lakhs.

Vermicomposting unit as an important component of agro-ecotourism unit

Introduction to speciality fruits

Garcinia hombroniana (Seashore mangosteen), *Flacourtia jangomas* (Governor›s plum), *Artocarpus lakoocha* (Monkey jack) and *Artocarpus hirsutus* (Wild jack) were added to the collection of speciality fruits. The other fruit plants planted during the previous year were maintained. The peanut butter fruit plant flowered and fruited, from which seedlings were also raised for sales.

Introduction of Traditional vegetable crops of Goa

Vegetable crops *viz.,* Amaranthus (Goa Tambdi Bhaji-1 and 3 promising accessions), Bhendi (Goa Bhendi-1 and Jai Kisan-42 (F_1 hybrid) and Cluster Bean (Ankur Rani) were introduced for vegetable seed production.

Introduction of flower crops in AET unit

Flower crops *viz.,* Crossandra (3 types-Ratan Aboli, Pissi Aboli and Blue Crossandra), Heliconia (5 types) were introduced for establishing permanent block for showing to visitors and to enrich the plant diversity.

Making Video Film on AET

Professional Video Film of 5 minutes' duration was made during the reporting period. The Hindi version of video film also made during the reporting period.

Inventory of plants in AET

Work on inventory of plants in AET was initiated by recording photographs during different growth stages such as vegetative, flowering and fruiting stages for compilation purpose. Once completed, the same will be compiled as booklet with detailed information to distribute to the visitor as information source.

Fish pedicure and ornamental fish unit

The fish pedicure unit was stocked with new set of sucker fish, *Garra mullaya* at a stocking density of 25 number per 100 liters of water. The size of the species stocked was ranging from 8.4 cm to 10.3 cm. The three tanks were stocked with 25 numbers of the sucker fish species. The average number of nibbling per minute is estimated to be 52.3, 50.6, 51.7 numbers in tank1, tank2 and tank3 respectively. Two aquariums each for indigenous fish (10 species) and exotic fish (5 species) were established within the agro-eco tourism premises. The revenue generated from the unit is ₹ 0.08 lakhs per annum and the annual maintenance cost of unit in terms of energy, fish food, and disinfectants is ₹ 0.04 lakhs.

Quantitative and qualitative analysis of phytochemicals in Kalmegh (*Andorgraphis paniculata*) and Kaala adusa (*Justicia jendarussa*)

Phytochemicals of Kirayate/ Kalmegh (*Andorgraphis paniculata*) and Kaala adusa (*Justicia jendarussa*) were extracted by maceration method with hexane (S1), chloroform (S2), acetone (S3), Methanol (S4) and water (S5) in ascending and descending polarity by keeping 25 g powdered sample with 100 ml of the solvents in shaker for 24 hrs. The samples were filtered and centrifuged and concentration was determined. In ascending polarity extracts of Kirayate, the maximum concentration of phytochemicals were extracted by acetone (0.13 g ml^{-1}) and minimum by water (0.02 g ml^{-1}). In descending extracts, the maximum concentration was recorded in water extract (0.04 g ml^{-1}) and minimum was in hexane extract (0.009 ml g^{-1}). Bio active compounds such as tannins, saponins, quinines, phlobatanins, alkaloids, terpenoids, coumarins and flavanioids were tested by standard qualitative analysis procedures.

The total alkaloid content in *Andrographis paniculata* was 0.094 g ml^{-1} and *Justicia jendarussa* was 0.036 g ml^{-1}. Total phenolic compounds (gallic acid equivalent) in Andrographis and Justicia were 2.92 mg and 2.33 mg, respectively. Total antioxidant content as determined by DPPH scavenging activity was found highest

Presence of phytochemicals in the ascending and descending polarity extracts of *Andrographis paniculata* and *Justicia jendarussa*

Bioactive Components	Ascending polarity extracts of *Andrographis paniculata*					Descending polarity extracts of *Andrographis paniculata*				
	S_1	S_2	S_3	S_4	S_5	S_5	S_4	S_3	S_2	S_1
Tannins	-	-	-	-	+	+	-	-	-	-
Saponins	-	-	+	+	+	-	-	+	+	+
Quinines	-	-	-	+	+	+	+	-	-	+
Phlobatanins	-	-	-	-	-	-	-	-	-	-
Alkaloids	-	-	-	-	-	-	+	+	-	-
Terpenoids	-	-	-	-	+	-	-	-	-	-
Coumarins	-	-	-	-	-	+	+	-	-	-
Flavanioids	-	-	-	-	-	-	+	-	-	-
Bioactive Components	**Ascending polarity extracts of *Justicia jendarussa***					**Descending polarity extracts *Justicia jendarussa***				
	S_1	S_2	S_3	S_4	S_5	S_5	S_4	S_3	S_2	S_1
Tannins	+	-	-	-	+	+	-	-	-	+
Saponins	-	+	+	+	-	+	+	+	+	+
Quinines	+	-	-	-	-	+	+	-	+	+
Phlobatanins	-	-	-	-	-	-	-	-	-	-
Alkaloids	-	+	-	-	-	-	-	-	-	-
Terpenoids	-	-	-	-	+	-	-	-	-	-
Coumarins	+	+	-	-	+	+	-	+	+	-
Flavanioids	+	+	-	-	-	-	+	+	-	-

(-): absent; (+): present

(87.6 %) in *Justicia jendarussa.* Water and methanol extracts of *Andrographis* and *Justicia* were tested against '*Staphylococcus aureus*' (Gram positive bacteria) *E. coli* (Gram negative bacteria) and the results were found negative.

Studies on the Physical and Biochemical properties of Cashew Apple Pomace/Bagasse to Assess its Use for Paper Making

Cashew apple pomace which is a major by-product of the cashew feni industry was used to make paper using the following procedure:

Steps involved in paper making:

1. Collection of material: Collection of dry cashew apple pomace.
2. Soaking: Soak the collected sample in water prior to pulping.
3. Prewashing: To remove unwanted materials and microbial strains the material is washed with water 8-10 times.Cooking and pulping: The aim of pulping is break down the bulk structure of fibre source. Chemical pulping achieves this by degrading the lignin and hemicellulose into small, water soluble molecules which can be washed away from the cellulose fibre. soaked sample is converted into pulp (digestion of lignin) by using sodium hydroxide.
   a. Take soaked sample cooked in the container or retort.
   b. Water is added 10 times the amount of dry weight of sample (10 l)
   c. Add 150 ml NaOH (15% of dry weight of sample).
   d. Sample is boiled for 1 hour and stir continuously.
   e. After 1 hour boiling, sample becomes soft and black color pulp.
4. Bleaching and cleaning
   a. After cooking remove the unwanted solid material from pulp or clean the pulp.
   b. Use H_20_2 (50% concentration) for bleaching.
   c. From 1 kg dried sample we will get 5000 ml pulp.
   d. For 5000 ml pulp use 6% of H_2O_2 (50% conc.) and keep overnight.
   e. We will get 1200 ml pulp after bleaching & color of pulp is yellowish white.
   f. For more bright color, add 5% of H_2O_2 (50% concentration) in 1200 ml pulp.
5. Pressing -
   a. Thoroughly mixed pulp is poured in a plastic bucket.
   b. Required level of water is filled in the bucket before placing the sieve.
   c. Mix the contents thoroughly and place the sieve into the bucket.
   d. Lift the sieve gently and place another screen over the layer formed on the sieve.
   e. after draining out water from pulp, place it on plastic.
   f. Arecanut plate making machine was used for pressing.
6. Formation of sheet on a plastic: Demold the screen from the sieve and flip the sheet of paper on a plastic sheet.
7. Drying: Place the sheets of paper one above the other while placing cloth between each layer. Keep a heavy weight over it to remove the water and protect the paper from cracking.
8. Ironing: Iron the paper by placing a cloth over it. Continue to dry the paper by ironing it after every one hour until it dries completely.
9. Cutting: Cut the paper in suitable size pieces according to the requirement.

It was found that the average crude fibre content of cashew apple pomace was found to be 60.3% as compared to that of of wood ,45-60% and that of other non- wood feedstock, 10–25%. Thus the average crude fibre in the pomace are more than range of other typical wood.

Paper making using cashew apple pomace bagasse

Project : Enhancing the utilization of pseudostem and leaves of banana

V Arunachalam

Segregating progenies of banana form the major pre-breeding material in crop improvement programs. Half sib seeds of Sugandhi (AAB –Pisang Awak group) similar to Karpuravalli cultivar of banana were obtained with putative male parent of Rupa (BB). The seeds were extracted from the fruit and about 11 seedlings were raised and planted in the field along with clonal progenies (suckers) of Sugandhi variety for evaluation. The height of seedlings varied from 52.5 to 99 cm. Seedlings produced 4-8 leaves, each leaf 21.9 to 32.5 cm long, 6.2 to 19.4 cm wide and petiole length of 7.3 to 18.1 cm.

Sugandhi

One *Musa balbisana* Colla (BB) type was identified in the farmer's field (Ms Rupali Padwalkar) at Ponda, Goa. The plant was both male and female fertile and bore fruits with several seeds. Seeds were extracted and seedlings were raised and planted along with clonal progenies raised by suckers. After screening the seedlings for two years for leaves and suckers production traits, few were selected with potential for leaf industry with large number of suckers, large and wide leaves. The performance of 63 segregating seedling progenies of *Musa balbisiana* (Colla) at Old Goa in terms of leaves and suckers (mean, standard error) produced during Feb 2019 to Sep 2019 were recorded. It was named as Rupa and evaluated for leaf industry including foliar potassium and sodium contents. The seeds of the selected progenies were sent to State Horticulture farm, Kanya kumari, Department of Horticulture and Plantation Crops, Govt. of Tamil Nadu for establishment of mother plants for supply to banana leaf growing farmers.

Banana cultivation for leaf and pseudostem production

Production of suckers and leaves (Feb 2019 to Sep 2019) in *M balbisiana*

Number of suckers	Number of leaves	Leaf length (cm)	Leaf breadth (cm)	Petiole length (cm)
6.97±0.54	93.48±7.19	114.89	33.63±0.91	34.22±1.16

Biochemical Properties of four varieties of Banana

Property	Amti	Velchi	Red	Rasbali
Inorganics and ash content	83.28±0.610	90.14±0.27	81.09±0.37	85.68± 4.32
Crude fat/ether extractives	1.47±0.048	1.79±0.43	0.622±0.9	1.90±0.3
Crude Fibre	33.86±5.28	28.34±1.33	37.58±8.6	34.80±7.66

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

Production management studies under modified naturally ventilated single span and fan ventilated double span greenhouse under coastal conditions of Goa for Cucumber and Tomato vis-à-vis fertigation trials, different planting materials, growing media were conducted.

The introduction of insect nets decreased the air exchange rates and year-round the average temperatures in the greenhouse were found marginally higher or equal to ambient during most part of the year. But during April, May, the greenhouse daytime temperatures exceeded the acceptable range for Tomato. Cucumber was cultivated from June to August and the temperature was above optimum in June alone. The daytime relative humidity except during rains from June to October was controlled by the fan ventilation to some extent as compared to ambient but the nighttime humidity when fans were not operated was very high. Significant variability on microclimate across the span and length was observed.

Tomato cultivation under protected structures

For Tomato experiment which was started in the previous year, two Fertigation rates F1 -(N:P:K -159:257:400), Ca- 77 , Mg- 33, S- 42, B-4.6) & F2-(N:P:K -106:171:266.7), Ca- 51.3, Mg- 22, S-28, B-3.1, two growing media: Soil, Coco-pith, planting material : seedlings, vs grafted plants were assessed. The use of grafted tomato seedlings significantly reduced the mortality due to bacterial wilt to 20-40 % as compared to 60-97% in seedlings. The per plant yield varied from (1429.25 ± 888.04 to 68 ± 29.80 g.) Three varieties of Cucumber *viz.* Kian (F1 Hybrid) of Nunhems co., Fadia (F1 Hybrid) of Enza Zaden and Terminator (F1 Hybrid) of Yuksel Seeds with two growing media of soil and coco-pith and fertigation rate– N:P:K -50:91.5:130, Ca-20.7, Mg-10.6, S-13.2 B-1.6 were grown from June to August. But poor yield was realized due to incidence of leaf spot disease and red mite incidence.

Studies on Single Span Greenhouse

Under naturally ventilated conditions with insect nets over vents, the microclimate in single span greenhouse was above the optimum conditions required for a Cucumber crop i.e. 15-32 °C and 45-60% respectively, except during July and August, when the temperature was in the optimum range and December to May when the day time humidity was in the optimum range. Under stressed condition three crop cycles of cucumber cultivated in the greenhouse *viz.* Kian (F1Hybrid) of Nunhems co., Fadia (F1 Hybrid) of Enza Zaden and Terminator (F1 Hybrid) of Yuksel Seeds with two growing media of soil and coco-pith and two fertigation rates F1 – 150 % Fert – N:P:K -50:91.5:130, Ca-20.7, Mg-10.6, S-13.2 B-1.6 , kg/ha, F2 – 100 % Fert – N:P:K -33.33:60:86.7, Ca-13.8, Mg-7.05, S-8.8 B-1.05, kg/h were taken up. The date of 50% flowering in soil media varied from 28±0.0 days for Kian and Fadia to 33±1.0 fpr Terminator and for growbeds it varied from 27.7±0.6 for Kian and Fadia to 31.3±1.5 days in Yuksel with F1 fertigation rate. With F2 fertigation rate the date of 50% flowering was 28±0 (Kian), 29.3±0.6 (Fadia), 33.0±1.0 (Terminator) and in growbeds it was 28.7±1.2 days (Kian), 28.0±1.0(Fadia) and 32.7±1.5 (Yuksel). Similarly the per plant yield for F1 fertigation was found to be 1.23±0.45 kg (Kian), 1.09±0.64 (Fadia), 1.07±0.44(Terminator) in soil and 1.43±0.37 (Kian), 1.44±0.44 (Fadia) and 1.07±0.51 (Terminator) in cocopith growbeds, while with F2 Fertigation it was 1.33±0.38 (Kian), 1.18±0.49 (Fadia), 1.31±0.50 (Terminator) in soil media compared to 1.40±0.38 (Kian), 1.11±0.57 (Fadia) and 1.07±0.51 kg (Terminator) in cocopith growbeds.

In Season II (DOS 19 June 2019) only one Fertigation : N:P:K -33.33:60:86.7, Ca-13.8, Mg-7.05, S-8.8 B-1.05, kg/h)was used but very poor yield were observed in all three varieties due to severe leaf spot incidence.

In Season III (DOS February 7, 2019) only two varieties Kian and Fadia with two fertigation rates of season I were cultivated on soil beds. Poor yields per plant 0351 ± 0.16 kg to 0.655.18 ± 0.46 kg was realized due to leaf spot incidence.

Cucumber crop under single span greenhouse

RESEARCH ACHIEVEMENTS

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

Konkan kanyal goats
Photo Courtesy: Shivasharanappa N

All India Co-ordinated Research Projects (AICRP)

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

Development of rice based lowland integrated farming system

A rice based farming system model (crops-dairy-fishery) has been standardized on 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, one female calf), farm yard manure unit (10 m^2) and kitchen garden (80 m^2). The system produced 19 q of rice, 385 kg of baby corn, 72 kg of sweet corn, 72 kg of moong and 95 kg of cowpea with 1250 litres of milk. In terms of gross return (₹ 2.35 Lakh) the highest percentage contribution was from crops (59%) followed by dairy (29%). With regards to net return (₹ 1.39 Lakh) the highest % contribution is recorded from crops (56%) followed by dairy (32%), and fishery (12%). The total quantity of crops straw/stover, green fodder and crop residue produced from cropping system was 8336, 4012 and 161 kg, respectively, was recycled in the same manner 5828 kg cowdung and 3055 litre urine were used within the farm. An employment of nearly 339 man days worth ₹ 0.51 lakhs was generated from the model. The value of farm generated and value of products recycled within farm is ₹ 1.21 Lakh and ₹ 0.48 Lakh, respectively.

Development of plantation crop based upland integrated farming system

An upland model of area 0.8 ha comprising of enterprises such as plantation crops: cashew (variety Bhaskara) + pineapple (Variety Giant Kew), coconut (benaulim)+ pineapple (Giant Kew) + noni + tapioca, arecanut (Mangala) + banana (G-9), piggery, poultry, vermicompost unit, compost unit was evaluated for upland situations of Goa. The gross return from the system is around ₹ 1.73 lakh and the net profit is ₹ 1.18 lakh. The highest contribution to net profit is from the piggery unit (42%) followed by cashew-pineapple system (25%).

Plantation crop based IFS model

Rice-fish intergrated farming system

Project: All India Co-ordinated Research Project on Cashew
AR Desai

Collection, maintenance, evaluation of Cashew germplasm

A total of 97 cashew germplasm accessions, consisting of the following, are being maintained in the field germplam bank.

- Jumbo nut types : 14 + 3= 17 accessions
- Bold nut types : 40 accessions,
- Medium nut and high yielders : = 13 accessions
- Remaining 23: high yielders/ cluster bearers irrespective of nut size
- Dwarf canopy types : 3 accessions
- Very compact canopy type: 1 accession
- Total germplasm collection : 94+3 = 97 accessions

Results of evaluation of bold nut accessions led to the identification of an elite accession, Tudal – 1, which has been recording consistently promising performance, with 8.88 kg per tree nut yield, having 8.4 g nut weight, 28.1% shelling and mean apple weight of 88.6 g with 10.8% degree

Cluster bearing in Tudal-1 cashew selection

brix during the period under report. It is short listed for variety release for commercial cultivation in the state of Goa.

