

ICAR-CCARI

वार्षिक प्रतिवेदन

Annual Report

2016-2017

ISO
9001:2015



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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(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, Goa, India

ICAR-CCARI, Goa

Annual Report 2016-2017

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Correct Citation : **Annual Report, 2016-17**

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Cover page citation : **Cashew and Rice varieties released for Goa :** Goa cashew 2, Goa cashew 3, Goa cashew 4, Goa dhan 1, Goa dhan 2

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P R E F A C E

ICAR - Central Coastal Agricultural Research Institute (CCARI) is one of the research Institutes under Natural Resource Management (NRM) division of Indian Council of Agricultural Research (ICAR), New Delhi. The Institute is mandated to carry out the research and extension work on field and horticultural crops, livestock, and fisheries. Research activities are executed through five functional sections viz Natural Resource Management, Crop Science, Horticulture Science, Animal Sciences and Fisheries Science. The annual report of the ICAR - Central Coastal Agricultural research Institute documents the progress made in research and extension during the year 2016-17.

It is a pride of our institute that 3 cashew varieties, Goa cashew 1, Goa cashew 2 and Goa cashew 3, and two rice varieties, Goa dhan-1 and 2 have been released during current year. Besides this, identification of promising crop varieties/ accessions of field and horticultural crops, identification of salt tolerant microbe for plant growth promotion, selection of salt tolerant rice varieties, development of rice and plantation crop based farming system models for improved livelihood, development of eco-friendly management practices of major insect pests and diseases in major crops, development of low cost protected structures for vegetable and flower crop production, development of boar semen extender, standardization of package of practices for goat and poultry, exploration of fish diversity of Goa *etc.*, are significant. Scientists of the Institute published many research articles in peer reviewed journals and technical bulletins, extension folders, posters, *etc.* The staff of the Institute received recognitions for their research, administrative and extra-curricular excellence.

The mission of Institute is accomplished through execution of Institute research projects. Besides this it is a regular centre for AICRPs on cashew, integrated farming system, vegetable crops, palms, pig and animal disease monitoring & surveillance and voluntary centre for rice and arid legumes. Research projects are also funded by ICAR through various network platforms and collaborations, Department of Science, Technology & Environment, Department of Biotechnology, *etc.* Extension and development projects are channelled through various other programmes like Tribal Sub Plan, National Horticultural Mission, Rashtriya Krishi Vikas Yojana, NFDB *etc.*

Various trainings, workshops, group meetings, field days, *etc.* were organized to disseminate the technologies to the farming community and other stakeholders.

I place on record my gratitude to Dr. Trilochan Mohapatra, Secretary, DARE and DG, ICAR and Dr. Alagusundaram K., DDG (NRM), Dr. S. Bhaskar, ADG (A,AF&CC), Dr. SK Choudhary, ADG (SW & M) and Dr. Narendra Pratap Singh, Director, ICAR-NIASM & Former Director, ICAR-CCARI 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 of the editorial committee of the Annual Report for compilation and publication.

As a Director of the Institute, it gives me immense pleasure to present the Institute's Annual Report 2016-17 and I hope the report will be useful for researchers, policy makers, planners and extension personnel. I strongly believe that the information contained in the annual report would not only update the readers about the Institute activities but also act as reflection for self appraisal and improvement. While our esteemed readers take a note of our achievements, any feedback, suggestion or comment is welcome so that it can be incorporated in future publications.

(Eaknath B. Chakurkar)
DIRECTOR (A)

Place : Old Goa
Date : 03-07-2017

Major Achievements

Institute released three high yielding cashew varieties viz. Goa Cashew-2 (Tiswadi-3) , Goa Cashew-3 (Ganje-2), Goa Cashew-4 (KN-2/98) and two high yielding salt tolerant rice varieties viz. Goa dhan-1 (KS-12) and Goa dhan-2 (KS-17) during January 2017 for cultivation in the state of Goa

Patent application on extender for preservation of boar semen has been published in Patent Journal of India on 17/02/2017 with permanent serial number No.3037/MUM/2015

Bacillus methylotrophicus Strain STC-4 has been identified as a promising plant growth promoter under saline conditions which improved soil biological activity as well as grain and straw yield of Korgut Rice.

Khola Chilli Cultivators Group, South Goa was awarded with the prestigious *Plant Genome Savior Community Award* by Hon'ble Union Minister for Agriculture & Farmers' Welfare, GoI through PPV&FRA, New Delhi.

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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

- Research on field and horticultural crops, livestock, and fisheries relevant to 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

Executive Summary

ICAR - Central Coastal Agricultural Research Institute conducts strategic and applied research under five functional sections viz. Natural Resource Management, Crop Science, Horticulture Science, Animal Science and Fishery Science. The highlights of the research achievements of this Institute for the year 2016-2017 are presented below.

Natural Resource Management

This section focuses on judicious management of natural resources like land and water through research projects on conservation measures, region specific integrated farming system model development, coastal soil salinity – assessment and management, site specific nutrient management, socio economic assessment of coastal region and crop simulation modelling for weather based crop yield predictions.

Continuous contour trenching + vegetative barrier (VB) (*Vetiveria zizanioides*) (CCT+VB) in mango and circular trenching in coconut arrested the soil and runoff loss significantly over control and other soil and water conservation measures tested.

The highest infiltration rate (73.2 cm/h) and highest field capacity moisture at 60-90 cm depth was found in mango plot with CCT+VB. Likewise, the highest infiltration rate (21.1 cm/h) and highest field capacity moisture content at 30-60 cm depth was found in coconut plot with circular terracing treatment.

The application of the *Bacillus methylotrophicus* strain STC-4 at sowing and 7 days after sowing in paddy (korgut, landrace of Goa) resulted in grain and straw yield of 1.19 and 1.615 t/ha. As compared to control that recorded 0.91 and 1.578 t/ha respectively. A nursery management practice with 25 g/m² seed density, N:P:K@50:30:15 kg/ha and application of *Bacillus methylotrophicus* strain STC-4 at the time of sowing and 7 days after sowing resulted in seedlings with highest seedling vigour index (2226).

A co-existence of the acidic soil reaction (<7.0) and high soil salinity (electrical conductivity (Mean EC(1:2.5) = 13.55 dS/m and EC_e = 24.66 dS/m) was recorded in coastal saline soils from coastal districts of Maharashtra and Goa. These soils were deficient in available nitrogen and sufficient in phosphorus and potassium.

Sustainable livelihood security index, a composite index having three component indices, i.e. the ecological security index (ESI), the economic efficiency index (EEI), and the social equity index (SEI), was developed for 33 districts of West Coast of India.

Technological and HRD inputs for crop based and animal based integrated farming systems in Surla and Ibrahmpur villages, reportedly increased the confidence level of farm women.

Weather based statistical crop yield forecasting model for rice and coconut were developed for ten coastal districts of Maharashtra, Goa, Karnataka and Kerala. The performance of the calibration models were found to be good to very good with R² and RMSE ranging between 0.62-0.94 and 67.70-253.01 kg/ha, respectively for rice and 0.43-0.94 and 30.0-2888.4 nuts/ha for coconut. The rice model which was developed for North Goa district has been validated. Predicted yield of rice for 2016 generated from the model was found to be 2.48 t/ha while the observed yield was 2.81 t/ha, a deviation of 11.87%.

A rice based integrated farming system (IFS) model (crop-livestock) on 0.5 ha area recorded net returns of ₹ 1.05 lakh with the highest contribution from rice-chilli-dairy system (72%); BCR 0.94; energy output (33815.2 MJ/ha), energy use efficiency (2.0), energy profitability (1.0 MJ/ha) and human energy productivity (8.2) over other cropping systems. Thus, integration of rice-chilli - dairy system was found more profitable, with potential to generate employment and also energy efficient.

Among different horticulture based cropping systems, cashew + pineapple recorded highest net return (₹. 0.18 lakhs), followed by arecanut + banana (₹. 0.17 lakhs), with the piggery enterprise producing highest net return of ₹. 0.34 lakhs (38% contribution). The total net return from the upland horticulture based model on 0.79 ha was ₹. 0.89 lakhs, with BCR 1.25.

Among the different nutrients tested in rice-rice system, the growth and yield parameters like plant height (100.3 cm), number of tillers/m² (286), number of panicles/m² (207), panicle length (22.7 cm), grains/panicle (129) and grain yield of 5.06 t/ha was found significantly higher in 100% N through neem coated urea and the lower values were observed under control plots.

Crop Sciences

Research projects address crop improvement in field crops like paddy and cowpea, pest and disease management of field and horticultural crops and the significant accomplishments are here under.

Two high yielding salinity tolerant rice varieties viz., Goa dhan-1 (KS-12) and Goa dhan-2 (KS-17) were developed and released for cultivation in the state of Goa by State Variety Release Committee (SVRC) in January, 2017. Among the breeding materials derived from the cross Jyothi x Korgut, highest grain yield was recorded in the line JK-58 (3260.00 kg/ha) followed by JK-238 (3113.33 kg/ha), JK-84 (3086.67 kg/ha), JK-86 (3040.00 kg/ha) and JK-156 (2946.67 kg/ha). During the current year, F₄ generation populations derived from different crosses between high yielding salinity sensitive and low yielding tolerant lines were advanced further for their stabilization.

Fifty nine rice germplasm comprising 20 landraces, 23 wild rice, 8 advanced breeding lines, 6 improved cultivars and 2 check varieties (Tolerant Pokkali, Sensitive IR-29) were screened under micro-plot conditions for salinity stress tolerance (electrical conductivity of 12 dS/M) at seedling stage during kharif 2016. Genotypes Korgut, KS-17 and WR-18 were found to be highly-tolerant (HT) with SES score of 2-3 and KS-4, KS-12, KS-16-1, KS-19-2 and Kagga were found to be tolerant (T) with SES score of 3.

Sixty six rice cultures developed for salinity and alkalinity conditions by different NARS partners were evaluated under coastal salinity situation in farmers' field at Chorao Island of North Goa district. Highest grain yield was recorded by CR3881-M-3-1-5-3-1-1 (3130.91 kg/ha) followed by CSR-C27SM-117 (2425.25 kg/ha), JK-95 (2356.36 kg/ha), CSR-2748-4441-66 (2280.00 kg/ha) and CSR-2748-4441-133 (2258.18 kg/ha).

In total, 11 q of seeds were produced in rice, cowpea and green gram. About 7 q of seeds produced in varieties Jyothi and Karjat-3, 1 q in rice variety Vytilla, 2 q seeds in case of cowpea variety Goa cowpea-3 and 0.3 q each in case of green gram variety TM-96-2 and IPM-2-14.

The rice landraces of Goa were characterized for 39 agro-morphological characters for two years. Shannon diversity analysis showed the H index of 0.60 which indicated the existence of moderate diversity. Principal component analysis (PCA) produced four principal components (Eigen value > 1) which cumulatively accounted for 80.43 % of the total phenotypic variance. Cluster analysis grouped the genotypes into two major clusters with each cluster having three sub-clusters in each of them.

Among the thirty six rice entries of AVT-I evaluated under coastal saline conditions, top five entries with respect to grain yield were DRRH 106 (Hybrid) (3225.00 kg/ha) followed by TR-13-069 (3041.67 kg/ha), TR-09-27 (3005.56 kg/ha), GOA R 2015-IR 87848-301-2-1-3-B (2858.00 kg/ha) and FL-478 (2625.00 kg/ha). Our entry KS-12 (IET No. 25055) was promoted to AVT-II coastal salinity varietal trial.

Among the thirteen cowpea lines evaluated for yield during the rabi season, top five entries with respect to grain yield were CP-26 (1342.22 kg/ha) followed by CP-30 (1044.44 kg/ha), CP-21 (905.19 kg/ha), CP-34 (709.63 kg/ha) and CP-36 (661.48 kg/ha).

Studies on stem borers complex in cashew ecosystem revealed that around 15-20% of cashew trees were infested with CSRB in the plantations studied. Among the cerambycids, the species *Plocaederus* was the major one, with an average of 28.3 grubs found feeding in a tree. The species *Batocera rufomaculata* was also found in most of the affected trees with an average of 6 grubs/ tree. The buprestid *Belionota prasina* was found in almost all the affected trees with an average of 27.25 grubs/ tree; the grubs of all three species found from root region to up to 7 meter height. Mostly cocoons and adults of cerambycid species were found in the root and 1m above the ground region. An average of 2.40 and 2.75 cocoons of *Plocaederus spp*/tree were found in root and 1m above the ground region respectively.

Management of cashew stem and root borers showed that maximum recovery of 50% was recorded with Imidacloprid (0.01%) and Fipronil (0.005%).

Incidence of Jewel beetle *Belionota prasina* was mostly found on CSRB affected or stressed cashew trees with maximum of 132 grubs, 8 pre-pupae, 22

pupae and 61 adults collected in a single affected tree. An average of 55.8 grubs were found feeding in a single tree.

Evaluation of cue lure traps indicated that the Spherical jar + 4×1×1 cm lure has attracted more number of fruit flies *Bactrocera cucurbitae* @ 127.64/week.

Experiments on the management of *Aphis craccivora* in cowpea indicated that the least no of aphids (11.25/leaf/shoot) was recorded in STC-4 *Bacillus* biocontrol treatment.

Efficacy of different size and shape of methyl eugenol traps for mango fruit fly showed that the transparent tub + 4×1×1 cm lure has attracted more number of fruit flies (37.45/week) followed by Cylindrical white jar + 4×1×1 cm lure (33.33/week).

Management of sweet potato weevil *Cylas formicarius* with insecticides revealed that least percentage of tubers infestation (5.55) was recorded in vine dipping followed by spraying of Imidacloprid (0.009%), whereas highest percentage of tubers infestation (14.53) was recorded in control.

Experiment on integrated management of black pepper foot rot in farmers' field over a period of four years revealed that treatment with *Trichoderma* protected the black pepper plants from foot rot. The plants treated were healthy, vigorous and produced fruiting spikes early. This management strategy could be recommended for cultivation of black pepper in this region.

It was observed that LAMP PCR in water bath with agarose gel detected *R. solanacearum* from 83.80% soil samples.

Transcriptome profile of resistant and susceptible brinjal varieties challenge inoculated with *R. solanacearum* indicated several up regulated and down regulated transcripts in compatible and non-compatible interactions. SSRs were identified in the Unigenes. The GO sequence distributions were analyzed for all the three GO domains, *i.e.*, biological processes (8659), molecular functions (9210) and cellular components (6551).

Two hundred and seventy one F₆ lines of brinjal were screened for bacterial wilt resistance in greenhouse condition with *R. solanacearum* challenge inoculation. Grafting of susceptible cultivated types of brinjal and tomato on wild brinjal and other resistant root stocks (S-4 and Surya) reduced the incidence of bacterial wilt and hence this technology could be used in bacterial wilt management.

Bacillus methylotrophicus Strain RCh6-2b has

been identified as one of the promising bio-agents in suppression of various plant pathogens. The strain was identified and deposited in the national repository of NBAIM, Mau with the accession number NAIMCC-B-01889. A proposal of microbial registration has been submitted to NBAIM, Mau. *Bacillus methylotrophicus* Strain STC-4 has been identified as a plant growth promoter and is tolerant to saline conditions especially in rice. Hence, this bacterium could be used in saline soils of west coast for improved plant growth in paddy and other crops.

Synthetic medium for mass multiplication of promising bacterial bio-agents (RCh6-2b and STC-4,) was standardized. Carrier based and liquid formulation of RCh6-2b was standardized. Population in the talc formulation is over 9.0 Log CFU/g and in the liquid formulation is over 8.0 Log CFU/ml after 26 months. Population of RCh6-2b in sodium alginate formulation was above 10.0 Log CFU/ml till 22 months. The evaluation studies showed that talc, liquid and sodium alginate formulations of RCh6-2b and STC-4 improved plant growth in brinjal, tomato and other crops. Bacterial bio-agents (RCh6-2b and STC-4) improved plant growth parameters in brinjal, chilli and cowpea and reduced soil borne disease incidence in brinjal and chilli.

Horticulture Science

The research projects of horticulture science section mainly concentrate on collection, documentation and conservation of natural variability in fruit crops like banana, mango, jackfruit, kokum, plantation crops like cashew, arecanut, vegetable crops like chilli, brinjal, bhendi, amaranthus, cucurbits, spices like nutmeg, blackpepper, flower crops like jasmine, crossandra, foliage crops like caladiums, Asparagus, fern, *etc.*, evaluation and production trials on different fruits, vegetables, flowers, spices and location specific standardization of hi-tech horticultural interventions like Precision farming and protected cultivation. The section also maintains model coconut based cropping systems and medicinal plant block in the Institute. The salient findings of the research projects are furnished below.

A potential betacyanin pigment rich red amaranthus genetic stock (IC-598190) was confirmed by repeating for the second year. It was superior to Arka Arunima a released red amaranth variety. In allele mining of banana, the PCR products from eight target bands of banana were eluted, purified and sent for sequencing. One of the sequences matched with phenolic glucoside

malonyl-transferase 2-like gene located on chr. 4. One putative polyploid (AABB) plant derived from Safed Velchi (AB) was generated. One putative induced colchipooids (AABB) of Velchi (AB) banana was developed. Induced colchipooids (BBBB) of Rupa (BB) have been developed for evaluation. Half sib seedlings of a single banana plant of Rupa (BB) were planted in main field for allele mining and phenotyping experiments. A chimeric mutant of black pepper with modified leaf tip was identified and characterised. Progenies of promising pepper selections showed early and high yield. Goa Butki supari, a dwarf arecanut was selected from the progenies of Hirehalli Dwarf. Hybridization work was initiated in coconut and arecanut to develop early bearing, dwarf statured and high yielding progenies.