Hybridization and selection

Evaluation of first set of cashew hybrid progeny resulted in short listing of two hybrids *viz.,* HB-21/05 and HB-27/05 as the promising hybrid which recorded raw nut yield of 11.88 kg per tree and 12.78 kg per tree respectively having 8.4 g and 7.6 g nut weight; 29.38 and 28.42% shelling during 2019 season . Mean apple weight of 88.6 g with 10.8% degree brix was recorded in HB 21/05 as against the corresponding values of 76.4 g and 10.6% degree Brix in Hb27/05. HB 21/05 is short listed for variety release proposal for cultivation in the state of Goa.

These promising accessions and hybrids are also supplied to Odisha University of Agriculture and Technology, Bhubhaneshwar for evaluation under East coast conditions.

Third and fourth sets of hybrid progeny were planted in field for evaluation. Hybridization work was continued during flowering season 2019 for producing hybrid progenies. A total of 403 hybrid seed nuts of different parental combinations were produced and the nuts are sown for raising seedlings.

Production of planting material

About 11,000 grafts of cashew varieties were produced and supplied to farmers. Nucleus grafts of Goa cashew -2, Goa cashew-3 and Goa Cashew -4 were provided and facilitated the establishment of scion bank of cashew varieties in Farm C.

Project: All India Co-ordinated Research Project on Palms

V Arunachalam

Evaluation of coconut based cropping system models

Pre experimental coconut yield in the experimental plot was average nut yield per year per palm 47 during July 2014-June 2015. Coconut nut yield per palm during the current year after intercropping is 67 nuts per palm per year. Post-experimental nutrient data was recorded in the plot and the potassium levels in the soils were low.

Yields of intercrops in the coconut based cropping system model

Treatment	Crop and part harvested	yield
Coconut + Black pepper + Papaya + Drumstick	Papaya fruit	96 kg ha^{-1}
Coconut + Black pepper + Heliconia	Heliconia flower	2240 stems ha^{-1}
Coconut + Black pepper + Banana + Lemon	Lemon fruit	25.12 kg ha^{-1}
Coconut + Black pepper + Passion fruit + Pineapple	Pineapple fruit	1688.64 kg ha^{-1}
Coconut + Black pepper + Annona	Soursop fruit	320 kg ha^{-1}
Coconut + Black pepper + Crossandra	Crossandra flower	49.92 kg ha^{-1}

Current nutrient status of the soil of different treatments

Treatment	pH	EC	OC (%)	N (kg ha^{-1})	P_2O_5 (kg ha^{-1})	K_2O (kg ha^{-1})	Boron (ppm)
Coconut+ Black pepper+ Papaya+ Drumstick	5.99	0.05	0.61	335.83	11.82	230.99	0.30
Coconut+ Black pepper+ Heliconia	6.36	0.05	0.47	294.76	12.03	321.81	0.36
Coconut+ Black pepper+ Banana+ Lemon	6.08	0.06	0.51	306.78	12.59	311.92	0.35
Coconut+ Black pepper+ Passion fruit+ Pineapple	6.24	0.19	0.80	274.06	11.11	329.84	0.28
Coconut+ Black pepper+ Annona	5.95	0.04	0.44	249.44	11.56	188.91	0.34
Coconut+ Black pepper+ Crossandra	6.24	0.09	0.59	327.58	14.04	269.96	0.44
Coconut monocrop	6.13	0.06	0.57	319.70	14.19	231.28	0.23

Mother blocks and production of quality planting material in arecanut

Nucleus seed garden of Hirehalli Dwarf was established in different phases and being maintained with currently 271 surviving palms of which 72 are at reproductive stage. The vegetative DUS traits (Distinctness, Uniformity and Stability) recorded on 113 plants are given below which indicates the mean height of the plant from plant base to base of crown was only 1.19+0.07 m at 9 years of planting. Mean spadix length and breadth in 133 inflorescences of the study were 32.38+1.03 cm and 13.68+0.29 cm, respectively. 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 mg ml^{-1}) and Hirehalli dwarf (855.26+67.40 mg ml^{-1}) plants. The results for the past two years confirm the hypothesis of association of the dwarf plant with a high foliar glucose content and suggest the use of the glucose content as diagnostic biochemical assay.

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

M. Thangam

Under this national programme, multi-location trials brinjal (varietal and resistant trial) and chilli (varietal trial), tomato (hybrid trial), pumpkin (varietal trial) are conducted at the institute.

Brinjal (Long) IET

Nine lines in brinjal IET were evaluated for yield and yield contributing traits during 2018-19. The individual fruit weight ranged from 69.65 g (2018/BRLVAR-3, 2018/BRLVAR-7 and 2018/BRLVAR-12) to 240.25 g (Local check) The highest fruit yield of 323.27 q ha^{-1} was recorded in 2018/BRLVAR-7 followed by 291.04 q ha^{-1} in 2018/BRLVAR-9.

Brinjal (Round) AVT-I

Eight varieties along with one local check are being evaluated for different traits under Goa condition. The highest fruit yield of 258.78 q ha^{-1} was recorded in 2017/BRRVAR-8 followed by 248.55 g (Local check). The lowest yield of 211.98 q ha^{-1} was recorded in 2017/BRRVAR-1.

Brinjal Bacterial Wilt AVT-I1

Eight test varieties along with one local check were evaluated for incidence of bacterial wilt and other yield traits under Goa condition. There was incidence of bacterial wilt from moderate to high. The highest wilt incidence of 87.9% recorded in 2016/BRBW-4 followed by 2016/BRBW-5 (53.4%). The local check recorded the wilt percentage of 40.50 during the evaluation. The highest fruit yield was recorded in 2016/BRBW-8 (69.86 q ha^{-1}) with a bacterial wilt incidence of 39.8% followed by 2016/BRBW-1 (62.92 q ha^{-1})

Tomato Hybrid Det. AVT-II

Six entries of tomato were evaluated for different morphological traits. The individual fruit weight ranged from 49.00 g in 2016/TODHYB-4 to 77.75 g in 2016/TODHYB-5. The highest fruit yield of 339.07 q ha^{-1} was recorded in 2016/TODHYB-7 followed by 308.08 q ha^{-1} in 2016/TODHYB-2.

Pumpkin AVT-II

Six entries of pumpkin were evaluated during rabi season for yield and yield contributing traits. The individual fruit weight ranged from 1.25 kg in 2016/PUMPVAR-4 to 2.15 kg in 2016/PUMPVAR-6. The highest yield of 305.64 q ha^{-1} was recorded in 2016/PUMPVAR-7 followed by 297.74 q ha^{-1} in 2016/PUMPVAR-5.

Project : All India Co-ordinated Research Project on Pigs

EB Chakurkar

As per the AICRP on pig technical program, the crossbred pigs of 75% exotic Large White Yorkshire (LWY) and 25 % local Agonda Goan blood were produced and maintained to study their growth as well as reproductive performance. Total 30 numbers of breeding females and 10 numbers breeding males were selected as per approved guidelines. Generation wise growth data of four generation has been recorded and currently fifth generation data is being recorded. The least square mean of all the growth traits up to 10 months of age has been calculated and compared among all four generations. As per technical program 75% (exotic inheritance) crossbred are under study for performance which include litter performance, growth performance, mortality etc. Selective breeding along with artificial insemination are followed for all the experimental groups. The A.I technology is also transferred to the farmer's demonstration unit. Deworming is practised in pregnant sows on an around

105th day of pregnancy to prevent both transplacental and transcolostrol transmission of internal parasites (eg. Strongyliod) from sow to piglets as well as to reduce worm egg pass through faeces after pregnancy there by prevents postnatal transmission to piglets. Centre maintains pure Agonda Goan, Large White Yorkshire and their Crossbreeds. All the animals are fed with concentrate feed mixture prepared in the institute feed unit with different composition of ingredients for Pregnant, Growers and Piglets/ Creepers. Total herd strength of crossbreed pigs (75% LWY x AG) as on 31st March 2019 was 177 including 50 breeding sows and 19 breeding boars.

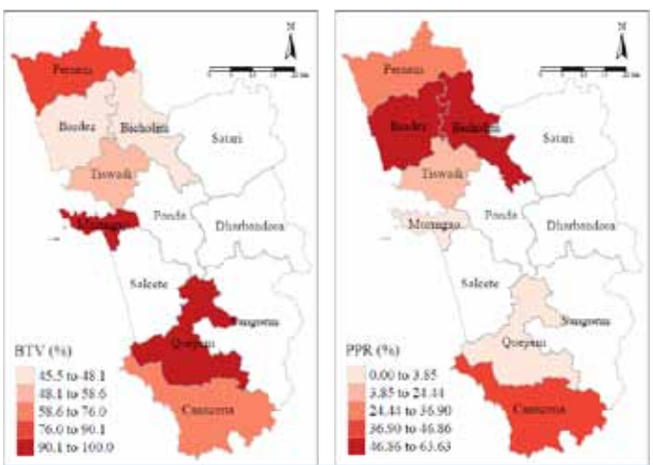
Project : All India Co-ordinated Research Project on animal disease monitoring and surveillance (ADMAS)

Shivasharanappa N

During this period, for epidemiological surveillance of pig diseases in Goa, a total of 105 sera samples were collected from pig farms from North and South Goa as per sampling plan of the year. The sera samples were sent to ICAR-NIVEDI, Bengluru for screening against classical swine fever (CSF), porcine respiratory and reproductive syndrome (PRRSV) viral disease and other important diseases in pigs. Three outbreaks suspected for FMD, CSF and Septicemia in pig farms were investigated that revealed negative results.

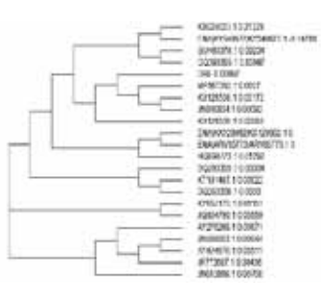
Sequencing Characterization of ORF viral infection in goats

The B2L gene was amplified from scab lesions and sequencing was deduced which showed closest similarity with the previously reported Orfv strain from Maharashtra (MF567362) and north eastern India (KU128538 and JN846834).



Mapping of BTV and PPR in goats in Goa

ORF viral infection in goats



PCR Diagnosis of Orf viral infection and sequencing charecterization in goats

Sero-prevalence of PRRSV and Classical Swine fever (CSF) in pigs screened by ELISA during 2018-19

Dist	Block	Pig population	Total sample collected	PRRSV		Classical Swine fever		
				Positive	Preva-lance (%)	Samples tested	Positive	% Preva-lance
North Goa	Tiswadi	70	24	0	0	15	13	86.66
South Goa	Salcete	1501	56	24	42.85	9	0	0
	Mormugao	555	28	9	32.14	14	1	0.07
	Total		108	33	30.55	38	14	36.84

The sero-prevalence of Blue Tongue (BTV) and PPR in goats was mapped for Goa state based on ELISA screening of sera samples as per ADMAS sampling plan.

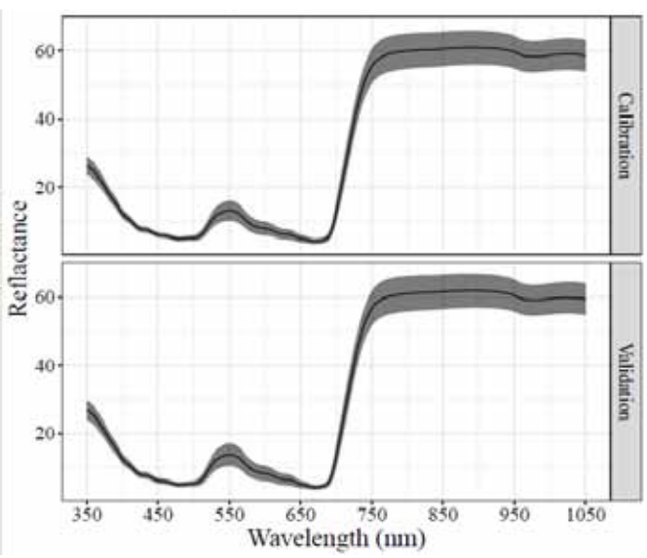
Externally Funded Projects

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

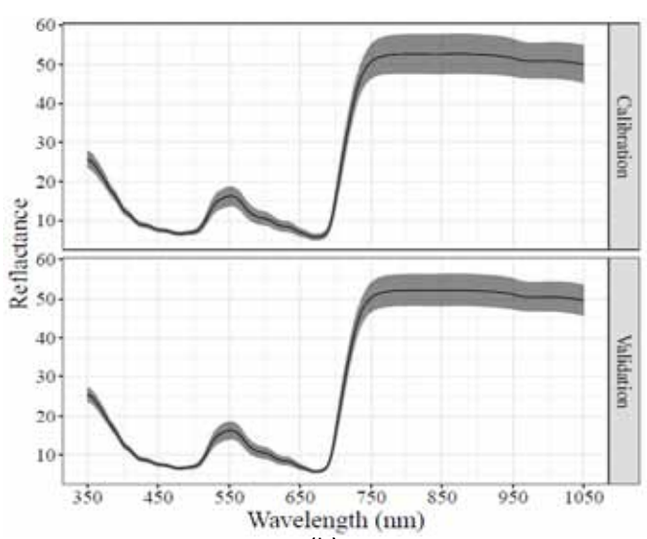
GR Mahajan

Study was undertaken to explore possibility of using hyperspectral remote sensing to predict the leaf nutrient status of mango and cashew crops. To achieve this, systematic sampling of the leaves from selected orchard and spectral data measurement was done as per the standard methods.

It is evident from the pattern of average spectral reflectance with standard deviation of the calibration and validation dataset of mango and cashew that it exhibits adequate variability.



(a)



(b)

Pattern of average spectral reflectance with standard deviation of the calibration and validation dataset of (a) mango and (b) cashew

Multivariate analysis techniques like partial least square regression (PLSR), principal component regression (PCR) and support vector machine regression (SVMR) were employed for processing the hyperspectral reflectance data to predict the leaf nutrient status of mango and cashew.

Performance of the multivariate analysis techniques to predict mango leaf nutrient content using the spectral reflectance data

None of the multivariate model could predict the leaf N concentration significantly. The performance prediction for all the models tested was unreliable. The highest prediction accuracy for P for the SVMR model but as per the ratio of performance to deviation (RPD), predictions were non-reliable RPD=1.30 i.e. <1.40). The calibration prediction accuracy was acceptable to predict K using the PLSR but it was non-reliable for validation. Acceptable calibration and validation prediction accuracy was observed for Ca using the PLSR model the corresponding regression coefficient (R^2) was 0.543 and 0.431, $p<0.05$). The PLSR and SVMR models had a acceptable calibration (RPD =1.56 and 1.41) and prediction accuracy (RPD=1.42 and 1.44) for magnesium. The corresponding coefficients of determination (R^2) for calibration and validation using PLSR were 0.58 and 0.52 and using SVMR were 0.52 and 0.43. The prediction performance of all the multivariate models tested for the prediction of S, Fe, Mn, Zn, Cu and B for calibration as well as the validation were found non-reliable. For all the predictions, highest values of index evaluation parameters like R^2 an RPD and lowest RMSE were recorded with the PLSR model.

Performance of the multivariate analysis techniques to predict cashew leaf nutrient content using the spectral reflectance data

Among the multivariate anlaysis techniques tested for prediction of N, the calibration and prediction accuracy was highest using PLSR model and found acceptable. The corresponding R^2 was 0.56 and 0.54 and RPD were 1.51 and 1.48, respectively. The prediction by the PCR and SVMR were non-reliable. The best performing model for the P prediction was PLSR with RPD of 1.41 and 1.43 for the calibration and validation. The performance of the PCR and SVMR was non-reliable for both calibration and validation. The R^2 of PLSR based K prediction for

calibration and validation were 0.55 and 0.52 whereas the RPD was 1.49 and 1.44 indicating acceptable predictability of the model. Of the three model tested for calibration, predictions were acceptable for PLSR (R^2=0.74, RPD=1.95) and for SVMR (R^2=0.63, RPD=1.55) to predict Ca. In case of validation, best performance was recorded for SVMR with acceptable prediction (R^2=0.74, RPD=1.95) and it was non-reliable for the PLSR (R^2=0.48, RPD=1.35). For magnesium, the calibration prediction accuracy was highest for PLSR with R^2=0.85, RPD=2.61 and it was excellent and the validation accuracy was acceptable with R^2=0.68, RPD=1.65. None of the multivariate technique could predict S and Fe with acceptable predicting accuracy for both calibration and validation. For prediction of Mn using calibration and validation dataset, performance of the SVMR model was the best with R^2=0.77 and RPD=1.61. The predictions of Mn using SVMR were acceptable. Though PLSR had at par prediction accuracy for calibration to that of SVMR, it reduced (R^2=0.07, RPD=0.49) for validation and had non-reliable predictions. The predictions of the Zn and Cu were found non-reliable. Excellent B prediction was achieved for calibration using PLSR and had excellent accuracy of prediction as R^2=0.86, RPD=2.70. But, the accuracy of prediction was non-reliable for the validation (RPD=1.32).

Project: Management of economically important insect pests with the use of pheromone technology through trainings and demonstrations (NABARD)

R Maruthadurai

Pheromone technology has been popularized for the management of fruit flies in cucurbits and mango. The performance of aggregation pheromone traps for the management of red palm weevil and rhinoceros beetle in coconut was assesed. Training and field demonstrations were conducted at various talukas of Goa. Experimental results showed that an average of 2-4 adults of red palm weevil were attracted per trap per week. An average of 1-2 adults of rhinocerous beetles were attracted per trap per week. More number of females were attracted to the traps compared to the males in both the species. Significant reduction of red palm weevil and rhinoceros beetle damage was recorded in pheromone implemented plantations. Hands on training on trap placement, lure replacement, food attractants, trap servicing and insect observation were given and imparted to the farmers.

Distribution of pheromone traps

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

R Maruthadurai

The aim of the study was to investigate the acoustic behaviour of stem and root borers in cashew and to identify the area of the infestation, feeding galleries and various bio-stages of stem borer employing thermal imaging concepts and to develop an acoustic device for early detection, monitoring and eradication of concealed insect pests. Laboratory rearing of grubs of stem and root borer on fresh cashew bark was initiated. The grubs were actively feeding and reached 3rd instar. The 2nd instar grub was introduced into the cashew log. stethoscope was ineffective to record the feeding sounds of the grub placed on the cashew log and tried. The grub may be emitting a low frequency sounds. Commercially available acoustic sensors or accelerometer are being tested to detect the feeding sound of cashew stem and root borer.

Detecting acoustic sounds of cashew stem and root borer

Project: Popularizing good post harvest management practices for field crops of Goa through research, trainings and demonstrations (NABARD)

Mathala J Gupta

The objectives of the project were 1) To Sensitize the Farmers about the extent and types of Post-harvest losses on their farms and 2) To build the capacity of the farmers through widespread trainings and demonstrations on good post-harvest management practices

As per the objectives, following activities were conducted

1) Three sensitization program on 19th January 2019 at KVK North Goa, 16th October, 2019 at ICAR-CCARI, Old Goa, and on 17th October, 2019 at Columb Sanguem, with a total of 160, 99 and 114 Paddy farmer participants respectively. The program had series of lectures given by various scientists of ICAR-CCARI, to sensitize them about various causes for postharvest losses and good management practices from correct variety selection, good agronomic practices, right nutrient management, pest and disease control during and post production and machineries and technologies available for reducing postharvest losses.

2) On farm training were conducted as below.

I. Harvest losses sensitization and management -3 numbers covering 87 farmers
II. Modern Parboiling using NRRI mini Parboiling units – 6 number covering 466 farmers
III. Drying, Milling and Storage losses sensitization and management – 6 numbers covering 207 farmers

3) A Pusa Bin was constructed on a farmer's field in Khadola, Marseille, North Goa. Training of farmers on storage management using Pusa bin is scheduled for the next year.

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

Shivasharanappa N

Computer Aided Sperm analysis (CASA) of Konkan Kanyal buck semen and standardization of artificial insemination was carried out.

The CASA was undertaken to study the sperm morphology, total motile, progressive motile, linearity and velocity parameters. Semen collection was done from 8 selected Konkan Kanyal bucks and a total of 27 ejaculates were collected using artificial vagina method (IMV Ltd). Semen samples were analyzed for volume, concentration, motility, abnormality and CASA. Modified Eosine Nigrosin staining was carried out to distinguish live and immotile from dead sperms. The live sperms didn't take any stain as their membrane is intact. The hypo-osmotic swelling (HOS) test was done to evaluate the functional integrity of the sperm's plasma membrane as only cells with intact membranes (live cells) swell in hypotonic solutions.

Mean volume, concentration and motility of konkan kanyal goat semen

Parameter	Average	Standard Error	Minimum	Maximum
Volume (ml)	0.8	0.09	0.4	1.5
Concentration (million / ml)	1128.81	83.77	760.4	1450
Motility (%)	83.77	1.25	76	90.1

CASA Analysis of Buck semen

	Normal Morphology	Mass motility	Progressive motility	Total sperm concentration (Billion/ml)	Live sperms (%)	HOST +ve sperms (%)
Mean	93.78	61.33	40.88	1.23	61.49	53.44
Standard Error	0.97	2.67	2.31	0.09	2.11	2.06
Minimum	77.20	27.20	25.00	0.35	52.90	44.20
Maximum	100.00	98.10	80.80	2.70	71.80	63.60

Semen preservation

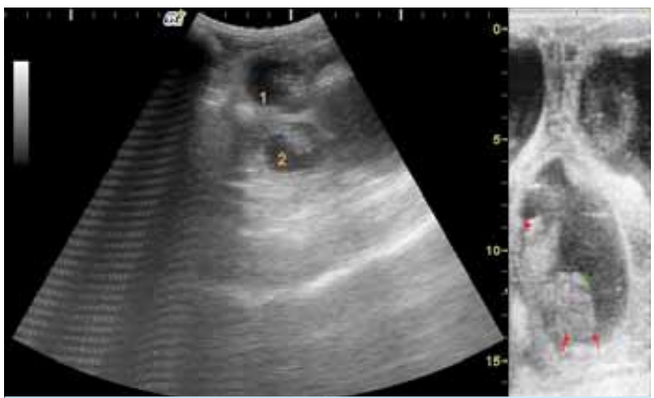
A total of 200 semen doses each diluted to get approximate final sperm cell concentration of 45 million ml^{-1} were preserved in goat semen extender developed by ICAR- National Dairy Research Institute, Eastern Regional Station, Kalyani Campus, West Bengal. The stored semen samples were evaluated for sperm cell motility at every 24 hours interval during storing until the motility reduced to below 30%.

Average motility (%) of semen on cold storage

Parameter	Average	Standard Error	Minimum	Maximum
Day 1	87.05	1.37	80.0	94.8
Day 3	75.4	1.29	70.2	80.6
Day 5	60.16	1.55	54.0	67.7
Day 7	35.44	1.61	29.3	47.9

Artificial insemination

Artificial Insemnination (AI) was carried out on 14 female goats using the preserved semen samples. Ultrasonography after 30 days of AI revealed 6 females positive for pregnancy out of 14 (46.2%). Second trial was conducted by oestrus synchronization using PGF2alfa and goats were grouped into three based on kidding history. Group I consisted 10 goats of one year age without any kidding history and were injected with PGF2 alfa analogue (Lutalyze 5 mg dinoprost per mL) @ 1 ml intramuscularly. Group II consisted of 10 goats with only one kidding and given 2 ml and 10 animals in Group III were not given PGF2alfa and observed for natural estrous signs. Field trial of estrus synchronization in farmer's field was undertaken at Keri village, Ponda taluk. PGF2alfa was injected @ dose of 2 ml in eight goats with the history of one kidding and observed for onset of oestrus signs.



Ultrasound pregnancy diagnosis in AI goats. Transabdominal and transrectal probe method showed twinning at 45 days of early pregnancy.

Project: Development of DUS guidelines for Kokum (PPVFRA)

S Priya Devi

Based on the work done by our centre (co-operating centre) and Dr. BSKKV, Dapoli (Main centre), the draft guidelines has been prepared. The grouping of characters, with variation groups (with range of values, wherever required) have been done for 41 plant characters including tree, leaf, flower, fruit, seed and quality characters. Diagrams have been included for tree/ canopy (pyramidal, conical, spreading), leaf (shape, tip, petiole attachment), flower (sex types), fruit (shape) and seed (shape) characters. Experts/ task force members shall review, followed by which, final guidelines will be submitted after relevant corrections.

Taking Kokum to other states

3000 kokum plants comprising grafts of promising accessions of Goa and bulk seedlings are sold to Department of Horticulture, Kanyakumari district, Tamil Nadu.

Sirsi Salkani - 3

Promising accession of Kokum from Sirsi Salkani, farmer's field

Project: Network Project on Transgenic in Crops (NPTC)– genetic mapping of salinity tolerant genes in rice (ICAR)

Manohara KK

Phenotyping for seedling stage salinity tolerance under microplot and identification of novel tolerant genotypes

Phenotyping of 71 genotypes of rice for salt stress at the seedling stage under microplot was repeated for the second year during the kharif 2019. Based on the reaction of genotypes to salt stress over two years, eleven genotypes were found to be tolerant (T) in both the years with Standard Evaluation Score scoring of 3-4 similar to that of standard tolerant check varieties Pokkali and FL478. Remaining genotypes were in moderately tolerant to sensitive to very sensitive category.

Genotypes found to be tolerant to seedling stage salinity stress in both the years (2018/19 and 2019/20)

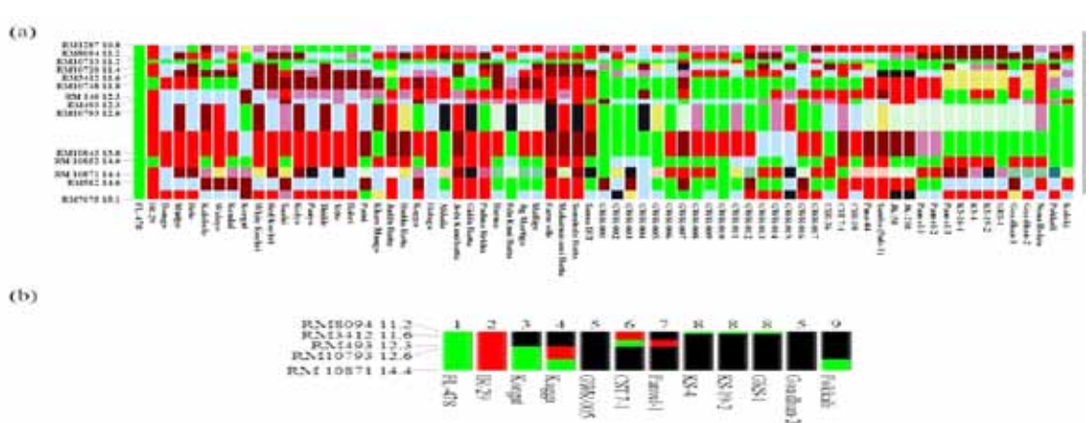
Genotype	SES scoring
Korgut	3
Kagga	3
GWR 005	3
CST 7-1	3-4
Panvel-1	3
KS-4	3
KS-19-2	2-3
Goa Dhan-2 (KS-17)	3
GRS-1	3-4
Pokkali	3
FL 478 (Tolerant check)	3
IR 29 (Sensitive check)	9

Haplotype analysis of Saltol QTL

A study was conducted to assess the haplotype diversity of Saltol region in the selected genotypes of rice and to identify the novel genotypes that possess distinct Saltol haplotype. Fourteen Saltol linked SSR markers were utilized in this investigation to study the Saltol allelic diversity. Among the markers used, marker RM10871 was found to be highly polymorphic with a Polymorphic Information Content (PIC) value of 0.90 and exhibited 14 different alleles followed by RM10793 (0.84) and RM3412 (0.80) with 8 and 7 alleles respectively.

Using the allelic information obtained from 14 SSR markers of Saltol region on chromosome 1 with FL478 as a reference tolerant check variety, the tested genotypes were segregated into different haplotypes. Every different color in a lateral line next to a marker represents a different allele for the respective loci thereby indicating the variation of the SSR with respect to the reference haplotype. All the genotypes studied exhibited a very high allelic diversity within each of the marker loci. The allelic variation of the tolerant genotypes, as well as the sensitive genotypes, were seen to be highly variable as compared to the reference genotypes.

Further, to check the deviation within the Saltol region of the phenotypically tolerant genotypes with FL478, a haplotype of only tolerant genotypes was prepared using five highly polymorphic markers (RM8094, RM3412, RM493, RM10793, and RM10871). Salt sensitive genotype IR29 was used as a sensitive check. The alleles which varied from both the reference haplotypes were considered as a novel allele, while the once which are similar to FL478 and IR29 were considered as positive and negative alleles, respectively. This has resulted in 7 different haplotypes from 10 tolerant genotypes in addition to the two reference haplotypes of tolerant FL478 and sensitive IR29. All the 10 genotypes which exhibited seedling stage salt tolerance had novel alleles. However, three genotypes namely Goa Dhan-2, Panvel-1 and GWR-005 were found to be entirely different from FL478 in their allelic constitution.



a. Haplotypes of the saltol region in 71 rice genotypes with reference to tolerant check FL478 and senitivee check IR 29.
b. Haplotypes produced by key polypor phoc and informative markers in only tolerant genotypes from the study.
Note: Green – FL471 ; Allele red – IR 29, Black – Novel allele

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

R Ramesh

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

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). Bacterial population in the formulation was 9.0-10.0 Log CFU g^{-1} till 21 months. In case of STC-4 (Himedia alginate alone), the population was 8.0 Log CFU g^{-1} till 18 months. It indicates that the low-cost materials like sago can be used along with sodium alginate to prepare granular formulation without compromising the quality.

Development of value added formulations of *B. methylotrophicus* (RCh6-2b & STC-4) and their evaluation

Formulations of *B. methylotrophicus* (RCh6-2b & STC-4) were prepared as per the standardized method with addition of amendments like agro byproducts (AP1) and other nutrient supplements (NS1, 2, 3, 4, C). The bacterial population in the various formulations of RCh6-2b and STC-4 was above 9.0 Log CFU g^{-1} till 21-25 months and there is no difference in the population between standard talc formulation and the value added formulations. Further, it was observed that the population of bacteria increased after six months of shelf life. Results indicate that agro byproducts 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.

Evaluation of liquid formulation of *B. methylotrophicus* RCh6-2b and STC-4 with nutrient amendments

Results of shelf life studies of liquid formulations indicate that the population of RCh6-2b and STC-4 was above 8 Log CFU mL^{-1} till 18 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 the plant growth by providing additional nutrients. Evaluation of liquid formulation of liquid formulation of RCh6-2b on brinjal and tomato indicated that % increase of growth parameters *viz.* shoot length, root length, shoot weight, root weight (from 15DAT to 30 DAT) was higher in 1:10 (10%), 1: 100 (1%) and 1:500 (0.2%) dilutions when sprayed at 10 and 20 days after planting.

Development 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. Results indicated that the population in the capsule formulation was above 9 Log CFU g^{-1} (RCh6-2b) and 8 Log CFU g^{-1} (STC-4) till 18 months. In tablet formulation, the population was above 9 Log CFU g^{-1} till 18 months. Studies on the population of RCh6-2b and STC-4 in the soil applied with tablet over a period was 18 months (540 days) indicated that the bacteria released to the soil within 7 days of application and the population of the applied bacteria was 6 Log CFU g^{-1} of soil till 18 months. Total soil bacterial population was 7-8 Log CFU g^{-1} of soil. These results indicate that the introduced bacteria from tablet formulation survive well in the soil and hence would provide better growth benefits and protection to the crop.

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

Field evaluation of talc formulation of bacterial bio-agents (RCh6-2b, STC-4 and RP-7) on chilli virus disease management was carried out. Soil borne disease incidence in the bio-agent applied plot was 2% to 12% (VNR hybrid) and 0-4% (G4 variety), while in untreated control the incidence was 22-25%. Further, the application of bio-agents improved plant growth and yield in G4 variety.

Project: Phenotyping for salinity stress of crop plants through thermal hyperspectral remote sensing (SERB, DST)

Bappa Das

Identification and development of salinity tolerant genotypes and varieties is one of the promising ways to improve productivity of salt-affected soils. Alternate methods to achieve this are required as the conventional methods are time-consuming and often difficult to handle large population of genotypes. In this context, hyperspectral remote sensing could be one of the rapid, repeatable and reliable methods. The aim of the present study is to develop non-invasive high-throughput phenotyping techniques for salinity stress monitoring in rice. Spectral signature of leaf samples from 56 salinity stress tolerant and sensitive rice genotypes were collected at maximum tillering and flowering stage in visible and near-infrared (VNIR), mid-infrared (MIR) and thermal infrared (TIR) region domain. The spectral reflectance data and rice leaf potassium, sodium, calcium, magnesium, iron, manganese, zinc and copper concentration were analyzed for optimum index identification and multivariate model development.

Novel hyperspectral indices sensitive to leaf nutrient status as affected by salinity stress were identified. The correlation coefficient during calibration and validation of the optimized indices varied between 0.34-0.63 and 0.36-0.66, respectively. To develop multivariate model, solo partial least square regression (PLSR), PLSR- and principal component analysis (PCA)-combined machine learning models were tested. The results revealed that the performance of PLSR-combined models was the best followed by PCA-based model while indices based model was found to be least accurate. The results obtained in the present study showed potential of hyperspectral remote sensing for non-destructive phenotyping of salinity stress.