Three promising cashew selections namely Tiswaidi-3, Ganje-2 and KN-2/98 were approved by the State Seed Committee for releasing under the proposed names Goa Cashew -2, Goa Cashew-3 and Goa Cashew -4, for cultivation in the state of Goa. Three new accessions having bold nut (>10 g) and big apple size with higher nut yield were identified. Hybridization work was undertaken and 194 hybrid seed nuts were produced for evaluation.

A total of 135 mango Germplasm comprising of 102 local varieties (including different popular varieties), 15 introduced hybrids and 12 introduced varieties and 5 exotic varieties and one wild species was maintained. Besides, seven pickling mango accessions from Cancona, Bardez, Tiswadi and Ponda talukas were identified and samples were collected for pickling quality analysis.

Of the 18 Mankurad variants of mango under evaluation, 12 accessions flowered during the current flowering season, but only two accessions viz. MKD-1-1/1 and MKD-19-3/6 recorded the normal fruit set due to unfavourable climatic conditions.

Amrapali, Ratna and Neelgoa continued to record higher fruit yield per tree (83.2, 69.4 and 44.8 kg/tree respectively). Although fruit yield was moderate in Ratna, fruit maturity time was optimum (second week of April) as against the late maturity of fruits (first week of May) in Amrapali. Fruits of Amrapali and Ratna recorded the higher levels of TSS (22.8 °B and 21.6 °B respectively) as compared to 16.8 °B in Neelgoa with corresponding values of total acids of 0.19, 0.16 and 0.28 per cent.

In nutmeg, female dominated monoecious genotypes, namely NMD1, NMD2, NMD5, NME4 and NMF6 gave higher yield in the range of 427 (NMD-1) – 1108 (NMF-6) fruits per tree. The genotypes namely, NME3, NMF5, NMG8, etc, having equal

proportion of male and female flowers appeared to be medium yielders. Promising selections Tamsuli-1 and Tamsuli-3, continued to record higher nut yield, while Tamsuli-1 recorded the unique feature of covering the entire nut with thickly developed mace. Tamsuli-1, a bold nut selection recorded higher yield of 289 fruits per tree (at 12th year of age).

The model of coconut based multi-species cropping system of about 0.51 ha recorded coconut yield of 4889 nuts from 48 yielding palms, with an average productivity of 102 nuts per palm. About 1340 kg of banana hands were harvested, besides the income from the sales of suckers as planting material. Other high value crops like nutmeg (15.5 kg seeds and 1.89 kg dry mace), black pepper (6.7 kg) and elephant foot yam (887 kg) contributed significantly to the system. A large quantity of biomass such as Glyricidia leaves, coconut fronds, banana leaves and pseudo stem and nutmeg leaves were re-incorporated back into basins for recycling of nutrients in the system.

Jack fruit accessions from Kindelkatta (Canacona Tq) and Loutalim (Salcete Tq) were found promising for yield and quality traits with more than 50 % of edible portion. Aonla variety Krishna is highly suitable for commercial cultivation in Goa; eight year old graft yielding to a tune of maximum 200 kg per tree per year, comprising two seasons *ie* Oct and Mar-April.

There was wide variation recorded in kokum flowering in more than 100 trees studied. The trees were monoecious or dioecios or trioecious. Flowers were either male or female or bisexual with stigma lobes ranging from 1 to 8, ovary locules from rudimentary to nine, anthers from 20 to 60 numbers.

A nutrient mixture with inorganic fertilizers, organic manures and also biofertilizers has been prepared and is being tested in banana and papaya. Papaya seed treatment with 1 % CaNO₃ (soaking for 24 hours) resulted in least days taken for germination (4.75) and highest germination percentage (82.56 %) in variety Arka Prabhat.

Among the chilli varieties evaluated under drip and fertigation system, the earliest flowering was observed in Nisha (24.50 days) followed by Preeti (26.80 days). The highest fruit yield of 345 g/plant was recorded in Nisha followed by Preeti (322.50 g/plant). In Okra, mulched beds with fertigation recorded the highest yield of 0.450 g/plant compared to 0.26 g/plant under unmulched treatment.

At present, 45 types of heliconia are being evaluated as intercrop under coconut for

morphological and floral traits including economics for flower production. In general, heliconia varieties like Sexy Pink, Temptress, Lobster Claw-I and II, Golden Torch, Bihai, Kauwachi, Bucky were highly preferred varieties for floriculture purpose with a wholesale price ranging from Rs.15 to 40 per spike.

Among thirteen varieties of gerbera evaluated under naturally ventilated polyhouse for cut flower production, average number of flowers per plant ranged from 38.45 (Pre Intense) to 51.25 (Malibou) per year. Among six varieties of Orchids evaluated under shade net house, the highest number of florets was recorded in Sonia Earsakul and Charming White (15.80) followed by 15.40 in Airy Red Bull.

Tuberose cultivars Mexican single, Suvasini and Pearl Double were found suitable for commercial cultivation in Goa. Pulsing solution comprising of 8HQS@200 ppm + GA3 @25 ppm + AgNO3 @ 50 ppm + Citric acid @50 ppm + Sucrose 3 % recorded the highest shelf life. Nerium types performed well with vase life ranging from 4 to 10 days. Suitability of Caladium as a foliage plant for shady areas in high rainfall zone like Goa has been established. Nearly 15 fern types are being evaluated in the Institute for suitability as cut foliage. A conservatory of medicinal plants with 27 medicinal herb, 24 medicinal shrubs, 17 medicinal trees and six medicinal climbers is being maintained in the Institute which also acts as a repository of useful information on all these species.

Single span and double span greenhouses modified to suit the high rainfall and high humidity Western Coastal ecosystem were evaluated with Cucumber and Tomato crops respectively. The results showed very positive effect of the modifications on the microclimate of the structures. In case of double-span greenhouses with most of the modifications incorporated, the temperature was maintained between 21.48 ± 3.02 to 33.87 ± 4.00 °C which was in tune with the recommended optimum temperature of 20 - 35 °C for a tomato crop and day time humidity between 60.66 ± 14.66 % to 79.58 ± 11.24 % when fans were operated and night humidities when fan was not operated between 84.93 ± 8.23 % to 95.15 ± 3.59 %. A microcontroller based automated operation of the various interventions viz., Horizontal Axial Flow fans (HAFs), Ventilating fans and shade net could have a better control of microclimate and energy efficiency.

For a single-span greenhouse with only HAFs, 25.71 ± 1.36 °C to 31.53 ± 4.30 °C was recorded for most of the crop season, falling in line with recommended range of 15-32 °C for cucumber. But the humidity could not be maintained in the optimum range of 45-60%. This could be attributed

to absence of fans and hence either side vents opening or introduction of ventilating fans could be a better option for climate control.

Animal Sciences

Research in animal science is on conservation and improvement of indigenous dairy cattle, pigs, buffalo and poultry breeds, development of diagnostic assays and molecular epidemiology of important diseases of livestock and standardising scientific dairy, piggery, goat and poultry farming practices for coastal region.

The boar semen extender (NBSE) for the preservation of pig semen was developed and evaluated. NBSE patent was published in Patent Journal of India and the commercialization has been initiated in collaboration with Agrinnovate India Ltd.

Baseline information on status of goat breeds and population of goats was assessed in west coastal India. Multiplex PCR assay was standardized to diagnose *E. coli* non O157:H7 strains targeting *stx1*, *stx2*, *EaeA*, *hlyA*, *Flic* and *rfB* virulence genes and out of 50 isolates, 24 isolates showed presence of virulence genes which indicated that *E. coli* non O157:H7 enteropathogenic strains were responsible for causing severe enteritis and diarrhoea in young goats. Pulse field gel electrophoresis (PFGE) method was standardized to characterize *E. coli* non O157:H7 enteropathogenic strains from goat origin. A total of 211 sera samples from North and South Goa were screened for IBR and FMD in dairy cattle, PPR and Brucellosis in goats and Classical Swine fever in pigs. The sero-prevalence of Infectious bovine Rhinotrachitis (IBR) of 19.76% (88/19) in dairy cattle was recorded. Rapid assay for detection of Bovine papilloma virus (BPV-1 and BPV-2) in dairy cattle was developed and sequence was published. Autogenous vaccine therapy was standardized for effective treatment of bovine papillomatosis in dairy cattle.

Morbidity and mortality of institute livestock was evaluated and lowest mortality (<2%) was documented in the institute farms. Stall feeding of Konkankanyal goat was standardized and evaluation of performance showed significant improvement of body weight at the age of 8 months (38 kg in males and 32 kg in female goats). Survey, documentation and registration of Shweta Kapila, a local indigenous dairy cattle from Goa state was initiated and A2 milk protein gene was characterized.

Prevalence of pig associated zoonotic pathogens from Goa and Maharashtra (Mumbai) was carried out and examination of 182 carcasses revealed lowest prevalence of hydatid disease.

Mastitis pathogens in dairy cattle mainly Coagulase positive *Staphylococcus aureus* and mycotic mastitis was diagnosed by isolation and PCR identification. Retrospective analysis of breeding performance in dairy buffaloes along with monitoring of different bio-meteorological factors in relation to reproductive performance under coastal climatic conditions was initiated. An experiment was undertaken to compare the efficacy of different prostaglandin analogue- based synchronization and re-synchronization protocols on overall reproductive performance in local and crossbred dairy cattle.

The growth performance and mortality pattern of Gramapriya and Srinidhi parent stock (total 1008 birds) procured from ICAR- DPR, Hyderabad was evaluated. The egg production at 32 weeks was 1236 eggs and the hen day egg production percentage was 32.94%.

Fishery Science

Research projects are focused mainly on fisheries resource management in coastal waters using artificial fish habitats and sustainable coastal aquaculture systems. Artificial Fish Habitats (AFH) of RCC were constructed and deployed and a total of

50 species were counted on AFH and the maximum abundance of *Heniochus acuminatus*, *Halichoeres nigrescens*, *Lutjanus russelli*, *L. fulvus*, *L. lutjanus*, *Pomadasys furcatus*, *Acanthurus blochii* and *P. chubbi* was noted. The species diversity and abundance were higher at deeper AFH with more of trophic guilds like mobile invertebrate feeders, omnivores and carnivores, oysters, sponges and ascidia etc. the favourable habitat characteristics in terms of vertical relief, upper column free of obstacles and deeper shelter habitats must have attracted the communities more towards the deeper AFH.

A mass balance trophic model was constructed for the semi-enclosed aquaculture system and provided useful information about ecosystem features of the ecosystem. The estimated ecosystem indices were generally high for the ecosystem in comparison with the values obtained for the major aquatic ecosystems of the world. From the results of the simulations for a period of 10 years using Ecosim, it was inferred that a battery of two cages for red snapper and two cages of pearlspot with 20 mussel ropes was considered as an optimal solution for coastal aquaculture in the semi-enclosed system.

कार्यकारी सारांश

भाकृअनुप-केन्द्रीय तटीय कृषि अनुसंधान संस्थान (ICAR -CCARI), गोवा में पांच कार्यपरक संभागों : प्राकृतिक संसाधन प्रबंधन; फसल विज्ञान; बागवानी विज्ञान; पशु विज्ञान; एवं मात्स्यिकी विज्ञान के अंतर्गत सामरिक एवं प्रायोगिक अनुसंधान किया जाता है। वर्ष 2016-17 के लिए संस्थान की प्रमुख अनुसंधान उपलब्धियों को नीचे प्रस्तुत किया गया है :-

प्राकृतिक संसाधन प्रबंधन

यह संभाग उपयुक्त मृदा एवं जल संरक्षण उपायों का विकास एवं मूल्यांकन, क्षेत्र विशिष्ट एकीकृत कृषि प्रणाली मॉडलों के विकास, तटवर्ती मृदा लवणता का आकलन एवं प्रबंधन, स्थान विशिष्ट पोषक तत्व प्रबंधन; तटवर्ती क्षेत्र का सामाजिक-आर्थिक आकलन एवं मौसम आधारित फसल उपज पूर्वानुमानों के लिए फसल अनुकरण मॉडलिंग जैसे विभिन्न अनुसंधान परियोजनाओं के माध्यम से भूमि एवं जल जैसे प्राकृतिक संसाधनों का विवेकपूर्ण प्रबंधन पर केन्द्रित अनुसंधान कर रहा है।

आम में निरन्तर समोच्च ट्रेन्चिंग + शाकीय अवरोध (VB) (*वर्टीवेरिया जिजेनॉइड्स*) (CCT + VB) और नारियल में वृत्ताकार ट्रेन्चिंग करने से अनुपचार तथा आजमाए गए अन्य मृदा एवं जल संरक्षण उपायों के मुकाबले में मृदा का कटाव और अपवाह नुकसान में उल्लेखनीय रूप से कमी आई।

अधिकतम अंतः स्पंदन दह (73.2 सें.मी. प्रति हेक्टेयर) एवं क्षेत्र नदी धारण क्षमता आम के प्लॉट में निरन्तर समोच्च ट्रेन्चिंग + शाकीय अवरोध (VB) (*वर्टीवेरिया जिजेनॉइड्स*) (CCT + VB) के 60-90 सें.मी. गहराई में पाई गई। इसी तरह नारियल में वृत्ताकार खाइयों में अधिकतम अंतः स्पंदन दह (21.1 सें.मी. प्रति हेक्टेयर) एवं क्षेत्र नदी धारण क्षमता 30-60 सें.मी. गहराई में पाई गई।

खेत परिस्थितियों में लवणता सहिष्णु जीवाणु (*बैसिलस मिथाइलोड्राॉफिकस* स्ट्रेन STC - 4) का बुवाई के समय और बुवाई के 7 दिन उपरान्त अनुप्रयोग करने से क्रमशः 1.19 एवं 1.615 टन प्रति हेक्टेयर दाना एवं पुआल उपज हासिल की जा सकी जबकि इसकी तुलना में अनुपचार के तहत यह क्रमशः 0.91 एवं 1.578 टन प्रति हेक्टेयर ही हासिल की जा सकी। नर्सरी प्रबंधन में 25 ग्राम प्रति वर्ग मीटर बीज घनत्व, N:P:K @ 50:30:15 किग्रा. प्रति हेक्टेयर और *बैसिलस मिथाइलोड्राॉफिकस* स्ट्रेन STC - 4 का बीज बुवाई एवं सात दिन बाद अनुप्रयोग करके उच्चतम पौध ओज सूचकांक वाली पौध विकसित हुईं। महाराष्ट्र एवं गोवा के तटवर्ती जिलों से तटीय लवणीय मृदाओं में अम्लीय मृदा प्रतिक्रिया (7.0) तथा उच्च मृदा लवणता (औसत विद्युत चालकता EC (1 : 2.5) = 13.55 dS/m तथा ECE = 24 - 66 dS/m) की सह-मौजूदगी पाया गया। इन स्थानों की मृदा में उपलब्ध नाइट्रोजन की कमी तथा फॉस्फोरस व पोटासियम की पर्याप्तता देखने को मिली।

दो पशु आधारित तथा फसल आधारित एकीकृत कृषि प्रणाली वाले गांवों, सुरला एवं इब्राहिमपुर में तकनीकी एवं मानव संसाधन विकास निवेशों के द्वारा कृषिरत महिलाओं का आत्मविश्वास में बढ़ोतरी पाई गई।

महाराष्ट्र, गोवा, कर्नाटक एवं केरल के दस तटवर्ती जिलों में चावल तथा नारियल के लिए मौसम आधारित सांख्यिकीय फसल उपज पूर्वानुमान मॉडल विकसित किए गए। मापांकन मॉडल्स का प्रदर्शन अच्छे से बहुत अच्छा पाया गया। चावल में R^2 तथा RMSE क्रमशः 0.62 - 0.94 एवं 67.70-253.01 किग्रा. प्रति हेक्टेयर के बीच पाए गए जबकि नारियल के लिए क्रमशः 0.43-0.94 एवं 30.0-2888.4 गिरी प्रति हेक्टेयर पाए गए। उत्तरी गोवा जिले के लिए विकसित इस मॉडल का प्रमाणन में उत्पन्न वर्ष 2016 के लिए चावल की पूर्वानुमान उपज 2.48 टन प्रति हेक्टेयर पाई गई जबकि वास्तविक उपज 2.81 टन प्रति हेक्टेयर थी, 11.87 प्रतिशत की भिन्नता देखने को मिली।

गोवा की विशिष्ट निचली भूमि परिस्थितियों के लिए 0.5 हेक्टेयर क्षेत्रफल में एक चावल आधारित एकीकृत कृषि प्रणाली (IFS) मॉडल (फसल-पशुधन) का मूल्यांकन किया गया। मॉडल में ₹1.05 लाख का शुद्ध लाभ दर्ज किया गया जिसमें सबसे अधिक योगदान चावल-मिर्च-डेयरी प्रणाली (72 प्रतिशत) एवं तदुपरान्त चावल-लोबिया-डेयरी (11 प्रतिशत) का था। प्रणाली का लाभ : लागत अनुपात 0.94, उच्चतर ऊर्जा आउटपुट (33815.2 MJ प्रति हेक्टेयर), ऊर्जा उपयोग प्रभावशीलता (2.0), ऊर्जा लाभप्रदता (1-0 MJ प्रति हेक्टेयर) तथा मानव ऊर्जा उत्पादकता (8.2) दर्ज की गई। अतः चावल-मिर्च-डेयरी प्रणाली का एकीकरण कहीं अधिक लाभप्रद पाया गया जिसमें कहीं अधिक रोजगार उत्पन्न करने और ऊर्जा प्रभावी होने की संभावना है।

विभिन्न बागवानी आधारित कृषि प्रणालियों में, काजू + अनानास में उच्चतर निवल लाभ (₹ 0.18 लाख) एवं तदुपरान्त सुपारी + केला (₹ 0.17 लाख) एवं शूकर पालन का योगदान (38 प्रतिशत)-उच्चतर निवल लाभ (₹ 0.34 लाख) पाया गया। उच्चभूमि में स्थित बागवानी आधारित कृषि प्रणाली के माध्यम से 0.79 हेक्टेयर क्षेत्र से ₹ 0.89 लाख निवल लाभ, तथा लाभ लागत अनुपात 1.25 पाया गया।

चावल-चावल प्रणाली में जांचे गए विभिन्न पोषक तत्वों में नीम लेपित यूरिया के माध्यम से 100 प्रतिशत नाइट्रोजन में वृद्धि एवं उपज पैरामीटर यथा पौधा ऊंचाई (100.3 से.मी.); दोजियों की संख्या प्रति वर्ग मीटर (286); पुष्पगुच्छ/वर्ग मीटर की संख्या (207); पुष्पगुच्छ लंबाई (22.7 सेमी);

दाना/पुष्पगुच्छ (129) तथा दाना उपज (5.06 टन प्रति हेक्टेयर) आदि उल्लेखनीय रूप से कहीं ज्यादा पाए गए जबकि कमतर मान अनुपचारित प्लॉटों में दर्ज किए गए।

फसल विज्ञान

इस विभाग के अनुसंधान कार्य चावल एवं लोबिया जैसे क्षेत्र फसलों की सुधार, बागवानी एवं क्षेत्र फसलों के कीट और रोग प्रबंधन पर केन्द्रित हैं। संभाग के महत्वपूर्ण उपलब्धियां निम्नलिखित हैं।

दो उच्च उपजशील लवणता सहिष्णु धान किस्मों यथा गोवा धान-1 (KS-12) तथा गोवा धान-2 (KS-17) को विकसित किया गया तथा जनवरी, 2017 में राज्य के किस्म निर्मुक्ति समिति (SVRC) द्वारा गोवा राज्य में इन्हें खेती के लिए जारी किया गया। नए प्रजनन वंशक्रमों/किस्मों में अधिकतम दाना उपज वंशक्रम JK-58 (3260.00 किग्रा. प्रति हेक्टेयर) में एवं तदुपरान्त JK-238 (3113.33 किग्रा. प्रति हेक्टेयर); JK-84 (3086.67 किग्रा. प्रति हेक्टेयर); JK-86 (3040 किग्रा. प्रति हेक्टेयर); एवं JK-156 (2946.67 किग्रा. प्रति हेक्टेयर) में दर्ज की गईं। नए प्रजनन वंशक्रमों को उत्पन्न करने के लिए, उच्च उपजशील लवणता संवेदी एवं कम उपजशील सहिष्णु वंशक्रमों को शामिल करते हुए विभिन्न क्रॉस के प्रयास किए गए। वर्तमान वर्ष के दौरान, विभिन्न संकर से उत्पन्न F4 पीढ़ियों का स्थिरीकरण के लिए पुनः प्रोन्नत किया गया।

खरीफ 2016 के दौरान पौद अवस्था में लवणीय दबाव सहिष्णुता के लिए कुल 59 धान जननद्रव्यों की स्क्रीनिंग सूक्ष्म प्लॉट परिस्थितियों (12 dS/m की विद्युत चालकता का लवणीय दबाव) में की गईं। इन जननद्रव्यों में शामिल थीं : 20 प्रजातियां, 23 वन्य धान, 8 प्रगत प्रजनन वंशक्रम, 6 उन्नत किस्में, एवं 2 तुलनीय किस्में (सहिष्णु पोक्काली, संवेदनशील IR-29)। जीनप्ररूपों में कोरगुट, KS-17 तथा WR-18 2-3 के SES स्कोर 2-3 के साथ अत्यधिक सहिष्णु (HT) पाए गए तथा KS-4, KS-12, KS-16-1, KS-19-2 एवं कग्गा 3 के SES स्कोर के साथ सहिष्णु (T) पाए गए।

विभिन्न NARS भागीदारों द्वारा लवणीय एवं क्षारीय परिस्थितियों के लिए विकसित 66 धान संवर्धनों का मूल्यांकन उत्तरी गोवा जिले के चोडन गाव में किसानों के खेतों पर तटवर्ती लवणीय परिस्थिति के तहत किया गया। अधिकतम दाना उपज CR3883-M-3-1-5-3-1-1 (3130.91 किग्रा. प्रति हेक्टेयर) में तदुपरान्त क्रमशः CSR-C27SM-117 (2425.25 किग्रा. प्रति हेक्टेयर); JK-5 (2356.36 किग्रा. प्रति हेक्टेयर); CSR-2748-4441-66(2280.00 किग्रा. प्रति हेक्टेयर) तथा CSR-2748-4441-133 (2258.18 किग्रा. प्रति हेक्टेयर) में दर्ज की गईं।

कुल मिलाकर, चावल, लोबिया और मूंग में 11 क्विंटल बीज उत्पन्न किया गया जिसमें धान-ज्योति एवं करजत-3 में लगभग 7 क्विंटल बीज, वाइटिला में 1 क्विंटल, लोबिया किस्म गोवा चवली-3 में 2 क्विंटल बीज और मूंग की किस्में TM-96-2 एवं IPM-2-14 में 0.3 क्विंटल बीज उत्पन्न किया गया।

गोवा की धान किस्मों का लक्षणवर्णन दो वर्षों के लिए 39 कृषि संबंधी आकृति मूलकों के लिए किया गया। वर्तमान वर्ष में, विविधता का अध्ययन करने के लिए आंकड़ों का संकलन एवं विश्लेषण किया गया।

शैलन विविधता विश्लेषण में 0.60 H सूचकांक से संतुलित विविधता की मौजूदगी का पता चला। प्रधान संघटक विश्लेषण (PCA) द्वारा चार प्रधान संघटक (आईगन मान >1) उत्पन्न किए गए जो कि कुल समलक्षणी भिन्नता का 80.43 प्रतिशत माप थे। क्लस्टर विश्लेषण द्वारा तीन प्ररूपों को दो प्रमुख क्लस्टरों में वर्गीकृत किया गया जिसमें प्रत्येक क्लस्टर में तीन-तीन उप-क्लस्टर थे।

तटवर्ती लवणीय परिस्थितियों के अंतर्गत AVT-1 की 36 धान प्रविष्टियों का मूल्यांकन किया गया, जिनमें प्रमुख दान उपज वाले प्रविष्टियां : DRRH 106 (संकर) (3225.00 किग्रा. प्रति हेक्टेयर); TR-13-069 (3041.67 किग्रा. प्रति हेक्टेयर); TR-09-27 (3005.56 किग्रा. प्रति हेक्टेयर.); गोवा R 2015-IR 87848-301-2-1-3-बी (2858.00 किग्रा. प्रति हेक्टेयर) एवं FL-478 (2625.00 किग्रा. प्रति हेक्टेयर)। हमारी प्रविष्टि KS-12 (IET संख्या 25055) को AVT-II तटीय लवणता किस्मीय परीक्षण में प्रोन्नत किया गया।

रबी मौसम के दौरान, धान परती परिस्थिति के अंतर्गत 13 लोबिया के वंशक्रमों का मूल्यांकन किया गया। दाना उपज के संबंध में क्रमशः पांच शीर्ष प्रविष्टियां हैं: CP-26 (1342.22 किग्रा. प्रति हेक्टेयर); CP-30 (1044.44 किग्रा. प्रति हेक्टेयर); CP-21 (905.19 किग्रा. प्रति हेक्टेयर); CP-34 (709.63 किग्रा. प्रति हेक्टेयर) एवं CP-36 (661.48 किग्रा. प्रति हेक्टेयर)।

काजू की पारिस्थितिकी प्रणाली में तना एवं जड़ छिद्रक अथवा बेधक (CSR) जटिलता पर किए गए अध्ययनों में पता चला कि अध्ययन किए गए फलोद्यानों में लगभग 15-20 प्रतिशत काजू वृक्ष CSR से संक्रमित हैं। सिरामबायसिड में, सबसे प्रमुख प्रजाति प्लोसीडेरस थी जिसमें एक वृक्ष पर औसतन 28.3 ग्रब पाए गए। अधिकांश संक्रमित वृक्षों में प्रजाति *बेटोसेरा रूफोमैकुलेटा* 6 ग्रब प्रति वृक्ष की औसत के साथ पाई गईं। सभी संक्रमित वृक्षों में बुपरेस्टिड बेलियोनोटा प्रैसिना 27.25 ग्रब प्रति वृक्ष की औसत के साथ पाई गईं। तीनों प्रजातियां जड़ क्षेत्र से 7 मीटर ऊंचाई तक पाई गईं। सिरामबायसिड प्रजाति के अधिकांश कृमिकोष और वयस्क जड़ क्षेत्र में एवं भूमि क्षेत्र से 1 मीटर ऊपर पाए गए। प्लोसीडेरस उप प्रजाति प्रति वृक्ष से औसतन 2.40 व 2.75 कृमिकोष क्रमशः जड़ क्षेत्र में तथा भूमि की सतह से 1 मीटर ऊपर वाले क्षेत्र में पाए गए।

काजू में तना एवं जड़ छिद्रक अथवा बेधक का प्रबंधन में इमिडाक्लोरपिड (0.01 प्रतिशत) तथा फिप्रोनिन (0.005 प्रतिशत) के उपचार से 50 प्रतिशत से अधिकतम पेड़ों का बचाव देखने को मिला।

ज्वेल भृंग बेलियोनोटा प्रैसिना का प्रकोप अथवा आपतन अधिकांशतः CSR संक्रमित अथवा दबावग्रस्त काजू वृक्षों पर पाया गया जहां अकेले संक्रमित वृक्ष में अधिकतम 132 ग्रब, 8 पूर्व-प्यूपा, 22 प्यूपा और 61 वयस्कों को संकलित किया गया। एकल वृक्ष पर औसतन 55.8 ग्रब पलते हुए पाए गए।

प्रलोभन ट्रैप का मूल्यांकन करने पर पता चला कि गोलाकार जार + 4 x 1 x 1 से.मी. प्रलोभन में सबसे अधिक संख्या में फल मक्खी बैक्ट्रोसिरा कुकुरबिटे /127.64/सप्ताह आकर्षित हुईं।

लोबिया में एफिस कैंक्सीवोरा के प्रबंधन पर किए गए प्रयोगों में पता चला कि STC-4 बैसिलस जैव नियंत्रण फार्मुलेशन में एफिड की सबसे कम संख्या (11.25/पत्ती/प्ररोह) दर्ज की गई।

आम फल मक्खी के लिए मिथाइल यूगेनॉल ट्रेप के विभिन्न आकार व आकृति की प्रभावशीलता में प्रदर्शित हुआ कि पारदर्शी टब + 4 x 1 x 1 सेमी. प्रलोभन में सबसे अधिक संख्या में फल मक्खी (37.45/सप्ताह) आकर्षित हुई जबकि तदुपरान्त बेलनाकार सफेद जार + 4 x 1 x 1 सेमी. प्रलोभन (33.33/सप्ताह) में फल मक्खी आकर्षित हुई।

कीटनाशकों के साथ शकरकंदी घुन साइलैस फॉर्मिकेरियस की रोकथाम करने पर पता चला कि बुवाईपूर्व बेल को इमिडाक्लोप्रिड (0.009 प्रतिशत) में डुबाने एवं तदुपरान्त छिड़काव करने पर सबसे कम कंद संक्रमण (5.55 प्रतिशत) देखने को मिला जबकि सबसे अधिक कंद संक्रमण (14.53 प्रतिशत) अनुपचार में पाया गया।

चार वर्षों तक किसानों के खेतों में काली मिर्च में फुट रॉट का एकीकृत प्रबंधन पर किए गए प्रयोग में पता चला कि जैव एजेन्टों के साथ उपचार करने पर काली मिर्च को फुट रॉट रोग से बचाया जा सका। जैव एजेन्टों से उपचारित पौधे स्वस्थ, ओजपूर्ण हैं और उनमें जल्दी ही फल स्पाइक उत्पन्न हुई। इस प्रबंधन रणनीति की सिफारिश इस क्षेत्र में काली मिर्च की खेती के लिए की जा सकती है।

एगरोज जेल के साथ वॉटर बॉथ में LAMP PCR द्वारा 83.80 प्रतिशत मृदा नमूनों से *R. सोलानेसियेरम* का पता लगाया गया।

R. सोलानेसियेरम के साथ टीकाकृत प्रतिरोधी एवं सुग्राह्यशील बैंगन किस्मों की ट्रांसक्रिप्टोम प्रोफाइल से संगत तथा गैर संगत पारस्परिकता में अनेक उर्ध्व निगमित एवं अधो निगमित ट्रांसक्रिप्ट्स का पता चला। SSR की पहचान यूनीजीन्स में की गई। तीनों GO डोमेन, यथा जैविक प्रक्रिया (8659), आणविक कार्य (9210) तथा सेलुलर संघटक (6551) के लिए GO अनुक्रम वितरण का विश्लेषण किया गया।

बैंगन के 271 F6 वंशक्रमों की स्क्रीनिंग *R. सोलानेसियेरम* चुनौती टीकाकरण के साथ ग्रीनहाउस परिस्थिति में जीवाण्विक मुरझान प्रतिरोधिता के लिए की गई। वन्य बैंगन तथा अन्य प्रतिरोधी मूलवृत्तों (S-4 एवं सूर्या) पर बैंगन तथा टमाटर की सुग्राह्यशील कृष्ट किस्मों का कलम-बंधन करने पर जीवाण्विक मुरझान का प्रकोप कम हुआ और इसलिए इस प्रौद्योगिकी का उपयोग जीवाण्विक मुरझान प्रबंधन में किया जा सकता है।

बैसिलस मिथाइलोड्रॉफिकस स्ट्रेन RCh6-2b की पहचान विभिन्न पादप रोगजनकों के दमन में एक आशाजनक जैव एजेन्ट के रूप में की गई है। इस स्ट्रेन की पहचान की गई और इसे भाकृअनुप - राष्ट्रीय कृषि उपयोगी सूक्ष्मजीव ब्यूरो (ICAR - NBAIM), मरु की राष्ट्रीय रिपोजिट्री में प्राप्ति संख्या NAIMCC-B-01889 के साथ जमा कराया गया। सूक्ष्मजीव पंजीकरण का प्रस्ताव भाकृअनुप - राष्ट्रीय कृषि उपयोगी सूक्ष्मजीव ब्यूरो (ICAR - NBAIM), मरु को प्रस्तुत किया गया है। बैसिलस मिथाइलोड्रॉफिकस स्ट्रेन STC-4 की पहचान एक पादप वृद्धि प्रोमोटर के रूप में की गई और यह लवणीय परिस्थितियों का सहिष्णु है, खासकर धान में। अतः इस बैक्टीरियम का उपयोग धान तथा अन्य फसलों

में पौधा बढ़वार सुधार हेतु पश्चिमी तट की लवणीय मृदाओं में किया जा सकता है।

आशाजनक जीवाण्विक जैव एजेन्टों (RCh 6 – 2b तथा STC-4) के व्यापक गुणनीकरण हेतु कृत्रिम मीडियम का मानकीकरण किया गया। कृत्रिम अथवा सिंथेटिक मीडियम में संख्या अनुपचार मीडियम के समतुल्य थी और इसलिए इस मीडियम का इस्तेमाल व्यापक गुणनीकरण के लिए किया जा सकता है। RCh 6. 2b के वाहक आधारित तथा तरल फार्मुलेशन का मानकीकरण किया गया। 26 महीनों के बाद पाउडर फार्मुलेशन एवं तरल फार्मुलेशन में संख्या क्रमशः 9.0 लॉग CFU/ग्राम तथा 8.0 लॉग CFU/ग्राम से ज्यादा पाई गई। 22 महीनों तक सोडियम एल्मीनेट फार्मुलेशन में RCh 6 – 2b की संख्या 10.0 लॉग CFU/मि. लि. से अधिक थी। मूल्यांकन अध्ययनों में प्रदर्शित हुआ कि RCh 6 – 2b तथा STC-4 के पाउडर, तरल एवं सोडियम एल्मीनेट फार्मुलेशनों से बैंगन, टमाटर व अन्य फसलों में पौधा बढ़वार में सुधार आया। जीवाण्विक जैव-एजेन्टों (RCh6 – 2b तथा STC-4) द्वारा बैंगन, मिर्च एवं लोबिया में पौधा बढ़वार पैरामीटरों में सुधार लाया गया जबकि बैंगन और मिर्च में मृदाजनित रोग प्रकोप में कमी लाई गई।

बागवानी विज्ञान

बागवानी विज्ञान संभाग की अनुसंधान परियोजनाएं मुख्यतः केला, आम, कटहल, कोकुम जैसी फलदार फसलें काजू, सुपारी जैसी रोपण फसलें; मिर्च, बैंगन, भिण्डी, चौलाई, खीरावर्गीय जैसी शाकीय फसलें; जायफल व काली मिर्च जैसी मसाला फसलें; जैस्मिन, कासैन्डा जैसी पुष्पीय फसलें; एवं कलैडियम, एस्पैरेगस व फर्न आदि जैसी पर्णय फसलें की प्राकृतिक विविधता के संकलन, प्रालेखन एवं संरक्षण, विभिन्न फलों, सब्जियों, फूलों व मसालों का मूल्यांकन एवं उत्पादन परीक्षण, स्थान-विशिष्ट हाय-टेक बागवानी हस्तक्षेपों जैसे की सटीक एवं संरक्षित खेती पर केन्द्रित हैं। इसके अलावा बागवानी विज्ञान संभाग द्वारा संस्थान में मॉडल नारियल आधारित फसल प्रणाली और औषधीय पौधा ब्लॉक का रख-रखाव भी किया जाता है। अनुसंधान परियोजनाओं के प्रमुख परिणाम नीचे प्रस्तुत हैं।