Comparison of best-performing PLSR- and PCA-based multivariate models during validation

Element	PLSR based			PCA based		
	Best model	r	RPIQ	Best model	r	RPIQ
Potassium (K)	Elastic net	0.928	2.717	GPR	0.543	1.482
Calcium (Ca)	GAM	0.881	2.193	XGB	0.529	1.300
Magnesium (Mg)	Elastic net	0.823	2.415	Elastic net	0.337	1.448
Sodium (Na)	SVMR	0.884	2.573	KNN	0.584	1.569
Zinc (Zn)	Elastic net	0.934	4.467	RF	0.627	2.039
Copper (Cu)	Elastic net	0.872	2.630	GPR	0.676	1.734

GAM: Generalized additive model, **KNN:** k-nearest neighbours, **RF:** Random forest,
SVMR: Support vector machine regression, **XGB:** Extreme gradient boosting,
GPR: Gaussian process regression, **RPIQ:** Ratio of performance to inter-quartile distance

Project: Centrally sponsored MIDH scheme (DASD, Kozhikode)

AR Desai

Planting material of spice crops namely, Black pepper (4 varieties: Paniyur-1, 5, Thevam, Shakti, and local betel leaf), seed rhizomes 5 varieties (Pratibha, Pragati, Sudarshan, Alleppey Supreme, Salem), Turmeric portray seedlings, Nutmeg grafts, Cinnamon, curry leaf, etc., was produced and supplied to farmers and development department.

Production of seed rhizome of turmeric (var. Pragati)

Front Line Demonstrataion for technology dissemination on HDP of grafted Bush pepper

Planting of Bush pepper grafts of Paniyur-1 variety in five FLD units (1 Unit of 200 Sq.m in ICAR Farm and 4 units of 160 sq.m in Farmers' fields) of HDP was completed.

The FLD units under shade net structures are provided with drip irrigation and fogger facility for irrigation management and maintenance of relative humidity level during dry period. Flowering and production of pepper started in all the units. Dry pepper yield of 16.9 kg and 12 kg was harvested from FLD Units at CCARI, Old Goa and

HDP model of grafted Bush pepper at CCARI Farm

FLD unit at Paiguenim, Canacona, South Goa respectively. From the Unit -3, of Bardez zone, 2.5 kg dry pepper yield was obtained during February 2020. Bush pepper grafts of four different varieties *viz.* Paniyur-1, Paniyur-5, Karimunda

High density planting of Paniyur -1 bush pepper graft at CCARI Farm

Five FLD units of HDP of grafted Bush Pepper in Goa

No.	Location of FLDs of HDP of Bush pepper grafts with contact Numbers	District	Remarks
1	ICAR-CCARI Unit, Old Goa. (0832-2284678, 9423061548)	North Goa	200 m^2 area; DOP : 18.09.2018 Dry pepper yield of 16.9 kg is obtained after 1year (9.1 kg: Paniyur-1 and 7.8 kg : Paniyur-5) @ 93 g from 180 plants. Simultaneously flowering is continued.
2	Shri. Santosh Nani Naik Mangueshi, Mardol, Ponda, North Goa (9011366430)	North Goa	160 m^2 area DOP : 28 May 2019 Plants are flowering
3	Shri. Anand Tukaram Mandrekar Podwal, Khorjuem, Bardez, North Goa (9763694070)	North Goa	160 m^2 area ; Planting is completed on10 June 2019 & first harvesting of 2.5kg dry pepper during Feb 2020.& Flowering is continued
4	Shri Lactancio Faleiro, Raia, Salcette, Goa (9822185664)	South Goa	160 m^2 area; Planting is completed on 20 July, 2019. Flowering has started
5	Shri. Ajit Pai, Kharga, Paiguenim, Cancona, South Goa, (9850414118, 8788038248)	South Goa	160 m^2 area; Planting is completed on 10 May 2019. 12.kg dry pepper yield is already obtained. Further Flowering is continued.

and Kottayam local are planted in FLD Unit-1 at CCARI. It is observed that both Paniyur -1 and Paniyur-5 yielded 9.1 kg and 7.8 kg of dry pepper indicating their better performance and suitability for HDP under 50% shade net structure. In the unit at CCARI Farm, the attempt was made to utilize the aerial space for cultivation of Oyster mushroom and orchid flower production. Two batches of Oyster mushroom cultivation were taken up successfully in the aerial space above the bush pepper grafts under shade net structure. Fresh mushroom yield of 2.34 kg and 7.83 kg was harvested from 10 and 19 inoculated bags (18" x 12" size) of 1st and 2nd batch respectively hung in the aerial space under shade net structure, within a period of 20-30 days, with mean yield of 234 g and 411 g per bag from the respective batches. Orchids of commercial varieties also produced flower spikes in the first batch. Thus, the FLD units started production right from the first year of their establishment. FLD Unit-1 at CCARI, Old Goa and FLD unit -5 at Poinguinim are completely maintained under organic practices.

Production of Oyster Mushroom and Orchids above the grafted Bush peppr under shade net structure

FLD Unit of HDP of grafted Bush pepper Var. Paniyur-1 at Raia, Salcette

FLD Unit: HDP of grafted Bush Pepper at Paiguenim, Cancona, South Goa

Project: ICAR – Mega Seed Project

a. Seed Production in Field Crops

Manohara KK

During kharif 2019, seed production (Breeder seed) in the 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. The following quantities of breeder seed was 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 Department of Agriculture, Govt of Goa

Varieties	Class of seed	Quantity available (Q)
Goa dhan 1	BS	4.50
Goa dhan 2	BS	4.50
Goa dhan 3	BS	6.00
Goa dhan 4	BS	0.50
Jaya	TLS	0.50
Jyothi	TLS	0.65
Sahbhagi dhan	TLS	0.90
Karjat 3	TLS	0.60

The nucleus seeds in paddy and cowpea varieties and breeder seed production of cowpea variety Goa cowpea 3 is planned in rabi 2019-20. The production of truthfully labelled seeds of moong varieties TM 96-2 and IPM 2-14 is also being taken up during rabi season 2019/20.

Field view of Seed production in rice during Kharif 2019

b. Seed Production in Horticultural Crops

V Arunachalam

Infrastructure for propagation and nursery facility for horticultural crops

A new shade net structure of 180 square meter area was erected in farm B near Institute canteen with the total expenditure of Rs. 0.75 Lakhs only. The shade net house was erected step by step using the required materials such as concrete poles, GI pipes and shade net fabric. First the installation of concrete poles of two heights 10' and 8' by digging pits was taken up. Later, galvanised iron (GI) pipes of two sizes 1.5 'and 1.25'diameter were fixed by welding and arranging among the erected poles. Shade net fabric is spread on the top of the structure. This cost effective facility established now is very useful for augmenting the horticultural nursery activities and generating the large number of elite planting materials. The shade net house also serve as a demo model for farmers willing to take up the horticultural nursery activities.

Description and conservation of local varieties of coconut

Goa state possesses rich biodiversity and heritage of coconut crop. Three cultivars of Goa Benaulim, Calangute and Nadora are currently conserved at national / state level agencies. During the current year, typical fruits representing coconut populations of Calangute, Rivona, Gaodongri, Canacona, were collected and seedlings were raised. Fruits from selected plants of Malayan Yellow Dwarf (MYD) varying for fruit shape (MYD23, MYD42, C13 C14), Gangabondom Green Dwarf (D5, D6) and Benaulim (C55), Goa Benualim Pani (C10) were characterised for fruit components. Set of fruits from D x T (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), along with check of bulk fruits from Savoi Verem were also characterised and raised for seedling production. Shape 1.3 software was used to quantify the shape of coconut fruits using elliptical fourier transformations and principal component analysis

Variability in shape of coconut germplasm

Generation and sale of planting materials

Quality planting materials numbering 4967 covering eight major horticultural crops and others were generated. A total of 4967 planting material were sold.

Generation of revenue

A revenue of ₹ 3,65,111 was generated during the year under report (April to December 2019) from the project by the sale of above planting materials and few farm produce generated.

C. Seed Production in Ornamental Fisheries

Sreekanth G B

Distributed a total of 2000 ornamental fish seeds (Guppy, molly, platy, sword tail, gourami, goldfish and koi carp), 40 kg of fish feed, 50 kg of freshwater fish (Rohu, Catla and Common carp), 100 seedlings of aquatic plants were produced and distributed to the farming community.

Ornamental fish seed, brooder, feed and accessory sale.

Item	Quantity	Rate (₹)	Total (₹)
Fish seeds (no)	2000	15	30000
Fish feed (kg)	40	1000	40000
Freshwater fish (kg)	50	130	6500
Fish posters (no)	20	100	2000
Aquatic plants (no)	100	15	1500
Total			80000

Project: Poultry Seed Project (ICAR)

Nibedita Nayak

The average body weight of the Srinidhi birds were 1.61 kg, 1.70 kg and 2.09 kg at 20th week, 40th week and 72nd weeks respectively. The highest hatchability rate of Srinidhi birds were 96.03% and the lowest hatchability rate noticed was 89.04%. The number of germplasm supply of only Srinidhi variety from April to December, 2019 is 17,567.

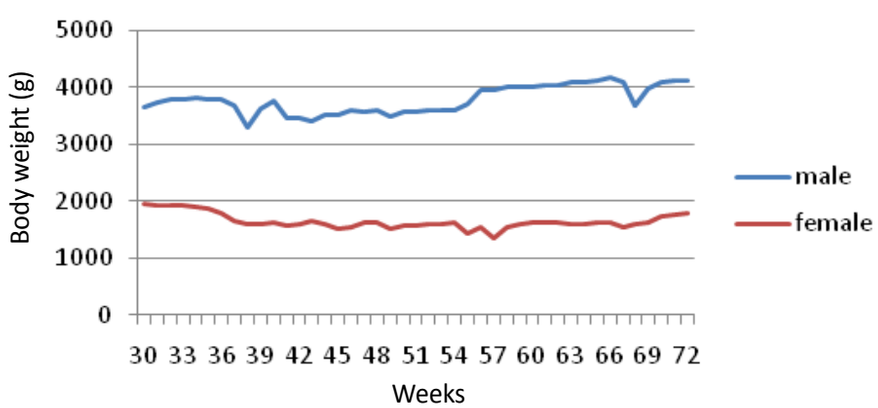
Evaluating the performance of backyard variety CARI-Nirbheek in intensive and semi-intensive system of rearing

Total 30 birds (25 Female + 5 Male) of CARI-Nirbheek varierty is being reared in coconut based multi-species cropping system. Feeding system-Scavenging +Supplementary (20 g of maize per bird per day) Feed source-insects, snails, leaves and fallen fruits.

Egg parameters under intensive and semi intensive system.

Parameters	Intensive	Semi-intensive
Egg wt (gm)	50.77 ± 0.92	51.22 ± 0.78
Width (mm)	41.23 ± 0.35	41.64 ± 0.39
Length (mm)*	56.29 ± 0.75^{a}	54.05 ± 0.38^{b}
Shape index*	73.61 ± 1.13^{b}	77.09 ± 0.92^{a}
Shell thickness (mm)*	0.36 ± 0.01^{b}	0.38 ± 0.01^{a}
Shell weight (gm)	5.09 ± 0.19	5.59 ± 0.17
Yolk colour**	7.17 ± 0.43^{b}	8.82 ± 0.29^{a}
HU	75.92 ± 4.43	85.61 ± 1.97

*P<0.05, **P<0.01



Sex separate weekly body weight from 30-72 weeks

SIGNIFICANT ACCOMPLISHMENTS

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

Shweta Kapila
Photo Courtesy: Shivasharanappa N

Intellectual Property Rights (IPR) Cell

Patent Filing

First examination report for the patent application (No.3037/MUM/2015) titled Extender for preservation of boar semen has been issued by the Indian patent office on 27th November, 2019. Processing of the relevant documents and follow up of procedures for filing reply to first examination report (FER) in consultation with patent attorney is under process.

Applicant names for the patent application entitled "Unmanned Remote controlled Palm tree Harvesting Robot" (with serial no. 201721022813 filed by Goa University under ICAR extramural research project) were amended to Goa University and ICAR-Central Coastal Agricultural Research Institute. This was in pursuant to the deliberations between the Institute and Goa University and communication from IP&TM Unit New Delhi, suggesting necessary amendments in the name of applicants for the above-mentioned patent application.

Commercialization of technologies

Techno-commercial assessment of two new Institute technologies viz. CCARI Bio-3 and CCARI Bio-4 was initiated during the period. Detailed information (Technology Disclosure and Technology Evaluation Form) for the technologies were submitted to Agrinnovate India Limited.

Techno-commercial meeting with the officials of Agrinnovate India Limited, New Delhi was held through web-conferencing on 18th December, 2019 to discuss the prospects and scope for commercialization and techno-commercial assessment of recently developed Institute technologies.

Information on potential commercializable technologies developed and plant varieties released by this Institute were compiled and uploaded on ICAR-KRISHI portal, repository of technology developed by ICAR, New Delhi.

Dr. Gokuldas P.P., IPR Cell Coordinator and Mrs. Anuradha Naik, R.A-IPR/NAIF Scheme participated in Vibrant Goa Global Expo and Summit 2019 on 17th October, 2019 held at Dr. Shyama Prasad Mukherjee Indoor Stadium, Taleigao Goa. Details of the commercialisable technologies developed by the Institute were shared with participants and entrepreneurs from Goa and Maharashtra States to explore the scope of technology commercialization.

Necessary procedures like license fee payments were followed up with concerned agri-entreprenuers for the previous year technology commercialization agreements.

Two new plant variety release proposals for the release of promising Brinjal variety proposed as "Goa Brinjal-5 (27-7-2) and Goa Brinjal-6 (42-7-1)"developed by Dr. R. Ramesh, Principal Scientist, (Pt. Pathology) were submitted to State Variety Release Committee & Director, Directorate of Agriculture, Govt. of Goa on 4th October, 2019.

Material Transfer Agreement (MTA) signed

Material Transfer Agreement (MTA) related to the released rice varieties of the Institute viz. Goa Dhan 1, Goa Dhan 2, Goa Dhan 3 and Goa Dhan 4 for testing and trial purpose with private firm M/s Siri Seeds (India) Private Limited, Hyderabad.

Material Transfer Agreement (MTA) for procurement of the plasmid genetic material (Ref. No. 42875 pCRISPR, 42876 pCas9, and 62225 pCas) for research purpose from Addgene (non-profit repository for plasmids).

Geographical Indication

Khola Chilli

Khola Chilli was granted GI Certification tag with application No. 618 registered under class 30 by GI registry, Chennai on 26th August, 2019. Institute facilitated the application process for registration of Khola Chilli for Geographical Indication through Dept. of Science and Technology, Goa. IPR Cell facilitated the process by providing relevant information on Khola Chilli and required linkage with farmer's society Khola/Canacona Chilli Cultivators Group, South Goa.

Meetings attended

Dr. Gokuldas P. P., IPR Cell Co-ordinatior and Mrs. Anuradha Naik, RA-IPR/NAIF Scheme, participated in a meeting organized by Goa State Council of Science and Technology under the chairmanship of Mr Levinson Martins, Director/Jt. Sec S&T, along with members of Khola/Canacona Chilli Cultivatoirs Group, South Goa held at Pt. Deen Dayal Bhavan, Porvorim Goa on 17th October, 2019. Meeting was convened to discuss future course of action for promoting and branding Khola Chilli as GI Produce.

Technology Evaluation

Performance evaluation of process machinery

Four process machineries viz 1) Cashew Apple Crusher 2) Juice extractor - Omkar Krushi Yantra, Brahmakarmali 3) Motocart 125 and 4) Motocart 350 - M/s Easy Life Enterprises, Udupi, Karnataka, were evaluated and performance evaluation reports given to the farmer innovators. These machineries would be useful for in the horticulture based cropping systems of the coastal region. All four machines performed well and were certified as good.