दूसरे वर्ष के लिए पुनरावृत्ति करके एक क्षमताशील बीटासायनिन रंग से भरपूर लाल चौलाई आनुवंशिक स्टॉक (IC – 598190) की पुष्टि की गई। यह लाल चौलाई के रूप में जारी की गई किस्म अर्का अरुणिमा से बेहतर पाया गया। केले की विकल्प माइनिंग में, केले के आठ लक्षित बैण्ड्स में से PCR उत्पादों को हटा कर शुद्धीकृत करके अनुक्रमण के लिए भेजा गया। इनमें से एक अनुक्रम का मिलान chr.4 पर स्थित फिनोलिक ग्लूकोसाइड मैलोनिल-ट्रांसफिरेज 2 – लाइक जीन के साथ हुआ। सफेद वेल्ची (AB) से एक कल्पित पॉलीप्लॉइड (AABB) पौधा उत्पन्न किया गया। वेल्ची (AB) केले का एक कल्पित उत्प्रेरित कोल्चीप्लॉइड्स (AABB) को विक. सित किया गया। रूपा (BB) के उत्प्रेरित कोल्चीप्लॉइड्स (BBBB) का विकास मूल्यांकन के लिए किया गया। विकल्प माइनिंग एवं समलक्षणी परीक्षणों के लिए रूपा (BB) के एकल केला पौधे की अर्ध-सहोदर पौधे का रोपण मुख्य खेत में किया गया। संशोधित पत्ती सिरा के साथ काली मिर्च के काइमेरिक उत्परिवर्ती की पहचान एवं लक्षणवर्णन किया गया। आशाजनक काली मिर्च सेलेक्शन की संततियों में अगेती एवं उच्च उपज प्रदर्शित हुई। एक बौनी सुपारी, गोवा बुटकी सुपारी को हिरेहल्ली ड्वार्फ

की संततियों से चुना गया। नारियल तथा सुपारी में संकरण कार्य प्रारंभ किया गया ताकि अगेती फलन, बौनी संरचना व उच्च उपजशील संततियों का विकास किया जा सके।

राज्य बीज समिति द्वारा काजू के तीन आशाजनक सेलेक्शन नामतः तिसवाडी-3, गांजे-2 एवं KN-2/98 को गोवा राज्य में प्रस्तावित नामों, क्रमशः गोवा कैश्यू-2, गोवा कैश्यू-3 तथा गोवा कैश्यू-4 के साथ खेती के लिए जारी करने का अनुमोदन किया गया। उच्चतर गिरी उपज के साथ बड़ी गिरी (> 10 ग्राम) एवं बड़े फल आकार वाली तीन नई प्राप्तियों की पहचान की गई। संकरण कार्य किया गया और मूल्यांकन के प्रयोजन हेतु 194 संकर बीज गिरी उत्पन्न की गई।

एक सौ दो स्थानीय किस्मों (विभिन्न प्रचलित किस्मों सहित), क्षेत्र के लिए प्रस्तावित गए 15 संकरों एवं 12 किस्मों तथा 5 विदेशी किस्मों एवं एक वन्य प्रजाति को शामिल करके कुल 135 आम जननद्रव्य का रख-रखाव किया गया है। इसके अलावा, कनकोना, बारडेज, तिसवाडी एवं पोंडा तालुका से अचार प्रयोजन हेतु सात आम प्राप्तियों की पहचान की गई और नमूनों का संकलन अचार गुणवत्ता विश्लेषण के लिए किया गया।

मूल्यांकन किए गए आम के कुल 18 मनकुराद परिवर्त में से वर्तमान पुष्पन मौसम के दौरान 12 प्राप्तियों में पुष्पन हुआ लेकिन प्रतिकूल जलवायु के कारण केवल दो प्राप्तियों यथा MKD-1-1/1 एवं MKD-19-3/6 ने सामान्य फल स्थापन दर्ज किया।

हर वर्ष की तरह आम्रपाली, रत्ना एवं नीलगोवा किस्मों में प्रति वृक्ष उच्चतर फल उपज (क्रमशः 83.2, 69.4 एवं 44.8 किग्रा. प्रति वृक्ष) दर्ज करना जारी रहा। हालांकि, रत्ना किस्म में फल उपज संतुलित थी और आम्रपाली में पछेती फल परिपक्वता (मई का प्रथम सप्ताह) की तुलना में फल परिपक्वता समय इष्टतम (अप्रैल का दूसरा सप्ताह) था। आम्रपाली एवं रत्ना के फलों में क्रमशः 0.19 एवं 0.16 प्रतिशत के कुल अम्ल मान के साथ कुल घुलनशील ठोस पदार्थ का उच्चतर स्तर (क्रमशः 22.80 ब्रिक्स एवं 21.60 ब्रिक्स) पाया गया जबकि इसकी तुलना में नीलगोवा में 0.28 प्रतिशत कुल अम्ल एवं घुलनशील ठोस पदार्थ 16.80 ब्रिक्स था।

जायफल में, मादा प्रभुत्व वाले उभयलिंगाश्रयी जीन प्ररूपों नामतः NMD1, NMD2, NMD5, NME4 तथा NMF6 में 427 (NMD1)-1108 (NMF6) फल प्रति वृक्ष की भिन्नता में उच्चतर उपज हासिल हुई। नर तथा मादा फूलों के समान अनुपात वाले जीन प्ररूपों नामतः NME 3, NMF5, NMG8 आदि मध्यम उत्पादक पाए गए। आशाजनक सेलेक्शन नामतः तामसुली-1 एवं तामसुली-3 में अधिक गिरी उपज दर्ज करना जारी रहा जबकि तामसुली-1 में सघन विकसित एवं सम्पूर्ण गिरी को ढकने वाली जावित्री जैसी अनूठी विशेषताएँ दर्ज की गईं। तामसुली-1, एक बड़ी गिरी वाला सेलेक्शन, में बारहवें वर्ष के दौरान 289 फल प्रति वृक्ष की उच्चतर उपज दर्ज की गई।

लगभग 0.51 हेक्टेयर में नारियल आधारित बहु-प्रजाति फसल प्रणाली मॉडल में प्रति ताड़ 102 गिरी की औसत उत्पादकता के साथ 48 उपजशील ताड़ से 4889 गिरी की नारियल उपज दर्ज की गई। लगभग 1340 किग्रा. केला गुच्छों की तुड़ाई की गई और साथ ही रोपण सामग्री के तौर पर सकर्स (अंकुरों) की बिक्री करके आय सृजित की गई। प्रणाली में

अन्य उच्च मूल्य वाली फसलों यथा जायफल (15.5 किग्रा. बीज एवं 1.89 किग्रा. सूखा जावित्री); काली मिर्च (6.7 किग्रा.) तथा जिमिकंद (887 किग्रा.) का योगदान उल्लेखनीय था। प्रणाली में पोषक तत्वों की पुनारावृत्ति के लिए ग्लाइरीसीडिया पत्तियों, नारियल के फ्रॉण्ड्स, केले की पत्तियों तथा छद्मतना व जायफल की पत्तियों जैसे जैविक पदार्थों को बड़ी मात्रा में बेसिन में पुनः शामिल किया गया।

प्राकृतिक रूप से मौजूद, मूल रूप से पौद से उत्पन्न एवं संकर परागित कटहल के वृक्षों का अध्ययन किया गया। अतः वृक्ष एवं फल विशेषताओं में व्यापक भिन्नता देखने को मिली। किन्डेलकट्टा (कनकोना तालुका) तथा लोटालिम (सालसेत तालुका) की प्राप्तियां 50 प्रतिशत से भी अधिक खाने योग्य अंश के साथ उपज एवं गुणवत्ता विशेषताओं के लिए आशाजनक पाई गईं। आंवला की किस्म, कृष्णा व्यावसायिक खेती के लिए अत्यधिक उपयुक्त पाई गईं जिसमें आठ वर्ष पुरानी कलम बंधन द्वारा उत्पादित वृक्षों से दो मौसमों यथा अक्टूबर एवं मार्च-अप्रैल को शामिल करते हुए प्रति वर्ष प्रति वृक्ष से अधिकतम 200 किग्रा. तक उपज हासिल की गई।

अध्ययन किए गए 100 से भी अधिक वृक्षों में कोकम पुष्पन में व्यापक भिन्नता देखने को मिली। वृक्ष उभयलिंगाश्रयी या पृथकलिंगाश्रयी अथवा त्रियोकसी प्रवृत्ति वाले थे। फूल 1 से 8 की भिन्नता वाले वर्तिकाग्र लोब्स के साथ नर या मादा अथवा द्विलिंगी थे जिनमें बीजांड अथवा डिम्ब लोक्यूल्स 1 से लेकर 9 तक और परागकोश 20 से 60 की संख्या में थे।

अजैविक उर्वरकों, जैविक खाद तथा साथ ही जैव उर्वरकों के साथ एक पोषक तत्व मिश्रण तैयार किया गया और इसका परीक्षण केला तथा पपीते में किया गया। अर्का प्रभात किस्म के पपीता बीजों को 1 प्रतिशत CaNO_3 (24 घंटे भिगोना) के साथ उपचार करने पर अंकुरण में कम समय लगा (4.75 दिन) और अधिकतम अंकुरण प्रतिशत (82.56) हासिल की गई।

ड्रिप एवं उर्वरण प्रणाली के तहत मूल्यांकन की गई चार मिर्च की किस्मों में, सबसे पहले पुष्पन निशा (24.50 दिन) में एवं तदुपरान्त प्रीति (26.80 दिन) में पाया गया। अधिकतम फल उपज निशा (345 ग्राम प्रति पौधा) में एवं तदुपरान्त प्रीति (322.50 ग्राम प्रति पौधा) में पाई गई। उर्वरण अथवा फर्टिगेशन के साथ पलवार करने पर भिण्डी में जहां 0.450 ग्राम प्रति पौधा की अधिकतम उपज दर्ज की गई जबकि इसकी तुलना में बिना पलवार वाले उपचार के तहत केवल 0.258 ग्राम प्रति पौधा की उपज ही हासिल की गई।

पुष्पोत्पादन के लिए अर्थशास्त्र सहित आकृति एवं पुष्पीय विशेषताओं के लिए नारियल के अंतर्गत अंतर-फसल के तौर पर 45 प्रकार के हेलिकोनिया का मूल्यांकन किया जा रहा है। सामान्यतया, सेक्सी पिंक, टेम्पट्रेस, लोबस्टर क्लॉ-1 एवं II, गोल्डन टॉर्च, बिहाई, कॉवाची, बुकी जैसी हेलिकोनिया किस्मों की मांग एवं थोक मूल्य (रूपये 15 से 40 प्रति स्पाइक) अत्यधिक पाई गई।

जरबेरा की 13 किस्मों का मूल्यांकन कर्तित पुष्पोत्पादन के लिए प्राकृतिक रूप से हवादार पॉलीहाउस के अंतर्गत किया गया। औसत पुष्पोत्पादन प्रति वर्ष प्रति पौधा 38.45 (प्री इन्टेंस) से 51.25 (मालीबो) हासिल किया गया। शेडनेटहाउस में मुल्यांकित आर्किड्स की छः किस्मों में अधिकतम पुष्पकों की संख्या सोनिया इरसाकुल एवं चार्मिंग व्हाइट (15.80)

एवं तदुपरान्त ऐयरी रेड बुल (15.40) में दर्ज की गई।

रजनीगंधा की किस्में मेक्सीकन सिंगल, सुवासिनी तथा पर्ल डबल गोवा में व्यावसायिक खेती के लिए उपयुक्त पाई गई। पल्लिंग घोल (8 HQS / 200 PPM + GA 3 / 25 PPM + AgNO₃ / 50 PPM + सिट्रिक अम्ल / 50 PPM + सुक्रोज 3 प्रतिशत) के परिणामस्वरूप इनका अधिकतम पुष्प-पात्र जीवन दर्ज किया गया। नेरियम के मुल्यांकित सभी किस्मों ने बेहतर प्रदर्शन किया एवं पुष्प-पात्र जीवन 4 से 10 दिन के बीच पाया गया। गोवा जैसे अधिक वर्षा वाले एवं छायादार क्षेत्रों के लिए पर्णीय पौधे के तौर पर कलैडियम की उपयुक्तता स्थापित की गई। कर्तित पर्ण के रूप में उपयुक्तता का पता लगाने के लिए संस्थान में लगभग 15 फर्न का मूल्यांकन किया जा रहा है। संस्थान में 27 औषधीय जड़ी बूटी, 24 औषधीय झाड़ी, 17 औषधीय पौधों तथा 6 औषधीय लताओं सहित एक वनस्पति संग्रहालय (कन्जरवेट्री) का रख-रखाव किया जा रहा है जो कि इन सभी प्रजातियों पर उपयोगी जानकारी की रिपोजिट्री के रूप में भी कार्य करता है।

अधिक वर्षा तथा उच्च आर्द्रतावाले पश्चिमी तटीय पारिस्थितिकी प्रणाली के अनुरूप संशोधित किए गए एकल विस्तार एवं द्वि-विस्तार वाले ग्रीनहाउस का मूल्यांकन क्रमशः खीरा एवं टमाटर फसलों के साथ किया गया। परिणामों में संरचनाओं की सूक्ष्म जलवायु पर संशोधनों का अत्यधिक सकारात्मक प्रभाव देखने को मिला। संशोधित द्वि-विस्तार वाले ग्रीनहाउस तापमान को 21.48 ± 3.02 से 33.87 ± 4.00 डि.से. के बीच बनाए रखा गया जो कि टमाटर फसल के लिए संस्तुत इष्टतम तापमान $20-35$ डि.से. के अनुरूप था और पंखा चलाने पर दिन के समय आर्द्रता 60.66 ± 14.66 प्रतिशत से 79.58 ± 11.24 प्रतिशत के बीच और पंखा नहीं चलाने पर रात्रि के समय आर्द्रता 84.93 ± 8.23 प्रतिशत से 95.15 ± 3.59 प्रतिशत के बीच पाई गई। विभिन्न हस्तक्षेपों यथा क्षैतिज बहाववाले पंखे (HAFs), संवातन पंखे, थर्मल नेट आदि का एक सूक्ष्म नियंत्रक आधारित स्वचालित ऑपरेशन द्वारा सूक्ष्म जलवायु का बेहतर तरीके से नियंत्रण और इससे बिजली की बचत की जा सकता है। केवल क्षैतिज अक्षीय बहाववाले पंखे (HAFs) वाले एक एकल विस्तार के ग्रीनहाउस के लिए अधिकांश फसल अवधि में 25.71 ± 1.36 डि.से. से 31.53 ± 4.30 डि.से. तापमान दर्ज किया गया जो कि $15-32$ डि.से. की संस्तुत क्षमता के अंदर था लेकिन आर्द्रता को $45-60$ प्रतिशत की इष्टतम क्षमता में नहीं बनाए रखा जा सका। इसका कारण संवातन पंखों की अनुपस्थिति हो सकती है और इसीलिए जलवायु नियंत्रण के लिए वायु संवातन बढ़ानेवाले पंखे एवं वेंट क्षेत्र को बढ़ाना बेहतर विकल्प हो सकता है।

पशु विज्ञान

पशु विज्ञान संभाग में अनुसंधान परियोजनाएं मुख्यतः देसी दुधारु पशुओं, शूकरों, भैंस तथा पोल्ट्री नस्लों के संरक्षण एवं सुधार; नैदानिकी आमाप के विकास; पशुधन के प्रमुख रोगों के आणविक महामारीविज्ञान; तथा तटीय क्षेत्र में वैज्ञानिक डेयरी, शूकर पालन, बकरी एवं पोल्ट्री पालन रीतियों का मानकीकरण आदि पर केन्द्रित हैं।

शूकर के वीर्य का परिरक्षण करने हेतु शूकर वीर्य एक्सटेंडर (NBSE) का विकास एवं मूल्यांकन किया गया। पेटेन्ट जर्नल ऑफ इंडिया में

NBSE पेटेन्ट प्रकाशित किया गया और एग्रीनोवेट इंडिया लि. द्वारा इसके व्यावसायीकरण की पहल की गई।

पश्चिमी तटवर्ती भारत में बकरी की नस्लों एवं बकरी संख्या की स्थिति पर आधारीय सूचना का आकलन किया गया। *stx1*, *stx 2*, *EaeA*, *hlyA*, *Flic* तथा *rtB* विषैले जीन को लक्षित करने वाले *E. coli* non O157 : H 7 स्ट्रेन की पहचान करने के लिए पीसीआर आमाप का मानकीकरण किया गया और कुल 50 पृथक्कों में से, 24 पृथक्कों में विषैले जीनों की उपस्थिति देखने को मिली जिससे पता चलता है कि *E. coli* non O157 : H 7 कीटारोगजनक स्ट्रेन युवा बकरियों में गंभीर आंत्रशोध एवं पेचिस रोग के लिए उत्तरदायी था। बकरी मूल से *E. coli* non O157 : H 7 कीटारोगजनक स्ट्रेन का लक्षणवर्णन करने के लिए पल्स फील्ड जेल इलेक्ट्रोफोरेसिस (PFGE) विधि का मानकीकरण किया गया। उत्तरी एवं दक्षिणी गोवा से कुल 211 सेरा नमूनों की स्क्रीनिंग दुधारु पशुओं में IBR तथा खुरपका-मुंहपका रोग के लिए, बकरियों में PPR तथा ब्रूसेलोसिस रोग के लिए एवं शूकरों में क्लासिकल स्वाइन बुखार के लिए की गई। दुधारु पशुओं में 19.76 प्रतिशत (88/19) की संक्रामक बोवाइन राइनोट्रैकीटिस (IBR) की सेरो-प्रबलता को दर्ज किया गया। दुधारु पशुओं में बोवाइन पैपीलोमा वायरस (BPV-1 एवं BPV-2) की पहचान के लिए त्वरित आमाप का विकास किया गया और अनुक्रम को प्रकाशित कराया गया। दुधारु पशुओं में बोवाइन पैपिलोमेटोसिस रोग के प्रभावी उपचार के लिए स्वदेशी वैक्सीन थिरेपी का मानकीकरण किया गया।

संस्थान के पशुधन में मृत्यु संख्या एवं मृत्युदर का मूल्यांकन किया गया और संस्थान के फार्म पर सबसे कम मृत्युदर (< 2 %) दर्ज की गई। कोंकण कन्याल बकरियों की स्टॉल फीडिंग का मानकीकरण किया गया और प्रदर्शन मूल्यांकन में 8 माह की आयु अवस्था पर शरीर भार (बकरों में 38 किग्रा. एवं बकरियों में 32 किग्रा.) का उल्लेखनीय सुधार देखने को मिला। गोवा राज्य के एक स्थानीय देशी दुधारु पशु श्वेता कपिला का सर्वेक्षण, प्रालेखन एवं पंजीकरण के कार्य की शुरुआत की गई और A2 दुग्ध प्रोटीन जीन का लक्षणवर्णन किया गया।

गोवा तथा महाराष्ट्र (मुम्बई) से शूकर से संबंधित प्राणिरूजा रोगजनकों की प्रबलता देखी गई तथा 182 शवों की जांच करने पर जलस्फोट रोगों की सबसे कम मौजूदगी का पता चला।

पृथक्करण तथा PCR पहचान के माध्यम से दुधारु पशुओं में थनैला रोगजनकों कॉगुलेज पॉजीटिव स्टेफाइलोकोकस ऑरियस तथा मायकोटिक थनैला की पहचान की गई। दुधारु भैंस में प्रजनन प्रदर्शन का पूर्व-प्रभावी विश्लेषण किया गया और साथ ही तटवर्ती जलवायु परिस्थितियों के तहत प्रजनन प्रदर्शन के संबंध में विभिन्न जैव मौसमविज्ञान कारकों की निगरानी शुरु की गई। स्थानीय एवं संकर नस्ल के दुधारु पशुओं में समग्र प्रजनन प्रदर्शन पर विभिन्न प्रोस्टाग्लैन्डिन एनालॉग आधारित समकालिकता एवं पुनः समकालिकता प्रोटोकॉल की प्रभावशीलता की तुलना करने के लिए एक परीक्षण किया गया।

भाकृअनुप - पोल्ट्री अनुसंधान निदेशालय (ICAR - DPR), हैदराबाद से खरीदे गए ग्रामप्रिया एवं श्रीनिधि पैतृक स्टॉक (कुल 1008 पक्षियों) के वृद्धि प्रदर्शन एवं मृत्युदर पैटर्न का मूल्यांकन किया गया। 32 सप्ताह की

आयु अवस्था में अण्डा उत्पादन 1236 अण्डे था जबकि वर्तमान हेन-डे उत्पादन 32.94 प्रतिशत था।

मात्स्यिकी विज्ञान

मात्स्यिकी विज्ञान संभाग के अंतर्गत अनुसंधान परियोजनाएं मुख्यतः कृत्रिम मत्स्य आवास (AFH) एवं टिकाऊ तटीय जल जीवपालन प्रणालियों का उपयोग करके तटवर्ती जल में मात्स्यिकी संसाधन प्रबंधन पर केन्द्रित हैं।

कृत्रिम मत्स्य आवास (RCC) निर्मित किए गए और उन्हें आजमाया गया। AFH पर कुल 50 प्रजातियां मौजूद पाई गईं जिसमें हीनियोकस एक्यूमिनेटस, हेलीकोरस नाइग्रेसेन्स, ल्यूट्जैनस रसेलाई, L. फ्लवस, एल. ल्यूट्जैनस, पोमाडेजिस फर्कटस, एकैन्थुरस ब्लॉकाई, तथा P. छब्बी की अधिकतम प्रचुरता देखने को मिली। प्रजाति विविधता एवं प्रचुरता गहरे

AFH पर अधिक थी। इसके अलावा, गतिशील रीढ़रहित फीडर्स, सर्वभक्षी एवं मांसाहारी जैसे ट्रॉफिक गिल्ड्स की सघनता गहरे AFH पर सबसे अधिक पायी गई। उर्ध्वाकर राहत, बाधाओं से मुक्त ऊपरी कॉलम और गहरे आश्रय मूलवास के संबंध में अनुकूल आवास विशेषताओं के कारण ही प्रजातियां गहरे AFH की ओर कहीं अधिक आकर्षित हुईं।

अर्ध खुले पिंजड़े वाली जल जीवपालन प्रणाली के लिए एक जन-संतुलित पोषण मॉडल का निर्माण कर के पारिस्थितिकी प्रणाली विशेषताओं का अध्ययन किया गया। विश्व की प्रमुख जल जीवपालन पारिस्थितिकी प्रणालियों के तुलना में इस पारिस्थितिकी के आंकलित सूचक, इंक सामान्यतया अधिक थे। मॉडल से 10 वर्ष की अवधि के लिए अनुकरण द्वारा अर्ध-खुली पिंजरा प्रणाली में तामुसो एवं पर्लस्पॉट के दो पिंजरों और 20 शंबुक डोरियां की बैटरी तटवर्ती जल जीवपालन के लिए सबसे अनुकूल समाधान पाया गया।

Introduction

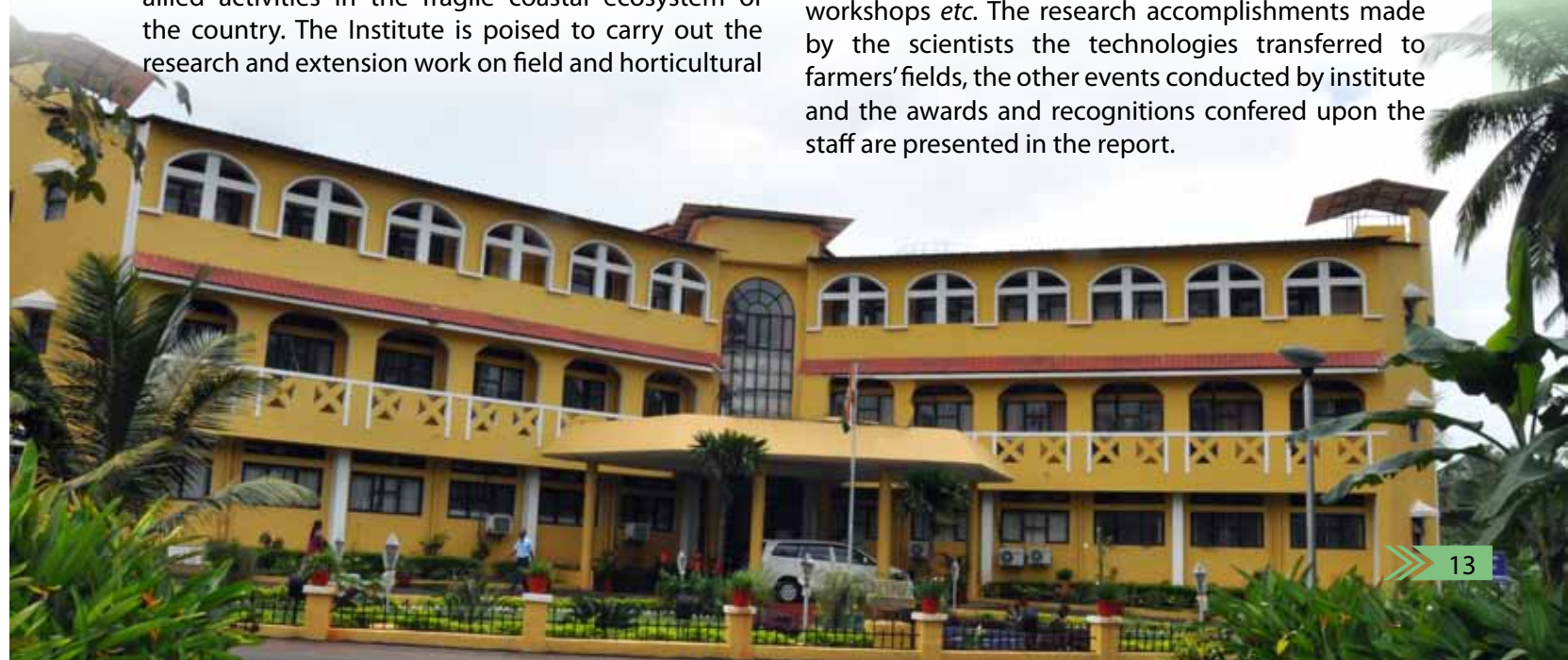
The Indian Council of Agricultural Research, New Delhi, established the ICAR Research Complex for Goa in April, 1976. After a short spell under the ICAR Research Complex for North East Hill Region, the complex was brought under the administrative and technical control of the Central Plantation Crops Research Institute, Kasaragod, Kerala. After functioning at different Government agricultural farm sites in Goa, the location was finally shifted to Ela, Old Goa in 1982. In order 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.

In India, the coastal ecosystem covers an area of 10.78 million ha along 7516 km long coastline. This coastline covers 33 districts under 9 peninsular coastal states, with an area of 3.85 lakh square km to form the coastal ecosystem of the country with an estimated population of about 17.10 crores accounting for about 14.20% of the total population of the country. 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 agricultural needs of Goa, and now the institute has been further upgraded to ICAR- Central Coastal Agricultural Research Institute to address the sustainable agricultural and allied activities in the fragile coastal ecosystem of the country. The Institute is poised to carry out the research and extension work on 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 Director, who is supported by 20 Scientists, 18 Technical, 21 Administrative and 28 Skilled Support staff, making the total staff strength 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 and vegetable crops; development and standardization of production technologies for field and horticultural crops of Goa; standardization of low cost protected structures for vegetable and flower crop production; standardization of packages for rearing cattle, goat, buffalo, pig and poultry; standardization of hydroponics green fodder production and bypass fat production; disease diagnosis and animal health management; standardization of ornamental fish culture, carp culture and brackish water fish farming; standardization of mussel farming practices; dissemination of PFZ advisories and validation of advisories; and exploration of fish diversity of Goa. The Institute is also engaged in transfer of technology through FLDs, trainings, workshops etc. The research accomplishments made by the scientists the technologies transferred to farmers' fields, the other events conducted by institute and the awards and recognitions conferred upon the staff are presented in the report.



Weather Report

Information on weather is of paramount importance for agricultural production. Observation of weather parameters is being continuously recorded by the Institute. Observations made during April 2016 to March 2017 are discussed here.

Air temperature

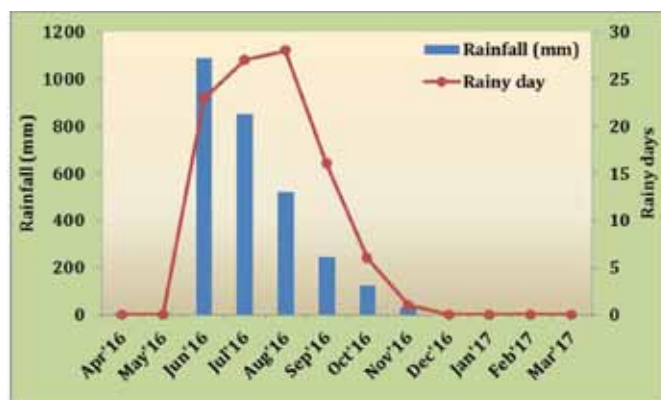
Mean maximum temperature during April 2016 to March 2017 varied from 29.0°C (July 2016) to 35.7°C (May 2016), whereas mean minimum temperature varied from 19.0°C (January 2017) to 25.2°C (May 2016).



Mean maximum and minimum air temperature during April, 2016 to March, 2017

Rainfall and rainy days

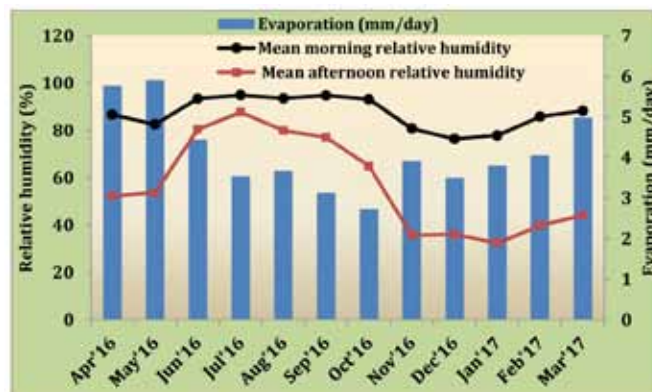
The total rainfall received during April 2016 to March 2017 was 2862.5 mm. Total of 2708.2 mm was received during kharif (June 2016 to September 2016). The annual rainfall of this year was 214.1 mm higher than that of 2015-16 (2648.4 mm). Total number of rainy days observed was 101 and was lower compared to last year (121 days).



Trend of mean monthly rainfall and number of rainy days

Evaporation and relative humidity

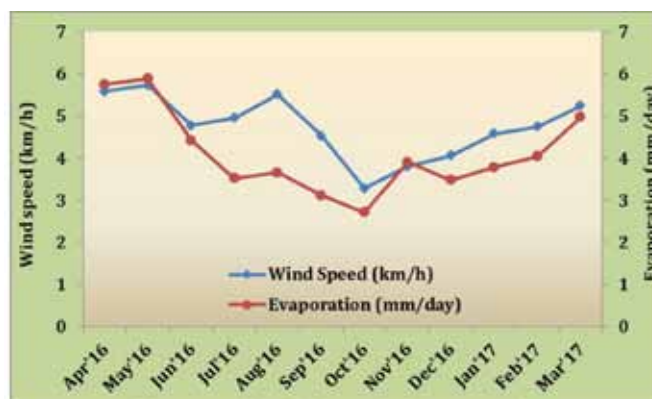
Daily evaporation was measured using USDA-Class A pan evaporimeter. Sum of monthly mean water evaporated from April 2016 to March 2017 was 49.2 mm. The highest morning as well as afternoon relative humidity was observed during July, 2016, whereas the corresponding lowest was recorded during December, 2016 and January 2017, respectively.



Mean monthly evaporation and morning and afternoon relative humidity

Wind speed

Mean monthly wind speed ranged from 3.3 km/h (October 2016) to 5.7 km/h (May 2016). Mean monthly wind speed started decreasing from August 2016 to October 2016 and it increased thereon till March 2017.



Mean monthly wind speed and evaporation

Sunshine hours

The mean monthly sunshine hour recorded ranged from 0.9 hours (July 2016) to 9.5 (February 2017). As expected, mean monthly sunshine hours were lower during rainy season compared to rest of the months of the year.

Soil temperature

The ranges of mean monthly soil temperature recorded in morning hours at 5 and 10 cm depths were 24.9-32.4 °C and 26.3-46.4 °C, respectively, whereas the corresponding ranges for afternoon observation were 26.4-47.7 °C and 29.0-41.8 °C.

Mean monthly weather parameters recorded at ICAR-CCARI from April, 2016 to March, 2017

Parameter	Months											
	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Mean max temp (°C)	35.1	35.7	30.7	29.0	29.8	29.7	31.9	34.8	38.5	34.5	35.5	35.0
Mean min temp (°C)	24.3	25.2	21.6	23.1	23.6	24.5	23.5	20.1	19.8	19.0	21.0	22.3
Mean morning R.H. (%)	86.6	82.5	93.4	94.9	93.5	94.7	93.2	80.8	76.4	77.8	85.8	88.3
Mean afternoon R.H. (%)	52.3	53.7	80.5	87.7	79.9	77.1	64.9	35.7	36.1	32.4	39.8	44.2
Mean wind speed (km/hr)	5.6	5.7	4.8	5.0	5.5	4.5	3.3	3.8	4.1	4.6	4.7	5.2
Sunshine (hrs/day)	8.1	8.1	1.8	0.9	2.6	3.8	6.0	8.5	8.7	9.2	9.5	8.0
Total rain (mm)	0.2	0.6	1089.6	850.7	522.3	245.6	124.3	29.2	0.0	0.0	0.0	0.0
Total rainy days	0	0	23	27	28	16	6	1	0	0	0	0
Evaporation (mm/day)	5.8	5.9	4.4	3.5	3.7	3.1	2.7	3.9	3.5	3.8	4.0	5.0
Cloudiness morning (hrs)	2.9	3.5	4.8	4.5	4.1	4.5	3.8	2.4	2.0	0.5	2.2	1.9
Cloudiness afternoon (hrs)	1.2	2.3	4.6	4.6	4.1	4.3	3.0	1.5	2.0	0.3	0.0	0.7

Important dates of observations during April, 2016 to March, 2017 with highest and lowest values of weather parameter

Particular of weather parameter	Value	Date
Highest maximum temperature	38.4 °C	23/02/2017
Lowest minimum temperature	15.5 °C	09/01/2017
Highest rainfall	185 mm	22/06/2016
Highest evaporation	8.3 mm	30/06/2016
Highest wind speed	9 km/h	11/07/2016



Research Achievements

Natural Resource Management





Soil and water conservation studies in mango

Soil Infiltration rate

The soil infiltration rate in different terrains planted with mango crop were subjected to soil and water conservation treatments. The soil infiltration rate in Continuous Contour Trench + Vegetative Barrier (CCT+VB) in lower, middle and upper portions were 13.5, 21.5 and 73.2 cm/h respectively. In Staggered Contour Trench + Vegetative Barrier (SCT+VB) the infiltration rate at lower, middle and upper portions were 35.9, 76.2 and 33.2 cm/h respectively. The soil infiltration rate in Vegetative Barrier (VB) in the lower, middle and upper portion were 19.3, 15.1 and 17 cm/h respectively. In the control the infiltration rate in the lower, middle and upper portion were 15.4, 21.3 and 16 cm/h respectively. The infiltration studies showed variation of infiltration rate in different terrains in all the treatments of Mango.