Name : **Cashew Apple Crusher**
Function : Crushing of cashew apples
Capacity : 1.2 t/h for cashew apples with crushing efficiency > 95%
Material : Stand: 38.1 mm x 3 mm MS angle cylinder 18 G SS sheet
Blades : 19.05 mm x 5mm
Funnel : 20G SS sheet All contact parts SS (304 grade)
Power Source : 1 Hp, Single Phase Motor 1425 RPM
Weight : 63 kg
Dimension : 800 x 900 x 1150 mm (length x width x height)

Name : **Cashew Apple Crusher and Pressing Unit**
Function : Juice extraction of cashew apples
Capacity : 188.8 kg/h (189.0 l/h) for cashew apple Juice with separation efficiency > 90%
Material : Stand: 38.1 mm x 4 mm MS angle 10-12 mm TMT bars 10G GP sheet Pieces (45cm x 45cm)
Power Source : 1 Hp, Single Phase Motor 1425 RPM
Weight : 142 kg
Dimension : 580 x 580 x 760 mm (length x width x height)

Name : **Motocart-125**
Function : Transporting load on farm (Max. 125 kg / 147 l)
Capacity : 6.7 (for trained operator), 4.0 (for untrained operator, assuming 60% efficiency)
Material : Body – Powder coated M.S. Bearing-Case hardened steel with pillow block bearing UCF 204 Wheels - Front -400-8 tractive TVS tyres-herringbone pattern, Rear- 8”x2” solid polymer wheel with 6204zz bearing
Power Source : 1.6 Hp, 4 Stroke, Petrol Engine (Honda GX35)
Weight : 82 kg
Dimension : 1450 x 750 x 940 mm (length x width x height)

Name : **Motocart-350**
Function : Transporting load on farm (Max. 350 kg / 188 l)
Capacity : 6.1 (for trained operator), 3.7 (for untrained operator, assuming 60% efficiency)
Material : Body – Powder coated M.S.
Wheels - Front -400-8 tractive TVS tyres-herringbone pattern, Rear-12” x 3” solid polymer wheel with 6204zz bearing
Power Source : 3.9 Hp, 4 Stroke, Petrol Engine (Honda GX160)
Weight : 154 kg
Dimension : 1651 x 813 x 1041 mm (length x width x height)

Ongoing Research Projects

Institute Projects

No.	Project Title	PI	Co – PI	Duration
Mega Project I : Conservation and management of natural resources of coastal region Leader : GR Mahajan				
1.	Assessment and mapping of trends in hydro-climatic variables over west and east coast regions of India	Sujeet Desai	Bappa Das	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 - 20
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
Mega project II: Conservation and utilization of genetic resources in the coastal region Leader: AR Desai				
5.	Breeding high yielding salt tolerant rice varieties for coastal saline soils	Manohara KK		2010 – 20
6.	Collection, evaluation of genetic resources and management of fruit and spices	AR Desai	Sujeet Desai Paramesha V Nibedita Nayak	2011 – 23
7.	Augmentation, morphological and molecular characterization and evaluation of okra and amaranth genetic resources of West Coast India for sustainable utilization	M Thangam	V Arunachalam	2017-20
8.	Assessment, management and designing improvement options for fisheries in selected low impacted estuaries along southwest coast of India	GB Sreekanth		2017-20
Mega project III: Development and validation of production technologies of major crops of coastal region Leader: R. Ramesh				
9.	Study and the management of major diseases of vegetable crops in coastal region	R Ramesh	R Maruthadurai	2017 -20
10.	Studies on emerging insect pests (white flies and fall army worm) and their management in coastal region of India	R Maruthadurai	R Ramesh	2019-22
11.	Development of good agricultural practices through integrated nutrient management for sustainable fruit production in coastal regions of India	Maneesha SR	R Ramesh GR Mahajan	2015-20
12.	Production and postharvest management of fruit crops kokum, jackfruit and breadfruit of west coast region of India	S Priya devi	MJ Gupta	2018-20
Mega project IV: Development and validation of production technologies of livestock and fisheries Leader: EB Chakurkar				
13.	Standardization of protocols for cryopreservation of boar semen	EB Chakurkar	Gokuldas PP	2017-20

14.	Study on the virulence factors and antimicrobial resistance of important mastitis pathogens from coastal areas and exploration of indigenous herbals against clinical and subclinical mastitis	Susitha Rajkumar	Chethan Kumar HB	2019-21
15.	Surveillance of Japanese encephalitis infection in pigs of selected endemic districts in west coast of India	Chethan Kumar HB		2019-22
16.	Seasonal modulation of reproductive performance in dairy buffaloes with special reference to west coast region	Gokuldas PP	Bappa Das	2016 - 20
17.	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
Mega project V: Improving livelihood security through post-harvest technologies and other agri- enterprises Leader: V Arunachalam				
18.	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 GB Sreekanth Sujeet Desai Nibedita Nayak	2017 - 20
19.	Enhanced utilization of pseudo-stem and leaves of banana	V Arunachalam	AR Desai MJ Gupta	2017 - 20
20.	Development of production technologies for successful management and semi-automation under suitable protected cultivation structures designed or adopted for west coastal ecosystem of India	MJ Gupta	AR Desai M Thangam R Ramesh S Priya Devi R Maruthadurai Maneesha SR GR Mahajan Sujeet Desai	2017-20

AICRP CENTRES

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 GB Sreekanth 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 Cashew	AR Desai	
4.	All India Co-ordinated Research Project on Vegetables	M Thangam	
5.	All India Co-ordinated Research Project on Pig	EB Chakurkar	
6.	All India Co-ordinated Research Project on Animal Disease Monitoring and Surveillance (ADMAS)	Shivasharanappa N	Susitha Rajkumar Chetan Kumar HB

EXTERNALY FUNDED PROJECTS

No	Project Title	PI	Co-PI (s)
SERB- 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	R Maruthadurai	
3.	Phenotyping for salinity stress of crop plants through thermal hyperspectral remote sensing	Bappa Das	Manohara KK
NABARD			
4.	Management of economically important insect pests with the use of pheromone technology through trainings and demonstrations	R Maruthadurai	R Ramesh
5.	Popularizing Good Post Harvest Management Practices for Field Crops of Goa through research, trainings and demonstrations	MJ Gupta	R Maruthadurai
DBT			
6.	Augmentation of rural pig production for socio economic upliftment of rural poor in Goa through artificial insemination	Shivasharanappa N	EB Chakurkar Susitha Rajkumar
DUS			
7.	DUS Testing for Kokum	S Priya Devi	
DASD, Kozhikode			
8.	Centrally sponsored MIDH Scheme	AR Desai	
ICAR			
9.	Network Project on Transgenic Crops (Functional genomics): Genetic Mapping of Salinity Tolerant Genes in Rice	Manohara KK	
10.	Production and formulation technology refinement of bacterial bio- agents for soil borne plant disease management under coastal ecosystem	R Ramesh	
11.	Seed production in agricultural, horticultural crops and fisheries	Manohara KK	V Arunachalam Sreekanth GB
12.	Poultry seed project	Nibedita Nayak	
ICAR-NBSSLUP, Nagpur			
13.	Characterization and mapping of land use resources of Goa in reference to cultivated and fallow land use system- a step towards enhancing agricultural productivity	GR Mahajan	

Awards and Recognition

Dr. Maruthadurai R

- Young Scientist Award by Dr. B. Vasantharaj David Foundation in National Conference on Trends in Higher Education, Taxonomy, Agriculture, Biotechnology and Toxicology 17 November, 2019 at Chennai.

Dr. Sreekanth GB

- Professional Member of the Australian Society for Fish Biology and Australian Marine Science Association, Sydney, Australia.
- Best paper award (first prize) in National Hindi Seminar "Harith Matsyaki 2019" on 30 July 2019 at ICAR-CIFT, Visakhapatnam, Andhra Pradesh.
- Best paper award in International conference on Aquatic resources and Blue economy, AQUABE-2019 from 28-30 November, 2019 at KUFOS, Kochi, Kerala

Dr. Sujeet Desai

- Best Oral paper award in the International conference on Soil and Water Resources Management for Climate Smart Agriculture and Global Food and Livelihood Security from 4 - 9 November, 2019 at NASC complex, New Delhi.

Dr. Nibedita Nayak

- Second best poster presentation award in IPSACON-2019 from December 11-13, 2019 at CGKV, Durg, Chattisgarh.

ICAR –CCARI, Goa

- ICAR- Central Coastal Agricultural Research Institute, Old Goa, Goa received the Green Maple Foundation Awards (GMF) – 2019 for outstanding contribution in research excellence in the award ceremony held at Goa on 29 December, 2019. The award bestowed for the excellent contribution of ICAR- CCARI, Old Goa in the field of research, development and upliftment of the society.

Dr. Sujeet Desai receiving best oral paper award at the International conference

Green Maple Foundation Awards (GMF) – 2019

Publications

Research Articles

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Institute as Publisher

Publications	Authors/ Editors/ Publishers
Reports	
Annual Report (2018-2019) pp.1-102	EB Chakurkar, S Priya Devi, MJ Gupta, Manohara KK, Chethan Kumar HB, GR Mahajan and Sreekanth GB
Technical Bulletins	
Plantation crop based integrated farming system for upland agroecosystem of Goa Technical Bulletin No 66 pp 57	V Paramesha, EB Chakurkar, BL Manjunath, GR Mahajan, SK Das, AR Desai, S Priya Devi, Chethan Kumar HB, Gokuldas PP, Manohara KK, N Ravishankar, Vishwanatha Reddy, S Rajkumar, Rahul Kulkarni and NP Singh
Pheromone technology for the management of economically important insect crops. Technical Bulletin No 67 pp 1- 52	Maruthadurai R and Ramesh R
Extension Folders	
Important diseases of chilli (*Capsicum annum* L.) in Coastal regions and their management. Extension Folder No. 95	Maruthadurai R and Ramesh R
Pheromone technology for the management of cucurbit fruit fly *Bactrocera cucurbirae*. (Hindi) Extension Folder No.96	Maruthadurai R and Ramesh R
Wide area management of red palm weevil and rhinoceros beetle using pheromone technology. Extension Folder No. 97 (Hindi)	Maruthadurai R and Ramesh R
Extension Leaflet	
Fishery Resource conservation and management Extension Leaflet 03	Sreekanth GB, Haragi S, Rathod J and Chakurkar EB
Pheromone technology for the management of mango fruit fly *Bactrocera dorsalis*. Extension Leaflet 04	Maruthadurai R and Ramesh R
News Letter	
Vol. XX. No.2 and 3, May- December, 2018 pp1-35	S Priya Devi, Manohara K K, Susitha Rajkumar and Bappa Das
Vol. XXI. No.1, January - April, 2019 pp1-14	S Priya Devi, Manohara K K, Susitha Rajkumar and Bappa Das

EDUCATION, TRAINING AND HUMAN RESOURCE DEVELOPMENT

Titan Trigger Fish
Photo Courtesy: Sreekanth GB & Pranay Sawant

Education and Training

Education

AR Desai	External Examiner, by UAS, Dharwad, Karnataka, for Qualifying Oral Examination of Ph.D student conducted on 28th August 2019 at Dharwad.
M Thangam	Attended as external examiner for qualifying viva of Ph.D. scholar at Faculty of Horticulture, UAS, Dharwad on 26th July 2019.
GR Mahajan	Coordinated six-week internship of a M.Sc. student, School of Environment, KUFOS, Kochi during May to June 2019 Coordinated two month internship of a M.Sc. student, Maharaja Shivajirao University of Baroda, Vadodara during May to July, 2019

Lectures delivered by the Scientists

Date	Lecture Topic/Programme	Participants	Venue
EB Chakurkar			
11-05-2019	Status, prospects and managemental techniques for pig production in India	Students	Parbhani, Maharashtra
13-05-2019	Prospects on pig industry in India	Students	Mumbai, Maharashtra
05-09-2019	Advances in cashew production and scope for improvement	Farmers	Balli, Goa
10-11-2019	Role of Livestock in Coastal Agriculture	Delegates	Pookode, Kerala
V Arunachalam			
13-09-2019	Intercropping in coconut	Trainees	Directorate of Agriculture, Tonca, Goa
AR Desai			
09-08-2019	Propagation techniques in horticulture plants	Trainees	KVK, North Goa
28-08-2019	Farming, its importance for the wellness of mankind	Delegates	Goa science Centre, Panaji, Goa
23-12-2019	An Overview of Cashew Production *Vis a Vis* Non-traditional areas	Delegates	ICAR- CCARI, Old Goa, Goa
M Thangam			
11-12-2019	Vegetable Production	Students	Chowgule College, Margao
R Ramesh			
10-10-2019 05-12-2019	Brinjal grafting and disease management in vegetable crops	Farmers	Cumbharjua, Goa
17-10-2019	Good management practices to reduce fungi/pathogen related losses in pield crops of west coastal ecosystem	Farmers	ICAR-CCARI, Old Goa
04-12-2019	Brinjal grafting and disease management in vegetable crops	Farmers	Dhulape, Goa
Mathala J Gupta			
16-10-2019	Machineries and Technologies for reducing Post harvest losses in Field crops of West Coastal Ecosystem	Trainees	KVK, North Goa

16-11-2019	Mechanization and post-harvest management technologies for doubling farmer's income	Trainees	KVK, North Goa
R Maruthadurai			
16-10-2019	Pest management for reducing post- harvest losses in field crops	Farmers	ICAR-CCARI, Old Goa
17-10-2019	Pest management for reducing post- harvest losses in field crops	Farmers	Rivona
GR Mahajan			
14-07-2019	Waste recycling - Vermicomposting	Farmers and parents	Old Goa Educational Society's Higher Secondary School, Ella, Old Goa
27-10-2019	Land and soil management in view of climate change	Bankers	Hotel Paradise Village Beach Resort, Calangute, Bardez, Goa
16-10-2019	Nutrient management in field crops in west coastal ecosystem for reducing post-harvest losses	Farmers	ICAR-CCARI, Old Goa
18-10-2019	Nutrient and resource management in organic farming	Officials	Krishi Bhavan, Directorate of Agriculture, Tonca Goa
22-10-2019	Awareness programme on fertilizer application	Farmers	KVK, North Goa, Old Goa
05-12-2019	Presentation on Agricultural Education: Introduction and Career Opportunities and Importance of soil testing and soil test based fertilizer recommendations	Students and farmers	ICAR-CCARI, Old Goa
Susitha Rajkumar			
17-11-2019	Avian health care management and Vaccination and Deworming in Goats	Trainees	KVK, North Goa
Sreekanth G B			
25-05-2019	Community and ecosystem based fisheries management in coastal ecosystems	Trainees	Karwar, Karnataka
17-08-2019 23-08-2019 25-09-2019	Ornamental fisheries and its scope in Goa	Students	ICAR-CCARI, Old Goa
31-08-2019	Aquarium fabrication and management, Disease treatment and management in ornamental fish culture	Students	ICAR-CCARI, Old Goa
23-09-2019	Ecosystem based fisheries management for estuaries	Students	Karwar, Karnataka
25-09-2019	Identification of fish species from freshwater and brackishwater ecosystems	Students	ICAR-CCARI, Goa
25-11-2019	Potential of aquaculture in Goa	Trainees	GIPARD, Old Goa, Goa
Gokuldas P P			
05-06-2019	Scientific pig farming	Farmers	ICAR-CCARI, Old Goa
18-10-2019	Ultrasonography in goats	Trainees	KVK, North Goa

Chethan Kumar HB			
27-04-2019	Diseases of goats	Farmers	KVK, North Goa
11-09-2019	Vaccination and diseases management in dairy cattle	Farmers	KVK, North Goa
15-10-2019	Housing and Farm management	Farmers	KVK, North Goa
17-10-2019	Goat diseases and health care management. Sample collection for various goat diseases	Farmers	KVK, North Goa
22-10-2019	Pig health management	Farmers	ICAR-CCARI, Old Goa
Paramesha V			
16-10-2019	Good agronomic practices for field crops of west coast ecosystem to reduce post-harvest	Farmers	ICAR-CCARI, Old Goa
Maneesha SR			
11-12-2019	Urban gardening- a holistic approach	Farmers	ICAR-CCARI, Old Goa
Sujeet Desai			
06-07-2019	Rain water harvesting and micro-irrigation for fodder crops	Farmers	ICAR-KVK, North Goa, Old Goa
20-07-2019	Rain water harvesting and water conservation in agriculture	Farmers, Line Departments and Stake Holders	Ravindra Bhavan, Sanquelim, Goa
27-07-2019	Rain water harvesting and Water conservation in agriculture	Farmers, Line Departments and Stake Holders	Ravindra Bhavan, Margao, Goa
Nibedita Nayak			
29-06-2019	Nutrition and feeding management on goats	Trainees	KVK, North Goa, Old Goa

Training programme on ornamental fish culture

Training programme on post harvest management

Human Resource Development

Training and Capacity Development

Date	Name	Programme	Venue
August 19-22, 2019	Maneesha SR	Training programme on 'Promotion of urban farming through innovative models'	MANAGE, Rajendranagar, Hyderabad, Telangana
October 31 – November 1, 2019	V Arunachalam	Training workshop of Vigilance Officers of ICAR institutes	ICAR-NAARM, Hyderabad, Telangana
November 16- 21, 2019	SK Marathe	Orientation Course in Record Management for Record Officers	National Archives Of India, Records Centre, Southern Zone, Puducherry

Participation in Conference / Seminar/ Symposia/ Workshops/Meetings

Date	Name	Programme	Venue
April 11-13, 2019	MJ Gupta	International Conference on Role of Agricultural Engineering towards Global Security	IEI State Centre, Bengaluru, Karnataka
May 29 – June 3, 2019	EB Chakurkar	54th Annual Rice Research Group Meeting	ICAR-National Rice Research Institute, Cuttack, Odisha
June 6-7, 2019	V Arunachalam	28th Annual Group Meeting of palms	Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu
June 11-12, 2019	AR Desai	Annual Review Meeting of MIDH programmes	OUAT, Bhubaneshwar
June 16, 2019	EB Chakurkar SK Marathe	Convocation	University of Agricultural Sciences, Dharwad, Karnataka
June 22-25, 2019	M Thangam	37th AICRP on Vegetable Crops workshop	TNAU, Coimbatore, Tamil Nadu
July 7-11, 2019	EB Chakurkar	Meeting on disaster management of cyclone	Sardarkrushinagar Dantiwada Agricultural University, Gujarat
July 11, 2019	M Thangam	Jal Shakti Abhiyan	South Goa Collectorate, Margao, Goa
July 16, 2019	EB Chakurkar	ICAR Foundation Day	ICAR- NASC Complex, New Delhi
July 16, 2019	Sreekanth GB	PAGE-UNEP-TERI workshop organised by TERI,	International Centre, Goa
July 24-27, 2019	Maruthadurai R	International Conference on Plant Protection in Horticulture	ICAR - IIHR, Bengaluru, Karnataka
July 30, 2019	Sreekanth GB	National Hindi Seminar "HarithMatsyaki-2019"	ICAR-CIFT, Visakhapatnam, Andhra Pradesh

August 9-10, 2019	EB Chakurkar	Regional Committee Meeting	ICAR-NBSSLUP, Nagpur, Maharshtra
August 28-31, 2019	R Ramesh	AMAAS project review workshop	NASC, New Delhi
September 9, 2019	MJ Gupta	Workshop on effect of environmental pollution on climate change	National Institute of Oceanography, Donapaula, Goa
September 16-20, 2019	Susitha Rajkumar	21st World Veterinary Poultry Association Conference (WVPAC)	BITEC, Bangkok, Thailand
September 26, 2019	Sujeet Desai	Seminar on Tsunami Warning System	CSIR-NIO, Donapaula, Goa
September 27-28, 2019.	EB Chakurkar	Annual Review Meet of AICRP and Mega Seed Project on Pig	ICAR Research Complex for NEH Region, Barapani, Meghalaya
October 14-17, 2019	Bappa Das	8th Asian-Australasian Conference on Precision Agriculture (ACPA)	Punjab Agricultural University, Ludhiana, Punjab
November 4-9, 2019	Sujeet Desai	International conference on Soil and Water Resources Management for Climate Smart Agriculture and Global Food and Livelihood Security.	NASC, New Delhi
November 9-10, 2019	EB Chakurkar	Kerala Veterinary Science Congress	College of Veterinary & Animal Sciences, Kerala Veterinary & Animal Sciences, Kochi, Kerala
November 10-14, 2019	R Ramesh	XIX International Plant Protection Congress (IPPC) 2019	Hyderabad, Telangana
November 15-18, 2019	GR Mahajan	National Seminar on Developments in Soil Science: 2019	Banaras Hindu University, Varanasi, Uttar Pradesh
November 17, 2019	Maruthadurai R	National Conference on Trends in Higher Education, Taxonomy, Agriculture, Biotechnology and Toxicology	Chennai, Tamil Nadu
November 27-29, 2019	Paramesh V	Annual Group Meeting of AICRP on Integrated farming system	Junagarh Agricultural University, Junagarh, Gujarat
November 28-30, 2019	Sreekanth GB	International Conference on Aquatic Resources and Blue Economy (AQUABE-2019)	Kochi, Kerala
December 1-2, 2019	Susitha Rajkumar	27th Annual Review Meeting of AICRP-ADMAS	ICAR-NIVEDI, Bengaluru, Karnataka
December 11-13, 2019	Nibedita Nayak	XXXVI Annual Conference of Indian Poultry Science Association from.	CGKV, Durg, Chattisgarh

TRANSFER OF TECHNOLOGY

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

Seeds distribution to the farmers in Fani affected areas
Photo Courtesy: AR Desai

ICAR- Krishi Vigyan Kendra, North Goa

In order to intensify the transfer of technology and to impart grass root level vocational training, Krishi Vigyan Kendra was established at the Institute in 1983, The major extension activities carried out are given below.