Soil Field Capacity (SFC) and Permanent Wilting Point (PWP)

The long term effect of soil and water conservation measures on soil physical properties such as SFC and PWP was studied. The moisture content at SFC and PWP of soil were estimated using pressure plate apparatus. The SFC moisture content range varied between 31.72 to 36.5 %, 31.11 to 37.09 % and 27.1 to 37.43 % at 0-30 cm, 30-60 cm and 60-90 cm depths respectively. The PWP moisture content range varied between 21.66 to 25.72 %, 22.4 % to 26.79 % and 21 to 26.79 % at 0-30 cm, 30-60 cm and 60-90 cm depths respectively.

Soil and water conservation studies in coconut

Soil Infiltration rate

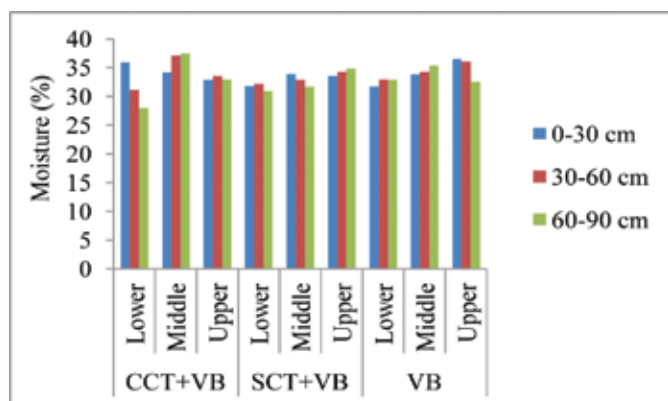
The soil infiltration rate in different terrains in soil and water conservation treatments of coconut were studied. The soil infiltration rate in circular trenching in lower, middle and upper portions were 13.6, 15.5 and 17.5 cm/h respectively. In circular terracing the infiltration rate at lower, middle and upper portions were 13.5, 21.1 and 5.8 cm/h respectively. The soil infiltration rate in control in the lower, middle and upper portions were 19.3, 15.1 and 17 cm/h respectively.



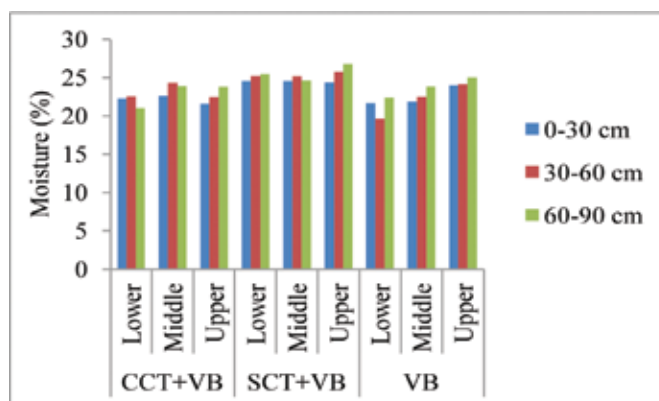
Measurement of soil infiltration rate



Soil saturation on pressure plates



Effect of soil and water conservation measures in mango on moisture content at field capacity

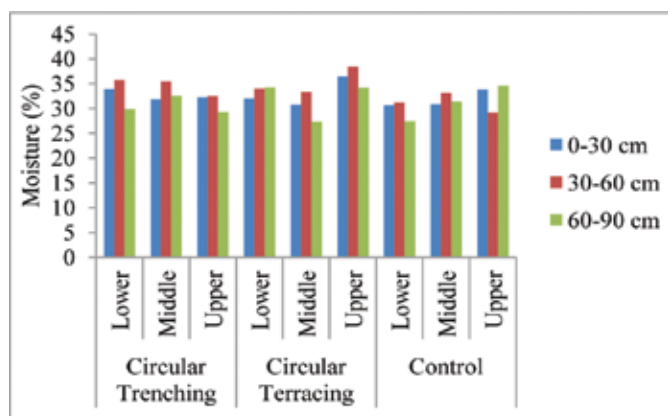


Effect of soil and water conservation measures in mango on moisture content at permanent wilting point

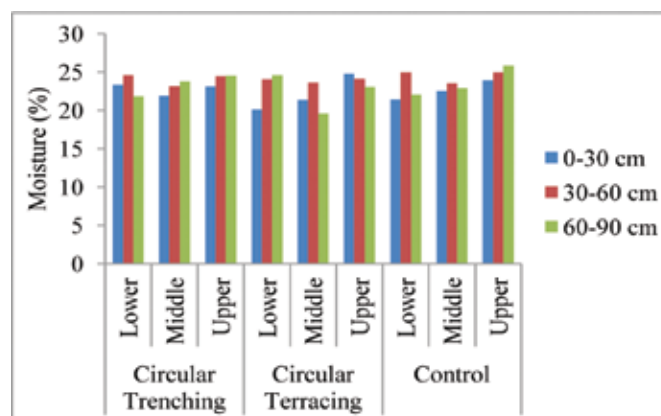
Soil Field Capacity and Permanent Wilting point

The SFC and PWP of soil under circular trenching, circular terraces and control treatments in coconut plots were studied. The SFC moisture content varied between 30.63 to 36.43 %, 29.13 to 38.45 % and 27.39

to 34.6 % at 0-30 cm, 30-60 cm and 60-90 cm depths respectively. The PWP moisture content range varied between 20.16 to 24.75 %, 23.17 to 24.99 % and 19.60 to 25.84 % at 0-30 cm, 30-60 cm and 60-90 cm depths respectively.



Effect of soil and water conservation measures in coconut on moisture content at field capacity



Effect of soil and water conservation measures in coconut on moisture content at permanent wilting point

Project: Site-specific nutrient management through rapid nutrient detection techniques in important crops of West coast of India Gopal Mahajan

The higher variability in soil, available and plant nutrient(s) status is a pre-requisite for understanding the spectral features of the vegetation. Thus, the variability in soil available macro-nutrients (soil available nitrogen, phosphorus and potassium) was studied by undertaking soil sampling from selected

cashew and mango orchards. The soil available nitrogen, phosphorus and potassium was found in deficient (<280 kg/ha), medium to high and low-medium-high categories, respectively. Based on the soil nutrient status, orchards would be identified for collection of canopy and leaf spectral signatures.

Project: An Economic Analysis of Agricultural Sustainability in West Coast of India Viswanatha Reddy K

This study presents empirical illustration of coastal districts in Western coast of India. This study indicates that the agricultural systems of all the districts in West coast display wide variations in their ecological, economic efficiency and social equity aspects. Ecological security is assessed based on four variables, viz. population density (per km²), proportion of geographical area under forest (%), cropping intensity (%) and livestock density (per km²).

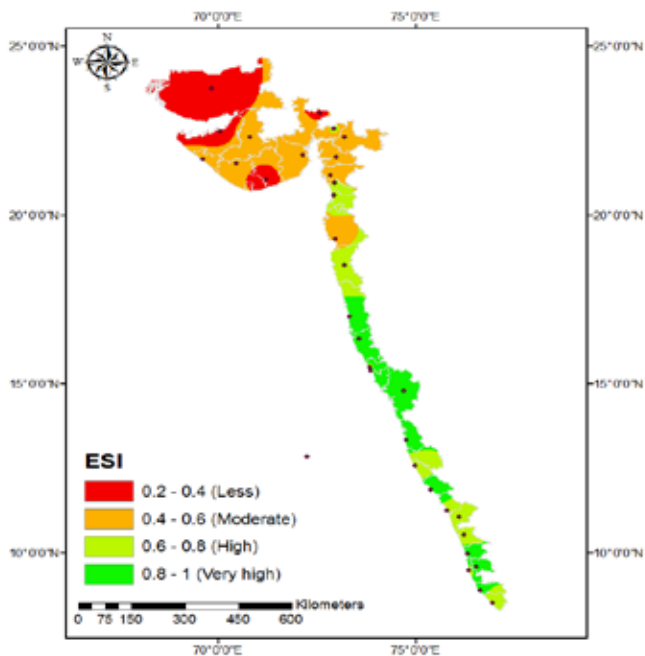
Ecological Security Index (ESI)

Classification of districts based on ESI score showed that 12 coastal districts lie in the category of 'less' to 'moderately' ecologically sustainable indicating wretched condition of the West coast on the ecological front. Except Thane district, all these coastal districts lie in the coast of Gujarat state. The pressure on natural resources, particularly forest,

could be realized by the fact that these districts support major chunk of human and livestock population of the state, with very less area under forest in the state. On the contrary, nine districts in the 'very high sustainable' category, with more than 60% of forest area in West coast districts supported very less proportion of the human and livestock population in West coast of India. The 'less' and 'moderate sustainable' districts also accounted for around 60% of the degraded and wasteland area in West coast of India. Kutch and Amreli districts secured the lowest and penultimate rank in ESI with scores of 0.26 and 0.32, respectively. This is mainly due to meagre forest area and the high level of groundwater stress with 75% and 61%, respectively.

The first and second ranks in terms of ESI were secured by Uttar Kannda and Udipi district with their respective scores of 1.0 and 0.95, owing to the large areas (80 and 48 %) under very dense and moderately

dense forests in these two districts. Strict forest conservation and protection practices in the area, presence of coffee plantations, spice gardens and low animal population had a positive effect on the ESI of the two districts. Most of districts in Kerala also have relatively high scores with respect to ecological indices.



Ecological Security Index Map of West Coast of India

Economic Efficiency Index (EEI)

Economic efficiency indicates resource or input productivity, that is, output per unit of input (land, labour, animal). In the West coast region of India, 2, 10, 13, 5 and 3 districts were observed to be in the categories of 'very poor EE', 'poor EE', 'moderate EE', 'high EE' and 'very high EE', respectively. The average food grain yield, labour productivity in total output in the 'very high EE' districts (Rajkot and Junagadh) were 1.8 and 4.6 times, respectively, higher than the 'very poor EE' districts (Ratnagiri and Raigarh). This is because of higher irrigated area and fertiliser consumption, and easy access to market for sale of farm produce leading to higher per capita income. The values obtained by the 'poor EE' and 'very poor EE' districts were very low (0.18–0.38) and a majority of these districts lie in coastal Maharashtra and Northern Kerala with predominantly rainfed farming. This was evident from the analysis which indicated that there was wide variation among the districts in terms of EEI. The maximum (1.0) and minimum (0.18) EEI scores were estimated for Rajkot in Gujarat and Ratnagiri districts in Maharashtra, respectively.

Social Equity Index (SEI)

Social equity implies fair access to resources and livelihood, and it also emphasizes the principle that each citizen, regardless of economic status, should

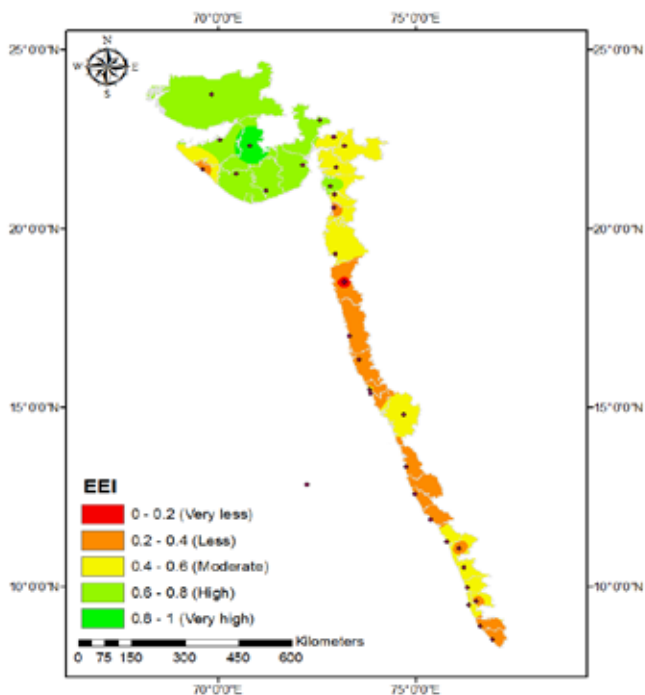
be given special attention to the needs of weak and vulnerable populations. The results of the study showed that out of 33 districts in the West coast of India 2, 3, 9 and 19 districts were placed in the 'less equity', 'moderate equity', 'high equity' and 'very high equity' categories, respectively.

The per capita availability of food grain was observed to be 370 g and 100% habitations have rural road connectivity, in the districts categorized under 'very high equity' category. On the contrary, in case of the districts categorized under 'less equity', the availabilities of the food grain were only 155 g, and 85 % habitations have rural road connectivity. Surprisingly, female literacy rate was observed to be more in 'less equity' category districts (74%) than that in 'very high equity' districts (57%). These values indicated that in spite of large disparities in social equity, inhabitants of disadvantaged districts were in favour of educating the girl child. The maximum score (1.0) of SEI was found in the case of Alappuzha district of Kerala whereas the minimum (0.37) was for Uttara Kannada district of Karnataka.

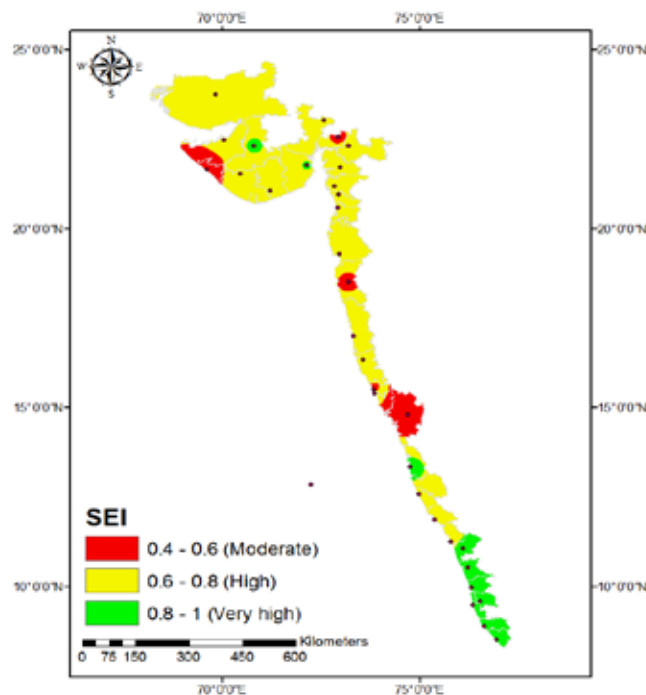
Sustainable Livelihood Security Index (SLSI)

The results of the study reveal that one, three, eleven, nine and nine districts were placed in 'very less sustainable', 'less sustainable', 'moderately sustainable', 'highly sustainable' and 'very high sustainable' categories of SLSI, respectively. Alappuzha and Kutch districts obtained maximum (1.0) and minimum (0.20) scores, respectively. The average values of ESI, EEI, SEI and SLSI for the west coast India were 0.66, 0.47, 0.71 and 0.63 respectively. Some districts such as Rajkot, Surat, Junagadh and Jamnagar were outstanding in terms of EE (with 1st, 2nd, 3rd and 8th rank in EE) but their status is very poor when we consider the ecology security index (with 28th, 25th, 27th and 30th rank in ESI).

In spite of their very high efficiency in production in Surat, Junagadh and Jamnagar, the level of distribution or social equity is low in these districts with 15th and 21st and 22nd rank in SEI, respectively. This indicated that exploitation of natural resources is taking place at the cost of environmental and social equity and most of the facilities were being utilized by the economically 'well off' strata of the society. Under these circumstances, sustaining livelihood security would not be possible and efforts should be directed to improve human well-being and social equity, while significantly reducing environmental risks and ecological insecurity. Districts such as Uttara Kannada, Udipi, Kottayam, Kannur, Sindhudurg, Ernakulam, Ratanagiri, South Goa and Kollam have relatively very good ecological security status with all being placed among the top 9 districts. However, the performance of Kannur, Ratnagiri and Sindhudurg is very poor on the economic efficiency and social equity front, Uttara Kannada and Udipi are not



Economic Efficiency Index Map of West Coast of India



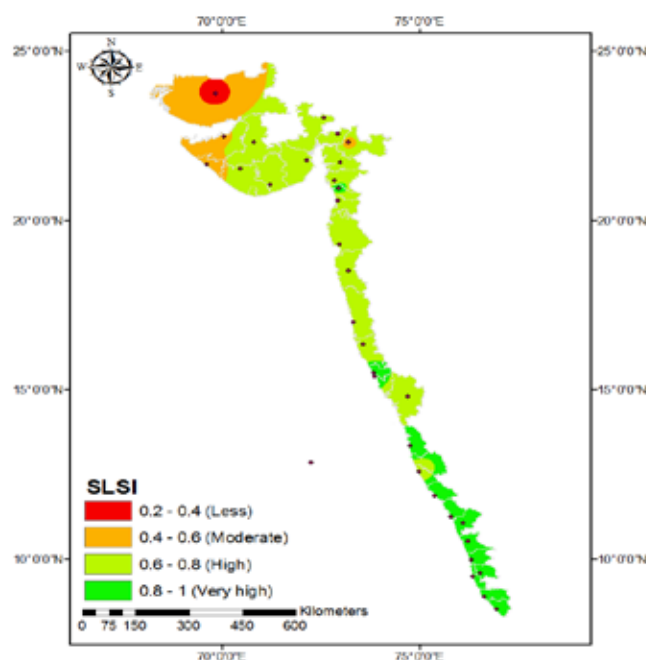
Social Equity Index Map of West Coast of India

well placed in terms of social equity whereas Kottayam has not performed well in terms of EE. Valsad, Vadodara Porabandar, Amereli, Kachchh, Raigarh and Bharuch are the districts which have performed poorly in all three fronts of SLS. In these districts integrated approaches are required so as to achieve conditions for SLS.

In districts such as Porabandar, Kutch, Junagadh and Vadodara which have very low score of SEI, priority and efforts should be directed to restore ecological balance to sustain their relatively higher present EE. For restoring ecological balance, efforts must be made for soil and water conservation, reclamation of degraded soils, afforestation, better utilisation of available groundwater through micro-irrigation and establishment of some forest or horticulture-based agriculture systems. Similarly, districts such as Uttara Kannada, Udupi, Kottayam, Kannur and Sindhurg have a strong ecological base but are very poor in EE. Efforts may be made to enhance the agricultural productivity by employing advanced but eco-friendly agronomic practices with site-specific crop varieties, nutrient management and use efficiency; water productivity enhancing irrigation methods; providing effective and efficient backward and forward market linkages; adequate infrastructure as such electricity, roads, information and communication technologies and programmes for skill development.

Further, in case of coastal districts such as, Uttara Kannada, Porabandar, Raigarh, Thane and Anand which are very poor in social equity but are strong

on both ecological and economic indices or either of the two, efforts should be directed to enhance the equity in benefit sharing through better education, health facilities, clean living environment and rural infrastructure for achieving the goal of socially equitable sustainability. For evolving a sustainable agricultural system for districts (Porabandar, Amreli) which are poor in all three fronts of SLS, appropriate planning based on integrated and holistic approach with use of local resources along with better management of the environment should be implemented.



Sustainable Livelihood Security Index Map of West Coast of India

Project: Calibration and validation of simulation and statistical crop yield model for major field crops of West Coastal Plains and Ghats

Bappa Das

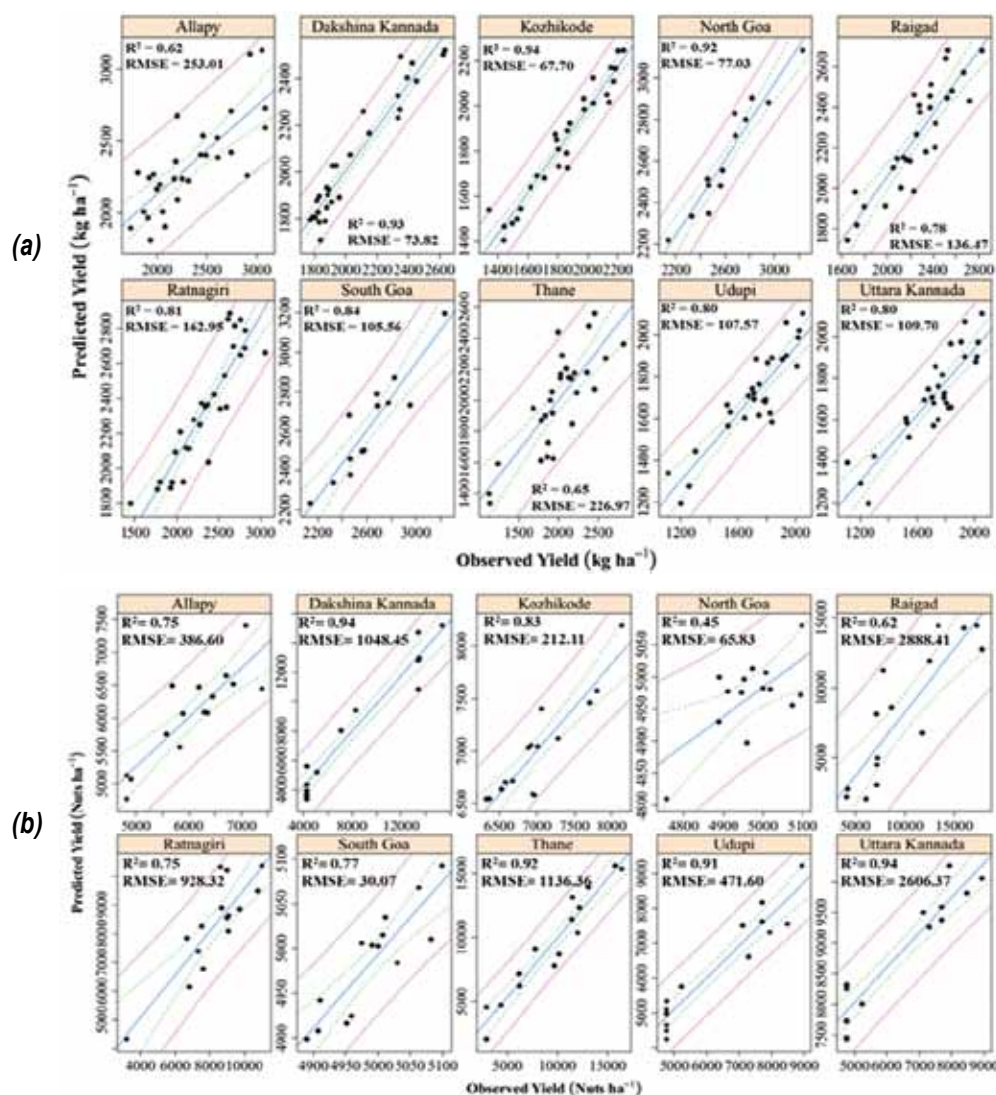
Rice

Using the dataset obtained from India Meteorological Department, Pune as well as from Institute observatory, statistical crop weather model were developed for rice and coconut crop for 10 weather stations of Maharashtra, Goa, Karnataka and Kerala. For development of district level rice yield forecast models, weather indices were generated using weekly cumulative value for rainfall and weekly average value for other parameters like maximum and minimum temperature, morning, evening relative humidity, bright sunshine hours etc. Long period rice yield data for those 8 stations was collected from the Directorate of Economics and Statistics, Department of Agriculture and Cooperation and State Department of Agriculture. The R^2 and RMSE ranged between

0.62-0.94 and 67.70-253.01 kg/ha, respectively during calibration of the crop yield model.

Coconut

While for coconut, weather indices were generated using monthly as well as seasonal cumulative value for rainfall and average value for other parameters like maximum and minimum temperature, morning, evening relative humidity, bright sunshine hours etc. Long period coconut yield data for those 10 stations was collected from the Coconut Development Board. The performance of the calibration models were found to be good to excellent with R^2 and RMSE ranged between 0.45-0.94 and 30.067-2888.412 nuts/ha respectively, during calibration using monthly weather data.



The relationship between predicted and observed values of (a) rice (kg/ha) and (b) coconut (Nuts/ha) for preharvest yield forecast using stepwise multiple linear regression models. Dashed lines indicate 95% confidence interval of the regression; outermost lines indicate 95% confidence interval of prediction

Project: Study of nutrient management and cropping system on greenhouse gas emission through infoRCT model in west coast of India
Paramesha V

The applied chemical fertilizers and organic matter decomposition are the main contributor of green house gas (GHG) emission from crop fields. Especially in rice paddies, the GHG emission is higher due to continuous flooding and anaerobic decomposition of organic matter. We have tested different combination of organic and inorganic sources in three different cropping systems such as rice-rice, rice-cowpea and rice-moong, the treatment includes control, 100% neem coated urea, 100% farm yard manure (FYM), 75%N+25% FYM, 75%

fertilizer nitrogen (N)+ 25% rice residue, 50% N+ 25% green leaf manure incorporation +25% rice residue. Among the different nutrients tested in rice-rice system, the growth and yield parameters like plant height (100.3 cm), number of tillers m² (286), number of panicles m² (207), panicle length (22.7 cm), gains panicle-1 (129) and grain yield of 5.06 t/ha was found higher in 100% N through neem coated urea and the lower values were observed under controlled plots. The same trend has been followed in rice-moong cropping system.

Influence of different N management practices on growth and yield parameters of rice under rice-rice system

Treatments	Plant Height (cm)	Tillers/ m ²	Panicles/ m ²	Panicle Length (cm)	Panicle Weight (g)	Grains/ Panicle	Grain Yield (t/ha)
T1	71.4	183.7	129	12.2	5.5	51.3	2.19
T2	94.6	286.0	207	22.7	15.0	129.4	5.06
T3	78.4	222.0	163	16.4	9.8	86.0	3.42
T4	83.1	254.0	184	18.2	11.5	107.1	4.20
T5	81.2	236.0	175	17.5	10.8	100.6	3.79
T6	78.1	212.0	162	17.2	10.5	91.2	3.64
SEm±	1.42	3.6	5.5	0.47	0.43	4.31	0.21
C.D at 5%	4.48	11.5	17.5	1.48	1.34	13.59	0.66

T1- Control, **T2-**100% neem coated urea, **T3-**100% farm yard manure,
T4-75%N+25% FYM, **T5-** 75% N+ 25% rice residue incorporation,
T6-50% N+ 25% green leaf manure incorporation +25% rice residue incorporation

Influence of different N management practices on growth and yield parameters of moong crop under rice-moong system

Treatments	Plant height (cm)	No. of branches	Pod length (cm)	No. of Pods	100 seed weight (g)	Seed yield (q/ha)
T1	42.1	2.7	4.05	18.0	2.78	3.29
T2	53.0	6.0	6.87	25.2	4.02	6.80
T3	48.6	3.7	5.40	20.2	3.15	4.59
T4	50.8	4.7	6.17	22.7	3.78	5.99
T5	49.6	4.7	6.07	22.0	3.76	5.85
T6	49.0	4.3	6.03	21.0	3.34	5.51
SE.m±	1.5	0.4	0.19	0.6	0.10	0.22
C.D at 5%	4.6	1.2	0.60	1.8	0.33	0.69

T1- Control, **T2-**100% neem coated urea, **T3-**100% farm yard manure,
T4-75%N+25% FYM, **T5-** 75% N+ 25% rice residue incorporation,
T6-50% N+ 25% green leaf manure incorporation +25% rice residue incorporation

Research Achievements

Crop science





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

Development and release of two high yielding salinity tolerant rice varieties for coastal saline soils of Goa

Two high yielding salinity tolerant rice varieties viz., Goa dhan-1 (KS-12) and Goa dhan-2 (KS-17) were developed and released for cultivation in the state of Goa. New rice varieties are the product of pure line selection from the locally cultivated salinity tolerant landrace Korgut.

Goa dhan - 1, is a semi tall, white kernelled selection having short bold grain type with maturity duration of 130-135 days. The average yield of the variety is 2.4 t/ha compared to the locally cultivated variety Korgut (1.3-1.7 t/ha).



Goa dhan - 1 (KS-12)

Goa dhan - 2, is a tall, red kernelled selection having long bold grain type with maturity duration of 125-130 days. The average yield of the variety is 2.7 t/ha (under stress) compared to the locally cultivated Korgut (1.3-1.7 t/ha).



Goa dhan - 2 (KS-17)

Phenotyping of Recombinant Inbred Lines (F₇) derived from Jyothi x Korgut under coastal salinity condition

242 recombinant inbred lines (F₇) derived from the cross Jyothi x Korgut along with parents and check varieties were evaluated under coastal salinity conditions at farmers' fields in Chorao Island of North Goa district during Kharif 2016. The trial was laid out in

Descriptive statistics for the yield and its attributing characters

Variable	Min	Max	Mean	Median	Mode	Std Dev	Variance	Std Error	Skewness	Kurtosis
Days to 50% flowering	80	131	104.06	104	104	11.41	130.2	0.73	0.29	-0.59
Plant height (cm)	74.33	147.67	103.8	102.75	101	12.21	149	0.78	0.71	1.19
Productive tillers per hill	2.67	9.5	4.61	4.5	3.83	1.07	1.15	0.07	1.13	2.06
Grain yield (kg/ha)	780	3260	1829.36	1796.67	2060	480.72	231094.7	30.9	0.42	-0.02

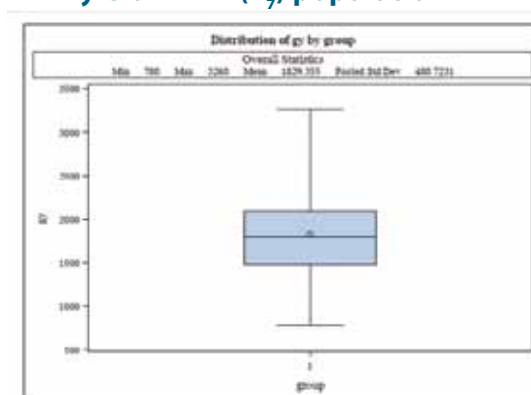


Field view of evaluation of RILs (F7) at choroa island in farmers' field

alpha-lattice design with two replications. All the 242 lines were phenotyped for 12 yield and its contributing characters.

Analysis of variance revealed significant differences among the entries for all the characters studied. Days to 50% flowering ranged from 80 days to 131 days with a mean of 104.06 days, plant height ranging from 74.33 cm to 147.67 cm with a mean of 103.8 cm, productive

Box plot representing distribution of grain yield in RIL (F₇) population



tillers from 2.67 to 9.50 with a mean of 4.50 and grain yield ranged from 780 kg/ha to 3260 kg/ha with mean of 1829.36 kg/ha. Highest grain yield was recorded by the line JK-58 (3260.00 kg/ha) followed by JK-238 (3113.33 kg/ha), JK-84 (3086.67 kg/ha), JK-86 (3040.00 kg/ha) and JK-156 (2946.67 kg/ha). National check for coastal saline soils CST 7-1 recorded grain yield of 1973.50 kg/ha.

Mean performance of top 10 entries of the cross Jyothi X Korgut F7 RIL population under coastal salinity conditions

Lines	Days to 50% flowering	Plant height (cm)	No of productive tillers / hill	Grain yield (kg/ha)
JK 58	95.00	115.83	4.83	3260.00
JK 238	100.00	115.83	5.17	3113.33
JK 84	107.00	116.67	5.17	3086.67
JK 86	104.00	107.67	4.17	3040.00
JK 156	108.50	108.00	4.50	2946.67
JK 233	104.00	101.67	6.83	2920.00
JK 72	110.00	103.00	5.00	2860.00
JK 90	106.00	106.50	5.17	2813.33
JK 85	101.00	105.00	5.33	2793.33
JK 4	98.00	103.67	4.17	2786.67
JK 116	105.50	100.33	4.83	2753.33
JK 95	92.50	96.50	5.50	2726.67
JK 146	102.00	93.50	3.17	2693.33
JK 242	120.50	101.50	4.83	2673.50
JK 140	104.00	110.17	5.00	2673.33
Jyothi (P1)	101.50	97.83	3.33	1300.00
Korgut (P2)	102	127.83	6.33	1556.00
Pusa-44	107	92.67	4.00	1486.67
CST 7-1	120.50	101.50	4.83	1973.50
Mean	104.06	103.80	4.61	1829.36
C.V.(%)	5.12	6.37	23.45	24.12
SE	3.76	4.67	0.76	312.00
CD	10.49	13.02	2.13	869.18

Note:- Pusa -44: Sensitive check; CST 7-1: Coastal salinity check

Stem borers diversity and density in cashew ecosystem

A survey was undertaken to record the stem borers association in cashew ecosystem. Samples were collected from borer affected trees in different locations. Among the cerambycids, the species *Plocaederus* was the major one, with an average of 28.3 grubs found feeding in a tree. The species *Batocera rufomaculata* was also found in most of the affected trees with an average of 6 grubs/ tree. The buprestid *Belionota prasina* was found in almost all the affected trees with an average of 27.25 grubs/tree. Beside these, *Aeolesthes holosericea*, *Glenea multiguttata* of Cerambycids and ambrosia beetle *Euplatypus parallelus*, of Platypodidae were also recorded on the infested trees. To study the density of stem borers in cashew, the borer affected trees were cut in to one meter length from above the ground level and cross sectioned.

The root region was also removed from soil and cross sectioned. The grubs of cerambycid *Plocaederus spp*, *B. rufomaculata* and buprestid grub were found from root region to up to 7 meter height. Mostly cocoons and adults of cerambycid species were found



Grub of *Plocaederus spp*



Adult male *Plocaederus ferrugineus*

in the root and 1m above the ground region. An average of 2.4 and 2.75 cocoons of *Plocaederus spp/tree* were found in root and 1m above the ground region respectively. The adults of *Plocaederus spp* @ 0.8 and 1.1/ tree were found in root and 1m above the ground region respectively. Maximum number of grubs of *Plocaederus spp* were found up to 3m height.

Management of cashew stem and root borers

Management of cashew stem and root borers was undertaken with five treatments viz., T1- Imidacloprid (0.01), T2-Fipronil (0.005), T3- Thiamethoxam (0.02), T4- Dichlorvos (0.15) and T5- Untreated check with four replications. Borers affected trees were identified and the grubs were mechanically extracted. A bore holes were made on each side of the infested trees above the affected region and the treatments were given through microinjection with used saline bottles. The results revealed that maximum recovery of 50% was recorded in Imidacloprid (0.01) and Fipronil (0.005). Treatments with Thiamethoxam (0.02) and Dichlorvos (0.15) led to 25% recovery of infested trees. None of the trees were recovered in untreated check where the grubs were only removed.

Occurrence and infestation of Jewel beetle *Belionota prasina* on cashew

The damage incidence was mostly found on stem borers affected or stressed cashew trees. Semi - circular D shaped exit bore holes measuring 7-10 mm in length and 4-7 mm in width were found along the main trunk and branches. Adult beetles were dark greenish blue in colour and measured about 21-28 mm in length; grubs fleshy, whitish yellow in colour measuring 9-50 mm in length. Various growth stages of grub were found on the infested trees. Pre-pupa and pupa were yellowish white in colour and measures 26-32 mm and 20-23 mm in length respectively. Maximum of 132 grubs, 8 pre-pupae, 22 pupae and 61 adults were collected in a single affected tree. An average of 55.8 grubs were found feeding in a single tree.