Trainings

To impart knowledge on advanced technologies in different farmers fields to farmers, several training programmes were conducted. Training were focused on skill development About 50 training programmes were conducted by the KVK involving 955 participants. The major training programmes were *viz:* processing technology of pickle, fingerlings, beekeeping, mushroom cultivation, management of cashew stem and root borer, value addition in jackfruit, virgin coconut oil production, dairy farming, backyard poultry farming, goat farming, pig farming, kitchen gardening, scientific management of goats and IPM in vegetables.

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 to KVK, celebration of important days – Vanmohatsav, Swachta pakhwada, Soil health day, exposure visits, Honey bee day, farmers group meeting etc. were undertaken.

No.	Programmes	Particulars
A.	**On Farm Trials (OFT)**	**Numbers of trials**
1.	Assessment of improved poultry varieties	5
2.	Assessment of hybrid Napier fodder varieties	3
B.	**Front Line Demonstrations (FLD)**	**Number of demonstrations**
1.	Demonstration on feeding of bypass fat and chelated mineral mixture in dairy cattle	10
2.	Clean milk production in dairy animals.	10

Participation of KVK, North Goa at different forums

Technology Dissemination

Demonstrations and Front Line Demonstrations

Demonstration of the improved crop establishment methods and nutrient management to improve rice growth, yield and income under salt-affected soils (Khazan lands)

The use of improved crop establishment method of the nursery inoculation (50 g m^{-2} at 7 and 15 Days after sowing (DAS) and one day before uprooting seedlings) of Goa Bio 1 (talc formulation of *Bacillus methylotrophicus* STC-4) and soil test based nutrient management was demonstrated at a farmers field affected with coastal soil salinity at Deewar Island, Goa. The demonstration were done for salt tolerant rice varieties Goa Dhan 1 and Goa Dhan 2. The use of improved management practices resulted in improved growth, yield and income. The percentage increase in grain yield for the package of practice over the farmers practice was 24.5% and 13.4% in Goa Dhan 1 and Goa Dhan 2, respectively. The corresponding increase in the net income was 27.8% and 15.2%.

A rice crop establishment method of broadcasting Goa Bio 1 treated seed: A cost-effective way to improve productivity and income under normal and salinity stress situation in coastal areas

Field demonstration on an improved rice crop establishment method (seed treatment with Goa Bio 1 and broadcasting) with 75% of the soil test based fertilizer recommendation against the farmers' practice of broadcasting and blanket fertilizer application was undertaken at Dulape, Tiswadi, Goa. The demonstrations were done under two typical rice growing situations i.e. normal (lowland) and salt-stress condition (coastal saline soils). Under normal cultivation condition (non-stressed), the grain yield improvement in variety Jyothi and Karjat-3 was insignificant. The grain yield with the improved crop establishment method and farmers practice was 4.32 and 4.28 t ha^{-1} for Karjat-3 and 4.36 and 4.24 t ha^{-1} for Jyothi, respectively. It implied that, the fertilizer use could be curtailed without compromising the grain yield. The results were significant for the salt-tolerant variety Goa Dhan 1. There was a grain and straw yield advantage of 23.8% with the improved practice besides saving of 25% of the fertilizer inputs.

Front Line Demonstrations (FLD)

25 FLDs on high yielding upland rice variety 'Sahbhagi dhan' was taken up at Gaodongrim village covering 10 ha area during the *Kharif* 2019.

Front Line Demonstrations on cashew varieties and coconut based cropping system in Ziltwadi wada of Gaondongruim village.

Farmers of the Ziltwadi Farmers' SHG were provided with Planting material (Black pepper, Var. Paniyur-1) and farm inputs (Fertilizers and Agro-chemicals) for the management of cashew plantation established under STC programme. On-farm practical demonstrations were undertaken under this programme about potential intercrops like chilli, sweet corn, hybrid maize, besides their local tuber crops.

A new FLD on cashew varieties and coconut based cropping system in Satorlim wada of Gaondongrim

A new FLD on cashew varieties and coconut based cropping system in Satorlim wada of Gaondongrim, of Cancona, South Goa was also initiated for the benefit of Satorlim Farmers' SHG of Gaodongrim village. Farmers were facilitated in clearing and laying out the land selected for FLD of cashew varieties and vegetables as intercrops.

Training

Training cum distribution on use of pheromone traps

A training cum distribution on use of pheromone traps for the management of red palm weevil and rhinocerous beetle in coconut and fruit flies in cucurbits was organised at ICAR- CCARI, Old Goa on 25 June, 2019. Dr EB Chakurkar, Director (A), ICAR-CCARI was the chief guest and addressed the farmers and briefed about the benefits of pheromone technology. More than 30 farmers were actively participated in the programme. 200 cue lure traps and 70 traps and lures of red palm weevil and rhinocerous beetle were distributed to the farmers.

Consultancy training on artificial insemination in pigs

A three day consultancy training programme for progressive pig farmers on artificial insemination in pigs was conducted by ICAR- CCARI, Old-Goa from 29 June - 1 July 2019. Total of 12 progressive pig farmers from Maharashtra were the participants. Dr EB Chakurkar, Director (A) and Coordinator of the training, inaugurated the training session with introductory preamble on scientific pig farming, its importance, advance technologies in piggery and AI in pigs. Participants were also taken to farmers field at Mr Thomas KG from Sal, Bicholim.

Training programme-skill development programme on ornamental fish breeding and culture

A three days training programme on "Ornamental fish breeding and culture" was conducted at ICAR-CCARI, Old Goa during 17, 31 August and 30 September, 2019. The training programme was attended by about 75 participants. The training covered lectures on ornamental fisheries, breeding and culture, aquarium fabrication and disease management in ornamental fish culture.

Consultancy training programme on scientific pig farming

A three day consultancy training programme on scientific pig farming for progressive pig farmers was organized at Institute during 21- 23 October, 2019. Ten progressive pig farmers from Maharashtra, Rajasthan, Haryana, Bihar and Karnataka were exposed to sessions on scientific rearing of pigs including boar semen processing and artificial insemination, scientific housing, feeding, health management strategies for pig farming.

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

Entrepreneurship training on dairy farming and clean milk production

A three days entrepreneurship training programme on "Dairy farming and clean milk production" was organized conducted by Institute during 27-28 April, 2019 at Ibrampur village, Pernem and on 4 May, 2019 at Tambose village, Pernem. The training programme was attended by about a total of 33 participants. The training covered lectures on Importance and scope of Dairy farming in Goa, scientific dairy cow nutrition and housing management, important diseases of cattle and control of disease by vaccination and deworming.

Training cum awareness programme on Fisheries resource conservation for fishermen from Karnataka

A training cum awareness programme on "Fisheries resource conservation and management" was organised at Karwar (PG study centre, Karwar) by the Institute on 25 May 2019. Fishing net material, ropes, life jacket floats, floats and sinkers were distributed among the traditional (SC) fishermen from SC fisheries co-operative societies from Bhatkal, Shirali, Mavinkurve, Heble, Bailuru and Murudeshwar. A total of 40 fishermen were benefitted with the inputs for the safe and sustainable fishing operations.

Training on scientific management of goats

A five days entrepreneurship development training programme on "Scientific management of Goats" was organized at Ibrampur village , Pernem Goa from 1-5 June, 2019. Total of twenty trainees were given lectures on various breeds of goats suitable for Goa, selection of breeding stock, scientific management of housing, health care management and future scope of goat farming in Goa.

Entrepreneurship development in poultry farming

A training on entrepreneurship development in poultry farming was organised during 3-4 June, 2019. A total of 23 participants took part from Karnataka, Maharashtra and Goa. Poultry equipment's were distributed to farmers.

Training on scientific pig farming

A training on scientific pig farming was held at Institute during 4-5 June, 2019. About 23 farmers and youths from Karnataka and Maharashtra actively participated in the training programme. During the course, the trainees were exposed to sessions on scientific rearing of pigs including housing, feeding, reproductive and health management. Field exposure visits to institute piggery units were organized during the programme.

Entrepreneurship training in vacuum fried technology based processing units

A two days entrepreneurship training program on vacuum fried technology based processing units was organized at Institute on 10-11 June, 2019. Around 63 trainees from Goa and Maharashtra, were given training on value addition in jackfruit vacuum fryer technology for products like ripe jackfruit bulbs, banana chips, chiku fruit slices, ripe mango slices, chickpea, garlic, ladies fingers.

Awareness and agricultural inputs distribution

An awareness and agricultural inputs distribution programme for the farmers of Maharashtra and Goa was organised during 20-21 June 2019, at Shivapur village, Kudal, Maharashtra and various villages like Mavlinge, Gavdongri, Savoiverem, Kavle of Goa.Various Agricultural Inputs were distributed to the paddy, coconut, cashew growers and also dairy farmers.The soil samples from 60 beneficiary farmers were collected and analysed and based on the soil analysis the soil health cards were prepared.

Training programme on entrepreneurship development in poultry farming

A two days training programme on entrepreneurship development in poultry farming was conducted at Institute during 3-4 July 2019. Various inputs like poultry feeder, waterer and feed supplements were supplied to the 23 trainees from Goa, Karnataka and Maharashtra.

Distribution of inputs

Program on distribution of farm machinery was held at Institute on 20 September 2019. The program was graced by Dr Pramod Sawant, Hon. Chief Minister of Goa. The various inputs were distributed by the Chief Minister to the SC and tribal farmers. A Marathi folder on "Murghas" was released by the chief guest.

Inputs distribution at Arshinageri, Mundugod, Uttara Kannada District

A program of inputs distribution was organised by Institute on 19 October 2019 at Arshinageri, Mundugod, Uttara Kannada District. Inputs like by-pass, mineral mixture for dairy cattle, vegetable seeds, knapsack sprayer, plastic crates, tools for vegetable cultivation, high yielding arecanut seedlings, grafts of jamun, sapota, amla, lemon and nutmeg were distributed.

Capacity building cum distribution programme on Aquaculture

A five day capacity building cum training programme on aquaculture was organised at Kerala University of Fisheries and Ocean Studies, Kochi by ICAR-CCARI, Old Goa during 4-8 November, 2019. Around 50 farmers participated in the programme and were benefitted with the knowledge on various aquaculture systems and their management. Inputs such as fish seeds, feed, air pumps, aeration materials, Silpaulin sheets, and water test kits were distributed among the fish farmers (SC) from different parts of Kerala.

Capacity-building programme on value addition of fish and fishery products

A capacity-building programme on value addition of fish and fishery products was held at Institute during 9-11 December, 2019. Around 23 trainees attended the training programme. Preparation of various fish based products like fish pickle, fish cutlets, fish balls, fish fingers and butterfly shrimp were demonstrated. Various inputs like insulated ice boxes, crates, insulated fish bags, fish mincers, sealing machines etc. were distributed to the beneficiary groups.

Disaster Management

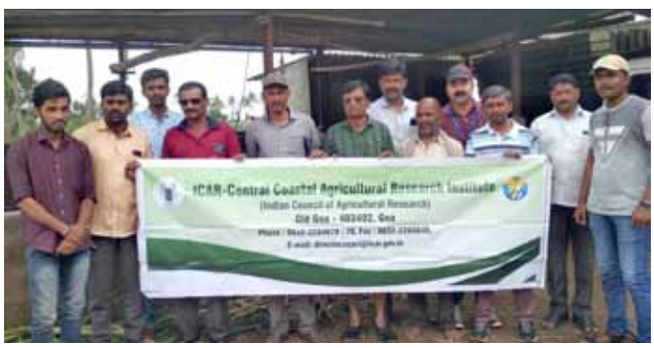
ICAR-CCARI, Goa scientist's visited Fani cyclone affected areas of Odisha

The Director and a team of scientists visited cyclone 'Fani' affected areas of Puri and Khordha district of Odisha from 29 May - 12 June 2019. The team visited about 15 villages to assess the effect of Fani cyclone and to organize animal health camps, for restoring health of livestock and advising the farmers about the general animal health and nutrition management. About 10 animal health camps were conducted in six Fani cyclone affected villages of Puri

and Khordha districts. About 1700 animals (cattle, buffalo, sheep, goat, poultry, dogs) were treated for various ailments besides distribution of mineral mixture, dewormers and other feed supplements for the livestock. Scientists also interacted with farmers and provided information on how quickly to restore and encash the potential of horticultural crops for stabilizing the economic condition. With a view to facilitate the farmers with quick returns, seeds of improved varieties of vegetables namely okra, gourds, tomato, chili, etc. were also provided to the farmers.

Organization of Flood relief-cum-animal health camps in Kolhapur district, Maharashtra

A team of scientists visited Kolhapur, Maharashtra during 19 - 21 August, 2019, where in the early part of August 2019, unprecedented heavy rainfall lead to severe flooding, prompting lakhs of people to relocate



to relief camps and also resulted in several human and livestock casualties. Scientists visited the affected areas for assessing the impact of flood on animal husbandry, for conducting animal health camps and also for performing advisory role in post-flood management of livestock. The activities were coordinated in collaboration with social workers, Baharatiya Kisan Sangh and local veterinarians. The veterinary team had an extensive interaction with livestock owners, panchayat members, members of non-government organizations and local vets. During the period, the team visited 15 flood affected villages and through animal health camps and house visits, 255 animals were treated for different ailments and also provided with necessary medicines and preventive vaccination.

Visit to Wayanad district to study the ill-effects of land slide

A team of scientist visited Wayanad, Kerela during 3-4 October 2019 to study the impact of floods and landslide that occurred in second week of August 2019. The team assessed the causes of the disaster, losses incurred and the mitigation measures envisaged by each one of the body were deliberated upon. The steps to prevent further such disasters and the measures envisaged by the departments were reported.

Dr EB Chakurkar, Director, of the Institute also visited Wayanad, Kerala to see the flood and landslide affected area of Puthumala as a part of mandated disaster mitigation of ICAR-CCARI.

GLIMPSES OF INSTITUTE

- Swachha Bharat Abhiyan
- संस्थान के राजभाषा प्रकोष्ठ की गतिविधियां
- Events
- Distinguished Visitors
- Committees and Meetings
- Personnel
- Budget

Awareness campaign on plastic waste managment
Photo Courtesy: Pranjali Wadekar

Swachha Bharat Abhiyan

Under Swachh Bharat Abhiyan or Clean India Mission, Govt. of India, the Institute organized a series of events to emphasize the importance of the cleanliness.

The scientists, administrative, technical, supporting, SRFs, RAs and contractual staff of the Institute and Krishi Vigyan Kendra have actively participated in the cleanliness drives organized.

The following events were organized as part of Swachha Bharat Abhiyan.

'Swachhata Hi Sewa' – (11-09-2019 to 02-10-2019)

Date	List of activities
11-09-2019	Display of Banner at prominent places with the message to stop the use Single–Use Plastic (SUP).
	Swachhta Pledge.
12-09-2019	Plastic waste collection drive within the campus and surroundings including residential colonies.
13-09-2019	Stock taking 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. Recycling of biomass for compost production with the help of regular use of biomass shredder and vermi-composting units
16-09-2019	Cleanliness drive including cleaning of Offices, Corridors and Premises, ensuring the Office becomes free of SUP.
17-09-2019	Promoting clean & green technologies and organic farming practices in kitchen gardens of residential colonies/one nearby village for generating wealth from waste.
18-09-2019	Review of progress on weeding out old records, disposal of old and obsolete furniture.
	Survey of Single-use plastic in use at this Institute.
19-09-2019	Campaign on cleaning of sewerage, water lines, water tanks & sumps.
20-09-2019	Swachhta Awareness at local level (organizing Plastic-Waste-free India Campaigns) involving and with the help of the farmers, farm women and village youth in new villages not adopted by any Institutes/Establishments.
21-09-2019	Awareness on plastic-waste-free India, recycling of waste water, water harvesting for agriculture/ horticulture application/kitchen gardens in residential colonies.
23-09-2019	Awareness on harmful effects of SUP, recycling of waste water, water harvesting for agriculture/ horticulture application/kitchen gardens in nearby villages with the involvement of local/village communities.
24-09-2019	Basic maintenance: Stock taking on digitization of Office records/e-office implementation.

25-09-2019	Plastic waste collection drive at public places, community market places and/or nearby tourist spots.
26-09-2019	Promoting clean and green technologies and organic farming practices in community places.
	Organizing Workshops, Exhibitions, technology demonstrations on agricultural technologies for conversion of waste to wealth, safe disposal of all kinds of wastes.
27-09-2019	Letter to Bapu: Conveying the Child's contribution to Swachhta and his/her commitment for the future. For Students of Classes V & VI and Classes VII & VIII. Total 22 Students
28-09-2019	Rally against the use of Single-use plastic in Old Goa.
30-09-2019	Training on "Ways to make different items from Coconut leaves", leading to reduction in plastic use.
01-10-2019	Display of alternatives of Single-use plastic in the Institute.
	Fostering healthy competition: Organizing competition and rewarding best offices/residential areas/ campus on cleanliness.
02-10-2019	Shramdaan for plastic waste collection & segregation. Drawing Competition

Pledge taking ceremony as a part of Swachhta Pakhwada

Awareness campaign on plastic waste managment

Swachhta Pakhwada 16th -31st Dec., 2019

Date	Name of activities as per theme
16-12-2019	Display of Banner at prominent places. Taking Swachhta pledge Stock taking & briefing of the activities to be organized during the Pakhwada Plantation of trees
17-12-2019	Weeding out of old records
18-12-2019	Awareness Programme on avoiding Single use plastic at Nagargaon Government Primary School at Mera Gaon Mera Gaurav
	Awareness Programme on Vermicompost Production at Mera Gaon Mera Gaurav
19-12-2019	Sanitation and SWM Cleanliness and sanitation drive within campuses and surroundings including residential colonies, common market places. Stock taking of biodegradable and non-biodegradable waste disposal status and providing on the spot solutions.

20-12-2019	Stock taking 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 proving on the spot technology solution.
21-12-2019	Awareness on recycling of waste water, water harvesting for agriculture/horticulture application/kitchen gardens in residential colonies/1-2 nearby villages.
22-12-2019	Organizing Workshops, Exhibitions, technology demonstrations on agricultural technologies for conversion of waste to wealth, safe disposal of all kinds of wastes.
23-12-2019	Celebration of Kisan Divas - Farmers Day and felicitation of progressive farmers
24-12-2019	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.
25-12-2019	Cleaning of public places, community market places and/or nearby tourist spots.
26-12-2019	Fostering healthy competition: Organizing drawing competitions for school children.
27-12-2019	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 new area.
28-12-2019	Campaign on cleaning of sewerage and water lines, awareness on recycling of waste water, water harvesting for agriculture/horticulture application/kitchen gardens in residential colonies/outside campus, nearby villages with the involvement of local/village communities.
29-12-2019	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.
30-12-2019	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.
31-12-2019	Highlighting the activities of Swachh Bharat Pakhwada by involving all stake holders including farmers

Cleanliness and sanitation drive within campuses and surroundings

संस्थान के राजभाषा प्रकोष्ठ की गतिविधियां

संस्थान में राजभाषा के, प्रचार - प्रसार तथा भारत सरकार की राजभाषा नीति का अनुकरण व प्रसार करने 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 गज़टमें अधिसूचित किया जा चुका है।

राजभाषा अधिनियम व राजभाषा नियम के अनुसार संस्थान में राजभाषा -संबंधी कार्योंकी समीक्षा तथा राजभाषा के प्रयोग को गति प्रदान करने हेतु संतान के निदेशक की अध्यक्षतामें राजभाषा कार्यान्वयन समिति गठित की गयी है, जिसमे 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

संस्थान द्वारा हिन्दी पखवाड़ें का आयोजन दिनांक 13.09.2019 से 28.09.2019 तक किया गया। हिन्दी पखवाड़ें का शुभारंभ दिनांक 13.09.2019 को शाम 3:00 बजे संस्थान के सम्मेलन कक्ष में किया गया।

हिन्दी पखवाड़े के दौरान 16.09.2019 से 28.09.2019 से आयोजित किए गए कार्यक्रम इस प्रकार है:

क्र.	प्रतियोगिता का नाम	दिनांक
1.	हिन्दी टिप्पण एवं प्रारूप लेखन प्रतियोगिता - सभी कर्मचारियों तथा संविदा कर्मचारियों के लिए।	16-09-2019
2.	हिन्दी निबंध प्रतियोगिता - सभी कर्मचारियों तथा संविदा कर्मचारियों के लिए।	17-09-2019
3.	सामान्य ज्ञान प्रश्नोत्तरी का प्रथम दौर / राउंड - सभी कर्मचारियों तथा संविदा कर्मचारियों के लिए।	18-09-2019
4.	सुलेख प्रतियोगिता - सभी कर्मचारियों तथा संविदा कर्मचारियों के लिए।	19-09-2019
5.	आशुभाषण प्रतियोगिता - सभी कर्मचारियों तथा संविदा कर्मचारियों के लिए।	23-09-2019
6.	हिन्दी काव्य पाठ प्रतियोगिता - सभी कर्मचारियों तथा संविदा कर्मचारियों के लिए।	24-09-2019
7.	सामान्य ज्ञान प्रश्नोत्तरी का अंतिम दौर / राउंड - प्रथम दौर में अहर्ता प्राप्त कर्मचारियों के लिए।	25-09-2019
8.	बच्चों के लिए विभिन्न प्रतियोगिताएं	28-09-2019
9.	हिन्दी पखवाड़े का समापन तथा पुरस्कार वितरण	03-10-2019

संस्थान द्वारा आयओजित हिन्दी पकवाड़ें का समापन समारोह दिनांक 03.10.2019 को सायं 3:00 बजे से संस्थान के सम्मेलन कक्ष में किया गया। समापन समारोह में मुख्य अतिथि श्री आशुतोष जोशी, प्रधान म हालेखाकार, महालेखाकार का कार्यालय, गोवा उपस्थित थे।

संस्थान में नगर राजभाषा कार्यान्वयन समिति के तत्वावधन में अंतर - कार्यालयीन हिन्दी निबंध लेखन प्रतियोगिता का आयोजन दिनांक 20.11.2019 को अपरान्ह 3:00 बजे किया गया।

संस्थान के राजभाषा प्रकोष्ठ की गतिविधियां

Events

Seminars and workshops organized

Zonal Workshop of KVK

Annual Zonal Workshop of KVKs was organized with ICAR-ATARI, Pune at the Institute during 14-16 June, 2019. Dr AK Singh, DDG (Agril Extension), ICAR, Dr Ashok Patel, VC, SDAU, SK Nagar; Dr KP. Vishwanatha, VC, MPKV, Rahuri; Dr SD Sawant, VC, Dr BSKKV, Dapoli, Dr VP Chahal, ADG (Agril Extension), ICAR, Dr P Das, Ex DDG (Extension), ICAR, Dr Lakhan Singh, Director, ATARI, Pune and Dr EB Chakurkar, Director, CCARI, were dignitories during the workshop. 79 KVKs of Maharashtra (47), Gujarat (30) and Goa (2) participated and presented their work progress. Directors/Professors of Extension Education of 8 SAUs shared their initiatives on innovative monitoring mechanism and extension methodologies for overseeing the KVKs in their area jurisdiction.

Workshop on integrated farming system

A Two day workshop on integrated farming system was organised by the Institute during 16-17 November 2019. Hon. Chief Minister, Dr. Pramod Sawant, and Shri Chandrakant (Babu) Kavlekar, Hon. Dy. Chief Minister and Minister for Agriculture, Govt. of Goa along with Dr EB Chakurkar, Director (ICAR-CCARI), Mr Madhav Kelkar (Director of Agriculture) and Dr Santhosh Desai (Director of Animal Husbandry and Veterinary Services) inaugurated the workshop. A total of 100 progressive farmers from different parts of Goa and 80 officials from Agriculture, Animal Husbandry and Fisheries were actively participated in workshop and field visits.

Workshop on basic Konkani learning'

Workshop on 'Basic Konkani learning' for the scientists and non- Konkani learning staffs of ICAR- CCARI, Old Goa was held at ICAR- CCARI, Old Goa during 18-20 November, 2019. Mr Anil Sawant, Asst. Director, Directorate of Official Language, Govt. of Goa along with Dr Kiran Budkuley, Professor, Goa University were the resource persons.

Workshop on scope of extending cashew plantations in non- traditional areas

Workshop on 'Scope of extending cashew plantations in non- traditional areas' was organized at the Institute on 23 December, 2019 under the chairmanship of Dr SK Chaudhari, ADG (SWM), ICAR. Dr EB Chakurkar Director (A) welcomed the dignitaries and delegates representing different states viz. Maharashtra, Karnataka, Gujarat, Chhattisgarh and Madhya Pradesh where cashew is expanding in the non-traditional areas. The presentations were followed by the brain storming session involving all the delegates and the scientists for formulating the future road map for exploring the possibility of expanding the cashew cultivation in non-traditional areas in the country.

Days Celebrated

International Day of Yoga

Fifth International Day of Yoga (IDY) was celebrated on 21 June, 2019. Mass demonstration of Yoga practice based on the Common Yoga Protocol and various programmes in daylong celebration of Yoga was attended by the staff. Shri Shailendra Gupta (Certified Yoga Instructor) co-ordinated the yoga function.

Foundation day

Foundation day of the Institute was celebrated on 2 April, 2019. Shri Madhav Kelkar, Director of Agriculture Govt. of Goa was the chief guest and Dr Santosh Desai, Director of Animal Husbandry & Veterinary Services, Govt. of Goa was guest of honour. Dr EB Chakurkar, Director (A) welcomed the guests and briefed the gathering about the research achievements and activities of the Institute. On this occasion progressive and award winning farmers were felicitated at the hands of the guests. The staff of the Institute were awarded with various annual awards.

World Coconut day

World Coconut day was celebrated during 11-12 September, 2019 at KVK, North Goa. Exhibition of coconut varieties, seedling selection method, were demonstrated to the trainees. A demo of usage of coconut climbing machine for climbing coconut palms was carried out.

Vigilance awareness week

The institute observed the vigilance awareness week from 28 October to 2 November, 2019 on the theme "Integrity a way of life". All the staff members actively participated in the week by taking pledge and rally. Banners were displayed at main locations of the campus to mark the vigilance awareness week. An off-campus campaign was also organized on 29th October, 2019.

World soil day and Agricultural education day

The Institute celebrated 'World soil day' and 'Agricultural education day' on 5th December 2019 Prof Varun Sahni, Hon. VC, Goa University and Dr SK Singh, Director, CSIR – NIO, Dona Paula, Goa were the Guests in the function. Dr. EB Chakurkar, Director (A), ICAR-CCARI, Old Goa welcomed the delegates and apprised about the importance of celebrating the World soil day and Agricultural education day. As a part of the event, soil health card to farmers from different villages of the Goa state were given the soil health cards. Students of three different schools participated in an essay competition.

Participations in exhibitions

Tourism expo

The Institute participated in three days Tourism expo at Goa Science Centre, Miramar, during 25-27 September, 2019. The technologies of the Institute were displayed.

Vibrant Goa Global expo and summit 2019

The Institute participated in Vibrant Goa Global expo and summit 2019 held on 17 October, 2019 at Taleigao Goa. Details of the commercialisable technologies developed by the Institute were shared with participants and entrepreneurs from Goa and Maharashtra States to explore the scope of technology commercialization.

AQUABE-2019

The Institute participated in AQUABE-2019 held at Kochi, Kerala during 28-30 November 2019. Smt. J. Mercykutty Amma, Hon. Minister of Fisheries, Kerela inaugurated the event along with Dr. A. Ramachandran, Vice Chancellor, KUFOS Kochi. The exhibition stall of ICAR-CCARI displayed various technologies, varieties, products, publications, research posters and charts.

Other Events

Participation in ICAR- Zonal Sports Meet

The ICAR Zonal sports meet 2019 (West Zone) was held at ICAR-CSWRI, Avikanagar, Rajasthan between 14-18 November, 2019. The group of 14 members from ICAR- CCARI, participated in the events such as football, volleyball, carom, table tennis, chess and athletics. Institute football team secured second place in football.

Distinguished Visitors

Date	Name of Visitor	Designation/ Institute/ Place
02-04-2019 16-11-2019	Dr Santosh Desai	Director, Directorate of AH&VS, Govt. of Goa
02-04-2019 16-11-2019 21-01-2020	Shri Madhav Kelkar	Director, Directorate of Agriculture, Govt. of Goa
14-06-2019	Dr Ashok Patel	Vice Chancellor, SDAU, S.K. Nagar
14-06-2019	Dr KP Vishwanatha	Vice Chancellor, MPKV, Rahuri
14-06-2019 21-01-2020	Dr SD Sawant	Vice Chancellor, BSKKV, Dapoli
14-06-2019	Dr VP Chahal	ADG (Agril Extension), ICAR, New Delhi
14-06-2019	Dr Lakhan Singh	Director, ATARI, Pune
15-06-2019	Dr AK Singh	Deputy Director Genera (Agril Extension), ICAR, New Delhi
15-06-2019	Dr P Das	Ex-DDG (Agril Extension), ICAR, New Delhi
27-06-2019	Dr Ravindra Chari	Director, ICAR-CRIDA, Hyderabad
17-08-2019	Dr HS Gupta	Ex Director, ICAR-IARI, New Delhi
23-09-2019 05-02-2020	Dr Narendra Pratap Singh	Ex Director, ICAR- NIASM, Baramati
20-09-2019 16-11-2019	Dr Pramod Sawant	Honourable Chief Minister, Government of Goa
16-11-2019	Shri Chandrakant (Babu) Kavlekar	Honourable Dy. Chief Minister and Minister for Agriculture, Government of Goa
05-12-2019	Prof Varun Sahni	Vice-Chancellor, Goa University, Taligaon Goa
05-12-2019	Dr SK Singh	Director, CSIR – National Institute of Oceanography, Donapaula, Goa
23-12-2019	Dr SK Chaudhari	Assistant Director General (SWM), ICAR, New Delhi

Distribution of agricultural inputs at the hands of Dr. Pramod Sawant, Hon. Chief Minister, Govt. of Goa

Visit of Shri Chandrakant (Babu) Kavlekar, Hon. Dy. Chief Minister, Govt. of Goa during IFS workshop

Committees and Meetings

Quinquennial Review Team

The Director General, ICAR constituted the 5th Quinquennial Review Team (QRT) in respect of ICAR – Central Coastal Agricultural Research Institute, Goa vide Office order no. NRM/7-2/2018-IA-II dated 31 May, 2018 to review the work done by the Institute during the period from 1-04-2013 to 31-03-2018. The constitution of the QRT is as under.

Dr Tapas Bhattacharya	Former Vice Chancellor, Dr. BSKKV, Dapoli, Ratnagiri District – 415712, Maharashtra	Chairman
Dr SR Das	Honorary Professor, Department of Plant Breeding & Genetics, Orissa University of Agriculture & Technology, Bhubaneshwar - 751003	Member
Dr M Anandraj	Ex- Director ICAR- IISR, Calicat, 48A "Madhoovan" 2nd Main Railway Men Layout Thanisandra, Bangalore - 560077	Member
Dr SMK Naqvi	Ex Director, ICAR- Central Sheep & Wool Research Institute, Avikanagar, via Jaipur – 304501, Rajasthan	Member
Dr Sreenath Dixit	Dy. Head & Principal Scientist, International Crops Research Institute for the Semi – Arid Tropics (ICRISAT), Patancheru, Hyderabad, Telangana - 502324	Member
Dr Z Abraham	Ex- OIC, NBPGR Centre, B-104, Gardenia Jasminoides, 2nd Cross, Lakshmaiah Layout, Opposite Agara Lake, Horamavu, Bengaluru, 560113	Member
Dr M Thangam	Principal Scientist (Horticulture), ICAR – CCARI, Old Goa	Member Secretary

Fourth and final meeting of 5th Quinquennial Review Team (QRT) was held during 24-25 April, 2019 under the chairmanship of Dr Tapas Bhattacharya, Former Vice Chancellor, Dr. BSKKV, Dapoli and other members. Chairman and members interacted along with IMC Members of Institute and Stakeholders and representatives from development departments from the state of Goa. QRT members also visited the agriculture cum livestovk farm at Valpoi, Goa and also interacted with about 50 farmers of Nagargaon village, Valpoi Goa adopted by KVK (North Goa). QRT also visited the unique Gaushala (Cow Rehabilitation Centre) namely "Akhil Vishwa Jay Sree Ram Gosamvardhan Kendra", Betkekar wada, Nanus, Valpoi, Sattari, Goa.

Institute Research Council Meeting

The 30th Annual Institute Research Council meeting of the Institute was held during 29 April- 1 May, 2019 at the Institute. The meeting was chaired by Dr EB Chakurkar, Director (A) of the Institute. He welcomed all the scientists and highlighted about the importance of this meeting. He suggested to incorporate the RAC recommendations in the existing ongoing projects or new project proposals if any. He also requested scientists to take up need based research projects as per the requirements of the coastal region. The scientists made their deliberations on the actions taken on recommendations of last IRC meeting and research activities carried out during last one 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 2018-19 and finalized the technical programmes of the ongoing research projects for the year 2019-20. The details of IRC are as follows

Dr EB Chakurkar - Chairman
Director (A),
ICAR - CCARI, Old Goa

All Project Leaders - Members

Dr Manohara KK - Member Secretary
Senior Scientist (Genetics & Plant Breeding)
ICAR – CCARI, Old Goa

Research Advisory Committee

The VIII Research Advisory Committee (RAC) for ICAR- Central Coastal Agricultural Research Institute was constituted for a period of three years from 11/08/2017 to 10/08/2020. The composition of RAC is given below.

No.	Name and Details	
1.	Dr SS Magar Ex- Vice Chancellor, Dr BSKKV, Dapoli, Runabandh Housing Society, Near Kotibagi Hospital, Aundh, Pune – 411008, Maharashtra	Chairman
2.	Dr BB Deshpande Ex- Dean, College of Veterinary & Animal Sciences, Parbhani Flat No 2, Raviraj Apartment, Umaji Colony, Bansilal Nagar, Aurangabad - Maharashtra	Member
3.	Dr PN Jagdev Dean of Research, Orissa University of Agriculture & Technology, Plot No. MIG-141, Phase -1, Khandagiri Housing Board Colony, Kolathia, Bhubaneshwar - 751030, Odisha	Member
4.	Dr AM Gosawami Former Head, Division of Horticulture, IARI, 40/7 (Pocket 40, House No 07), C R Park, New Delhi - 110019	Member
5.	Dr SD Singh Former ADG (Inland Fisheries), ICAR 5/85, Viram Khand, Gomti Nagar, Lucknow- 226010, Uttar Pradesh	Member
6.	Shri Babu Narhari Komarpant Near Dhavlikar Hospital, Devbag, Palolem, Cancona, Goa- 403702	Member
7.	Shri Shrirang Venktesh Jamble Sawai, P.O. Verem, Ponda - 403401	Member
8.	Dr S Bhaskar Assistant Director General (Agronomy/ Agroforestry) NRM, ICAR, KAB-II, Pusa, New Delhi	Member
8.	Dr EB Chakurkar , Director (A), ICAR-CCARI, Old Goa	Member
9.	Dr R Ramesh Principal Scientist, ICAR-CCARI, Old Goa	Member Secretary

The Institute undertook research in accordance with the recommendations second meeting of VIII RAC.

Institute Management Committee

The Institute Management Committee is constituted for financial and administrative guidance of Institute by the council for a period of three years from 20/03/2017 to 19/03/ 2020. Following is the composition of IMC,

Dr EB Chakurkar	Director (A), ICAR – CCARI, Old Goa	Chairman
Dr Nelson Figuredo	Ex Director of Agriculture, Directorate of Agriculture, Government of Goa, Krishi Bhavan, Tonca, Caranzalem, Goa.	Member
Dr PC Haldavanekar	Associate Director of Research, Dr. BS KKV, Dapoli Regional Fruit Research Station, Vengurle- 416 516, Maharahtra	Member
Dr H Basavaraj	Prof. of Economics & Controller, University of Agricultural Sciences, Krishinagar, Dharwad. Karnataka	Member
Dr Jagdish Rane	Head, ICAR-NIASM, Malegaon, Baramati -413 115 Maharshtra	Member
Dr Pradip Dey	Project Coordinator, ICAR-Indian Institute of Soil Science, Nabi Bagh, Berasia Road, Bhopal – 462038, Madhya Pradesh	Member
Dr SK Mishra	Principal Scientist, ICAR-CARI, Regional Centre, P.O. Baramunda, Bhubaneswar-751003, Odisha.	Member
Dr TK Behera	Principal Scientist (Horticulture), Division of Vegetable Science, ICAR-Indian Agricultural Research Institute, New Delhi -110 0012	Member
Shri Dattaprasad Prabhakar Kholkar	H.No. 245-A/9, Ganeshpuri Houding Board Colony, Mapusa, Goa	Member
Shri Prabhakar Gaonkar	H.No.21, Bendurden Balli Via Cuncolim, Salcete-Goa – 403 703.	Member
ADG (AG&AF)	ICAR, KAB-II, New Delhi -12	Member
The Finance & Accounts Officer	National Institute of Abiotic Stress Management Baramati, Maharshtra	Member
Shri Somnath	Administrative Officer, ICAR- CCARI, Old Goa	Member Secretary

The 49th meeting of the IMC was held at the Institute on 24 April, 2019.

Agriculture contingency plan

Agriculture contingency plan meeting for the Goa state with ICAR-CRIDA, Hyderabad was organised at the Institute on 27 June, 2019 to develop agriculture contingencies plan for various emergency and disaster situations such as flood, drought, heat wave, cold wave and cyclone in the pre-event, and post-event circumstances. Dr EB Chakurkar, Director (A), ICAR-CCARI chaired the meeting along with Dr Ravindra Chari, Director, ICAR-CRIDA, Hyderabad.

Quinquennial Review Team (QRT) meeting of All India Co-ordinated Rice Improvement Project (AICRP) of the west zone (Zone VI)

Quinquennial Review Team (QRT) meeting of All India Co-ordinated Rice Improvement Project (AICRIP) of the west zone (Zone VI) comprising of Gujarat, Maharashtra and Goa states was held at ICAR-Central Coastal Agricultural Research Institute, Goa, during 17-18 August, 2019. The meeting was chaired by Dr HS Gupta, former Director, Indian Agricultural Research Institute (IARI), New Delhi. The members of the QRT team Dr R Sridhar, Dr S Kundu, Dr TVK Singh and Dr PS Birthal also attended the meeting along with Dr EB Chakurkar, Director (A), ICAR-CCARI and Dr LV Subba Rao, Member Secretary of the QRT. Dr Manohara KK, Senior Scientist (Genetics and Plant Breeding) Co-ordinated the meeting.

Personnel

INSTITUTE

No.	Name	Designation	Additional Charge
Research Management			
1.	Dr EB Chakurkar	Director (A)	Animal and Fishery Science
Scientific Staff			
2.	Dr V Arunachalam	Principal Scientist (Spices, Plantation and Medicinal & Aromatic Crops)	
3.	Dr AR Desai	Principal Scientist (Fruit Science)	Horticultural Science
4.	Dr M Thangam	Principal Scientist (Vegetable Science)	
5.	Dr R Ramesh	Principal Scientist (Plant Pathology)	Crop Science, AKMU Cell, RAC
6.	Dr S Priya Devi	Senior Scientist (Fruit Science)	RKVY
7.	Dr Manohara KK	Senior Scientist (Genetics and Plant Breeding)	IRC
	Dr Mathala Juliet Gupta	Senior Scientist (Agricultural Structures and Process Engineering)	STC and SCSP
8.	Dr R Maruthadurai	Scientist (Agricultural Entomology)	Library
9	Dr R Soloman Rajkumar	Scientist (Livestock Products Technology)	On Study Leave
10.	Dr Susitha Rajkumar	Scientist (Veterinary Pathology)	
11.	Dr Shivasharanappa N	Scientist (Veterinary Pathology)	
12.	Dr Mahajan GR	Scientist (Soil Science)	NRM, PME, PIMS
13.	Dr Gokuldas PP	Scientist (Animal Reproduction and Gynaecology)	IPR
14.	Dr Sreekanth GB	Scientist (Fisheries Resource Management)	
15.	Mr Trivesh S Mayekar	Scientist (Fish Genetics and Breeding)	
16.	Dr Maneesha SR	Scientist (Fruit Science)	
17.	Dr Chethan Kumar HB	Scientist (Veterinary Public Health)	
18.	Dr Bappa Das	Scientist (Agricultural Meteorology)	
19.	Dr Paramesha V	Scientist (Agronomy)	
20	Dr Sujeet Desai	Scientist (Land and Water Management Engineering)	
21.	Dr Nibedita Nayak	Scientist (Poultry Science)	
22.	Dr Amiya Ranjan Sahu	Scientist (Animal Genetics and Breeding)	
Technical Staff			
1.	Ms Madina Sollapuri	Senior 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
5.	Mr Edward Crasto	Technical Officer (Stockman)	
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	Technical Assistant	
10.	Mr Prakash Parwar	Technician	
11.	Mr Gokuldas Gawas	Technician	
12	Mr Data Velip	Technician	
13.	Mr Laxman Naik	Technician	
Administrative & Accounts Staff			
1.	Shri Somnath	Administrative Officer	
2.	Ms Lizette Maria Carmel Noronha	Private Secretary	
3.	Ms Montia Rita D'Silva	Assistant Administrative Officer	Estt./ Bills
4.	Mr Agostinho Fernandes	Assistant Administrative Officer	Store/ DDO/Vehicle
5.	Ms Asha Manjrekar	Assistant Administrative Officer	Works
6.	Ms Pratibha Revodkar	Assistant	
7.	Ms Sunanda Chopdekar	Assistant	
8.	Ms Tarika Usapkar	Personal Assistant	
9.	Mr Vinod Pagi	UDC	
10.	Ms Bushra Ansari	Stenographer Grade.III	
11.	Ms Chitra Kankonkar	LDC	
12.	Mr Vyas Hiren Kumar	LDC	
13.	Ms Sujatha S. Kamble	LDC	
Skilled Supporting Staff			
1.	Mr Subhash Melekar		
2.	Mr Dhaku Kankonkar		
3.	Mr Dugu Khandeparkar		
4	Mr Ashok Gadekar		
5.	Mr Ravi S Kadam		
6.	Mr Chimmnu Tivrekar		
7.	Mr Anil Khandeparkar		
8.	Ms Maria S Dias		
9.	Mr Giri Madkaikar		
10.	Mr Gokuldas Kasker		
11.	Mr Umesh Marcelkar		
12.	Ms Prafulla Khandeparkar		
13.	Ms Rekha U Naik,		
14.	Ms Lalitha Naik		
15.	Ms Partibha Folkar		
16.	Mr Vilas P Gaonkar		
17.	Mr Prabhakar Goankar		
18.	Mr Sitaram Kuncolikar		
19.	Ms Janika S Shirodkar		
20.	Mr Shanu G Velip		
21.	Mr Nitin J Naik		
22.	Ms Swati R Khandeparkar		
23.	Mr Prallhad H Zambaulikar		

KVK, North Goa

No.	Name	Designation	Additional Charge
Technical Staff			
1	Mr HRC Prabhu	Subject Matter Specialist T-9 (Plant Protection)	Programme Co-ordinator
2.	Ms Sunetra Talaulikar	Subject Matter Specialist T-9 (Home Science)	
3.	Dr Sanjay Kumar Udharwar	Subject Matter Specialist T-6 (Animal Science)	
4.	Dr Monica Singh	Subject Matter Specialist T-6 (Agricultural Extension)	
5.	Mr Shashi Vishwakarma	Technical Officer	
6.	Mr Prajapati VS	Technical Officer	
7.	Mr Irappa M Chalwadi	Driver-cum-Mechanic T-5	
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		
2.	Ms Sarita Tuko Zaro		

STAFF ACTIVITIES

Foreign Deputation

Dr. Solomon Rajkumar, Scientist (Livestock Products Technology), ICAR-CCARI, Old Goa, participated in 21st World Veterinary Poultry Association Congress (WVPAC 2019) held at Bangkok, Thailand during 16-20 September, 2019.

Dr. Susitha Rajkumar, Scientist (Veterinary Pathology), ICAR-CCARI, Old Goa, participated in 21st World Veterinary Poultry Association Congress (WVPAC 2019) held at Bangkok, Thailand during 16-20 September, 2019.

Dr. Gopal Ramdas Mahajan, Scientist (Soil Science), ICAR-CCARI, Old Goa, participated in a Training Programme on "Environmental Management" held at Galilee International Management Institute (GIMI), Israel during 10–23 September, 2019.

Appointments / Joining

Name	Post	Date of Joining
Dr Amiya Ranjan Sahu	Scientist (Animal Genetics & Breeding)	02-12-2019
Mr Trivesh Suresh Mayekar	Scientist (Fish Genetics & Breeding)	09-12-2019

Promotions

Name/designation of the Officials	Promoted/ Granted higher Grade Pay in the Pay band/level	Date of promotion
Shri Omar Illroy Francisco Da Silveira Ursula Ds Souza Technical Assistant T-3	Senior Technical Assistant T-4 Level 6	08-08-2018
Shri Irappa M Chalwadi, Driver-cum Mechanic T-3	Driver-cum-Mechanic T-4 Level 6	07-11-2018
Smt Chitra Kankonkar, LDC	Upper Division Clerk, Level 4	27-08-2019

Dr Mathala Juliet Gupta, Scientist (AS&PE)	Senior Scientist in PB-3	14-04-2011
Smt Pratibha Sawant, Assistant	Assistant Administrative Officer, Level 7	03-09-2019
Shri Vinod D Pagi, UDC	Assistant, Level 6	23-09-2019
Dr Shivasharanappa, Scientist	Senior Scientist Level 12	15-12-2018
Smt Janika S Shirodkar, SSS	SSS Level 3	14-05-2019
Shri Shanu G Velip, SSS	SSS Level 3	20-05-2019

Transfer

Name	Post held	Transfer to	Date of transfer
Shri Saurabh Muni	Finance & Accounts Officer	ICAR, New Delhi	20-07-2019

Supperannuation

Name	Post held	Date of retirement
Shri Agostinho Fernandes	Assistant Administrative Officer	31-08-2019

Demise

Name	Post held	Date of demise
Shri Mayur Namdev Mandrekar	Skilled Support Staff	24-04-2019

Budget 2019-20 (₹ lakh)

No.	Head	TOTAL ALLOCATION 2019-20	Expenditure (Govt. Grant) 2019-20			Expenditure (Revenue Generation) 2019-20	TOTAL EXPENDITURE 2019-20
			TSP	SCSP	Other than NEH & TSP		
1.	Works	30.00	0.00	0.00	30.00	0.00	30.00
2.	Equipments	16.70	11.55	6.69	14.72	0.00	32.96
3.	Information Technology	5.00	0.00	0.00	4.75	0.00	4.75
4.	Livestock	2.00	0.00	0.00	1.52	0.00	1.52
5.	Furniture & fixtures	4.00	0.00	0.00	3.93	0.00	3.93
6.	Establishment Expenses (Salaries)	808.71	0.00	0.00	802.82	0.00	802.82
7.	Pension & Other Retirement Benefits	39.85	0.00	0.00	37.21	0.00	37.21
8.	Traveling Allowance	23.10	0.00	0.00	23.10	0.00	23.10
9.	Research & Operational Expenses						
	A. Research Expenses	101.60	0.00	0.00	101.59	0.00	101.59
	B. Operational Expenses	163.47	0.00	0.00	163.47	0.00	163.47
	Total - Research & Operational Expenses	**265.07**	**0.00**	**0.00**	**265.06**	**0.00**	**265.06**
10.	Administrative Expenses						
	A. Infrastructure	102.94	0.00	0.00	102.93	0.00	102.93
	B. Communication	1.95	0.00	0.00	1.94	0.00	1.94
	C. i. Equipments, vehicles & others	15.11	0.00	0.00	15.11	0.00	15.11
	C. ii Minor Works	10.48	0.00	0.00	10.48	0.00	10.48
	D. Others (excluding TA)	59.05	0.00	0.00	59.05	0.00	59.05
	Total - Administrative Expenses	**189.52**	**0.00**	**0.00**	**189.51**	**0.00**	**189.51**
11.	Miscellaneous Expenses						
	A. HRD	3.91	0.00	0.00	3.91	0.00	3.91
	B. Guest House – Maintenance	14.02	0.00	0.00	14.02	0.00	14.02
	C. Other Miscellaneous	9.39	18.45	35.73	9.39	0.00	63.57
	Total - Miscellaneous Expenses	27.31	18.45	35.73	27.31	0.00	81.50
	Total --Grants in Aid - General	544.85	18.45	35.73	542.19	0.00	596.38
	Grand Total (Capital + Establishment+General)	**1411.26**	**30.01**	**42.42**	**1399.92**	**0.00**	**1472.35**

Brinjal line 27-7-2

Brinjal line 42-7-3

Shweta Kapila

Kokum accession, Kasarpal-11

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2015-2024

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एक कदम स्वच्छता की ओर

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ICAR

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