Attraction potential of different types of cue lure traps for cucurbit fruit fly

A field trail was undertaken to evaluate the attraction potential of different types cue lure traps for cucurbit fruit fly *Bactocera cucurbitae*. The treatments were T₁- Cylindrical white jar + vial with wick, T₂ - Cylindrical white jar + 4×4×1 cm lure, T₃ - Cylindrical white jar + 4×1×1 cm lure, T₄ - Spherical jar + 4×1×1 cm and T₅ - Transparent + 4×1×1 cm with four replications. Weekly observations



Grub feeding inside the stem



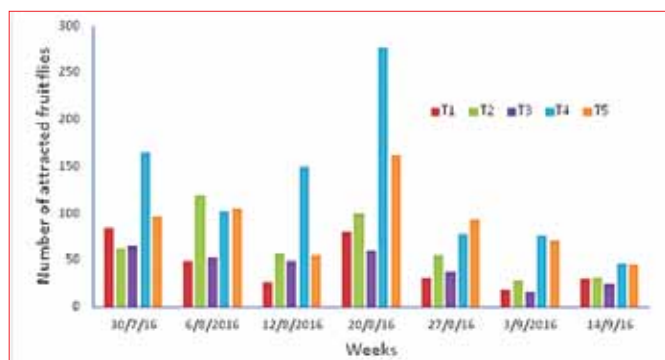
Grubs of *Belionota prasina*



Pupae of *Belionota prasina*



Adults *Belionota prasina*



Attraction of cucurbit fruit flies to different types of cue lure traps

showed that T_4 attracted more number of fruit flies @ 127.64/week followed by T_5 (89.82/week). Least number of fruit flies (44.03/week) was attracted in T_2 . Maximum number of fruit flies (277.25) was attracted to T_4 during 3rd week of August 2016 followed by 165 in the same treatment during 4th week of July 2016, whereas minimum number of fruit flies (16.5) was got in T_2 lure during first week of September, 2016.

Management of cowpea aphid *Aphis craccivora*

The bean aphid *A. craccivora* is a major insect pest in cowpea. A field trial was undertaken to evaluate seed treatment with liquid formulation of bio-agents followed by spraying. Bio-agents used were Rch6-2b (T_1), STC - 4 (T_2) and RP7 (T_3), along with Imidacloprid (T_4) as chemical control in variety Goa cowpea-3. The aphid population was recorded after one month of sowing. The least no of aphids (11.25/leaf/shoot) was recorded in T_2 followed by T_3 (24.91) whereas the highest no of aphids (61.58/leaf/shoot) was recorded in control (T_5). Spraying of the same formulations was taken up after 35 days of sowing. As a result, there was absolutely no aphids population in treatments T_1 , T_3 and T_4 . Maximum number of aphids (36.5/leaf/shoot) was recorded in T_5 distantly followed by (2.75) in T_2 .

Efficacy of different size and shape of methyl eugenol traps for mango fruit fly

A field trail was undertaken to evaluate the attraction potential of different size and shape of

methyl eugenol traps for mango fruit fly *Bactrocera dorsalis*. The treatments were T_1 - Cylindrical white jar + 4×1×1 cm lure, T_2 - Spherical jar + 4×1×1 cm lure, T_3 - Transparent tub + 4×1×1 cm lure, T_4 - Empty water bottle + 4×1×1 cm lure and T_5 - Transparent jar + 4×1×1 cm lure, each with four replications. Weekly observations revealed that T_3 attracted more number of fruit flies (37.45/week), followed by T_1 (33.33/week). Least number of fruit flies (20.62/week) was attracted in T_4 . Maximum number of fruit flies (74.25) was attracted to T_1 during first week of March, 2017 followed by 71.75 in T_3 during last week of March 2017, whereas minimum number of fruit flies (6.5) was got in T_5 during 2nd week of January 2017.

Management of sweet potato weevil *Cylas formicarius*

Sweet potato is an important crop of the rice based cropping system and mostly infested by the sweet potato weevil *Cylas formicarius*. A field trail of sweet potato variety (local white) was undertaken with seven insecticidal treatments including control. Insecticidal applications were made at two major stages of growth viz., (i) at planting, by dipping plant cuttings in insecticides solution viz., T_1 (Imidacloprid, 0.009%), T_2 (Fipronil, 0.002%) and T_3 (lambda cyhalothrin, 0.005%), for 30 minutes before planting and spraying of above said insecticides, T_4 (T_1 +Spraying of Imidacloprid, 0.009%), T_5 (T_2 +Spraying of Fipronil, 0.002%), T_6 (T_3 + Spraying of lambda cyhalothrin, 0.005%) and T_7 (control) at 45 DAP. Least percentage of tubers infestation (5.55) was recorded in T_4 whereas highest percentage of tubers infestation (14.53) was recorded in control. Similarly, highest percentage of marketable yield (94.44) was recorded in T_4 whereas lowest percentage of marketable yield (85.46) was recorded in control.

Project : Monitoring and study on the incidence of diseases and insect pests in protected cultivation

R Ramesh and Maruthadurai R

Survey and selection of polyhouses and periodical monitoring of plant diseases

Two polyhouses in farmers' fields and one polyhouse in ICAR growing vegetables (cucumber, tomato) were identified for the study. Severe incidence of insect pests (thrips, mealy bugs and whitefly), diseases (Downymildew, bacterial wilt, sooty mould) and nematodes (root knot) was recorded in cucumber, tomato and bhendi crops grown in polyhouses. In case of cucumber severe incidence of root knot nematode was observed and the entire crop was lost. Downymildew was also reported in cucumber. However in tomato, incidence of bacterial wilt, blossom end rot and sucking pests was recorded. In bhendi, severe incidence of root knot nematode was recorded.



Root knot nematode infection

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

Talc based formulation of *Trichoderma* was produced and was 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. over 260 kg of the talc formulation of *Trichoderma* was produced and used



Downymildew in cucumber

in field experiments, farmers as well as distributed to various sections in the Institute. Bacterial antagonists (60kg) was produced and given to farmer's demonstration plots to treat black pepper plants for management of foot rot (RCh6-2b), chilli disease management trials (RCh6-2b, STC-4) and paddy experiment (STC-4) in the saline areas.

Field evaluation of integrated strategies for the management of black pepper foot rot

Treatments for the integrated management of foot rot in black pepper were laid out at Torla, Shiroda during 2013. The application of bio-agents was repeated in the fourth year. Results indicated that plants treated with talc formulation of biocontrol agent (*Trichoderma sp*) protected the black pepper plants from foot rot for almost over three years. Higher foot rot incidence (28%) was observed in the chemical treatment and in capsule formulation (31%) treatment. When talc formulation of a single bio-agent was used, maximum incidence recorded was 12.5%. However, non-treated plants in the adjacent plot showed complete mortality. Observations over a period of four years indicated that treatment with bio-agents protected the black pepper plants from foot rot. The plants treated with bio-agents are healthy, vigorous and produced fruiting spikes early. This management strategy could be recommended for cultivation of black pepper in this region.

Further, talc formulation of *Trichoderma* and *Bacillus spp* were provided to the farmers for demonstration of black pepper foot rot management during 2015-16. It was observed that the incidence of foot rot in the bio-control treated plots was less compared to the non-treated plants.





Research Achievements

Horticultural Science



01.03.201



**Project : Allele mining of banana genome sequences for genetic improvement
V Arunachalam**

The objectives of the project are to mine the genome sequence information to develop reliable markers associated with desirable traits and to develop a suitable breeding population/colchiploids for harnessing phenotyping techniques. Genomic DNA samples representing of 52 accessions of global mini-core germplasm set were procured from Global Musa Genomic Consortium. These DNA samples were assayed by PCR genotyping with the salt tolerance associated markers designed as above. The PCR products from target bands were eluted, purified and sent for sequencing. The sequences obtained were matched with nucleotide sequence database of banana genome hub. One of the sequences matched with phenolic glucoside malonyl-transferase 2-like gene located on chromosome 4. Salt sensitivity assay was optimised by exclusion in leaf margins and electrolyte leakage assay in tolerant cultivar Sugandhi of Pisang Awak group vis-a-vis susceptible cultivar of Grand Naine.



Putative Velchi derived tetraploid (AABB)

of the Velchi variety were planted for characterisation. Morphological traits of the root system, plant height and number of leaves were recorded on the putative colchiploids and the control diploid Velchi plants.

Growing shoot tips of banana suckers of local deployed (BB) cultivar were treated with colchicine 0.2 % solution to induce polyploidy. One each of the putative polyploidy and untreated diploid banana plant have initiated flowering and were scored using 15 diagnostic traits.

Half-sib progenies for allele mining and phenotyping

About 252 sexual seedlings of cultivar Rupa with BB genome were raised and transplanted twice in nursery bags. Six and nine months old seedlings were characterized for root and leaf traits. About 137 seedlings were transplanted to main field. Seedling plants varied in their size and phenotypic traits. Height of the seedlings varied from 25 to 225 cm after 9 months. Leaf angle of the seedlings was measured by mobile phone captured images using Digimizer 4.0 image analysis software for developing the digital phenotyping protocols.



Exclusion of salts from banana leaves

Genetic enhancement of banana by colchiploidy

Velchi is a small fruited delicious Goan variety of banana with a diploid (AB) genome. In order to induce tetraploids of the Velchi cultivar, growing shoot tips of banana suckers of cv. Velchi (AB) were treated with colchicine 0.2 % solution. Nineteen putative tetraploid plants along with seven untreated diploid check plants



Mother plant of Rupa (BB) seedy banana



Seedling of half sib progenies of single mother plant of Rupa (BB) seedy banana

Variability of phenotypic traits of nine months old sexual seedlings of banana

Parameters	Height (cm)	Stem circumference (cm)	Leaf length (cm)	Leaf width (cm)	No. of suckers
Maximum	225.0	87.9	111.0	56.0	3.0
Minimum	25.0	2.0	2.0	5.0	0.0
Mean	108.8	13.0	49.1	21.9	0.2
Standard deviation	48.2	9.3	24.6	9.6	0.6

Performance of banana varieties as intercrop in arecanut

Seven banana varieties [Safed Velchi (AB), Robusta (Cavendish -AAA), Amti (Mysore Poovan -AAB), Rasbali (Silk-AAB), Red banana (AAA), Myndoli (Giant Plantain (AAB), Grand Naine (AAA)] were evaluated in the interspaces of areca plant. Height, number of leaves and stem circumference were recorded at periodic intervals. Days to flowering, days to harvest, yield and bunch traits were also recorded. All the plants in the experiment were characterised using Musalogue descriptors. Photosynthetic rate of the banana plants were recorded using infrared gas analyser equipment. Myndoli and Red banana varieties have performed poor in shade due to incidence of pseudo stem weevil pest. Grand Naine (AAA) gave good and early yields in areca based system.



Bunch of banana varieties grown in areca as intercrop

Project: Collection, evaluation and management of fruit and spices
AR Desai

Survey for collection for germplasm

Four Mankurad variants namely, MKD-Azosim-1/1-17 from Azosim (Pilar), MKD-Narve-1/2-17 (Bicholim), MKD-Shiroda-1/3-17 (Ponda) and MKD-Santa Cruz-2/4-17 (Santa Cruz) were identified for their early- mid season bearing habit coupled with excellent fruit quality.

Conservation of mango in field germplasm bank

The Institute mango germplasm bank has got 123 accessions, comprising of 87 local varieties, 15 introduced hybrids, 12 introduced varieties and 9 variants of local Mankurad varieties.

Salient features of mother trees of newly identified Mankurad variants

Accession	Approx. age of tree (yrs)	Bearing Habit	Fruiting season	Fruit weight (g)	TSS (°B)	Total acids (%)
MKD-Azosim-1/1-17	>80	Regular	Early (Feb)	251.16	20.6	0.22
MKD-Narve-1/2-17	>90	Alternate	Mid season (March)	267.60	20.4	0.19
MKD-Shiroda-1/3-17	>65-70	Alternate	Mid late (1 st week of April)	288.40	22.8	0.18
Santa Cruz-2/4-17	20	Regular	Early (Mid Feb)	257.30	22.6	0.21



MKD- Santa Cruz-2/4-17 : An early season regular bearing accession having excellent fruit quality.



MKD- Azosim-1/1-17 : A regular and early bearing tree with medium to big sized fruits having good fruit quality.



Fruit and stone variability in mango germplasm collection

Evaluation of Mankurad variants

Of the 18 mankurad variants under evaluation, 12 accessions flowered during the current flowering season, but only two accessions viz. MKD-1-1/1 and MKD-19-3/6 recorded normal fruit set. Although, good number of hermaphrodite flowers were observed in the remaining 10 accessions, the fruit set was perhaps adversely affected due to wide diurnal variations in temperature that prevailed during flowering and fruit set time. Growth and development of fruit also appeared to be delayed unusually. Six newly planted grafts and two grown up grafts of Mankurad accessions were completely damaged by the wild fire incident in February, 2017.



Amrapali fruits

in April end. Fruits of Amrapali and Ratna recorded the higher levels of TSS @ 22.8 °B and 21.6 °B respectively as compared to 16.8 °Bx in Neelgoa. The corresponding values of total acids were 0.19, 0.16 and 0.28 per cent.

Nutmeg genetic resources

A total of 28 nutmeg germplasm collection comprising of 24 local seedling genotypes, 1 precocious bisexual seedling genotype, 2 improved varieties viz. Konkan Swad (from Dr BSKKV, Dapoli) and Vishwashri (from IISR, Calicut) and 1 wild species (*Knema orientalis*) is being maintained in the field.

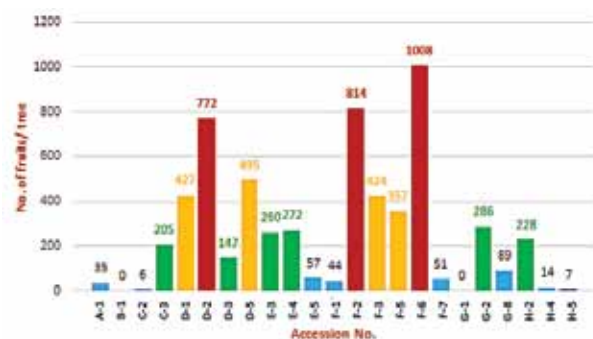
Nutmeg fruit yield varied from 6 fruits per tree to 1008 nuts per tree. Female dominated monoecious genotypes, namely NMD1, NMD2, NMD5, NME4 and NMF6 gave higher yield in the range of 427 (NMD-1) – 1108 (NMF-6) fruits per tree. The genotypes namely, NME3, NMF5, NMG8, etc, having equal proportion of male and female flowers appeared to be medium yielders. Male dominated monoecious genotypes



Fruit set in MKD-1-1/1

Performance of Mango hybrids

Amrapali, Ratna and Neelgoa continued to record higher fruit yield per tree (83.2, 69.4 and 44.8 kg/tree respectively). Although fruit yield was moderate in Ratna, fruit maturity time was optimum (2nd week of April) as against the late maturity fruits (1st week of May) in Amrapali, while Neelgoa fruits came to maturity



Yield performance of nutmeg genotypes



No of fruits /tree: 495,
Nut size: 4.6-5.6 g,
Mace wt : 1.15g

No of fruits /tree: 772,
Nut Wt.: 4.04-5.2g,
Mace wt : 1.06g

No of fruits/tree: 814,
Nut Wt.: 7.40g,
Mace wt : 1.0g

Female dominated Monoecious tree

namely, NMA1, NMC2, NME5, NMF1 consistently showed lower fruit yield trend. Female dominated monoecious tree NMF6 is found promising with 1008 fruits having mean seed nut weight of 8.02g and mace weight of 1.80g.

Promising selections, Tamsuli-1 and Tamsuli-3, continued to record higher nut yield, while Tamsuli-1 had unique feature of covering the entire nut with thickly developed mace. Tamsuli-1, a twelve year old bold nut selection recorded higher yield of 289 fruits per tree. The mean nut weight and mace weight per seed on dry weight basis were observed to be 6.2 g and 2.1 g respectively. On the other hand, Tamsuli-2 and Tamsuli-3 genotypes yielded 823 and 968 fruits with medium nut size (3.9 and 4.1g respectively) and dry mace per seed @1.55 and 1.78 g respectively.

Coconut based multi-species cropping system

A model of coconut based multi-species cropping system in about 0.5103 ha. comprising of banana, nutmeg, black pepper, betel leaf, elephant foot yam, drum stick, papaya and bee hive generated year round income from the unit. Coconut yield from the system was 4889 number of nuts from 48 yielding palms, with

an average productivity of 102 nuts per palm. About 1340 kg of banana hands were harvested, besides the income from the sales of suckers as planting material. Other high value crops like nutmeg (15.5 kg seeds, 1.89 kg dry mace), black pepper (6.7 kg) and elephant foot yam (887 kg) contributed significantly to the system. A large quantity of biomass such as Glyricidia leaves, coconut fronds, banana leaves and pseudo stem and nutmeg leaves were re-incorporated back into basins for recycling of nutrients in the system.



Elephant foot yam intercropping in coconut

Project: Survey, collection and evaluation and management of under utilized fruits of coastal regions

S Priya Devi

Various important tropical fruit crops are suitable for commercial cultivation in Goa and other coastal regions of the country. Under this project, biodiversity documentation and conservation are being focussed upon fruit crops like jack fruit and bread fruit, whereas, evaluation studies are being carried out on other fruit crops like, aonla, citrus, pomegranate, sapota etc., to find the suitability of the crop and also the variety for commercial cultivation in Goa. Postharvest studies on these fruit crops are also carried out under this project.

Jack fruit

In order to study the variability in jack fruit, field surveys were conducted in Ponda, Salcette talukas of

Goa and Sawantwadi (Maharashtra) for jack fruit during May-June, 2016. Based on descriptor, fruit characters of the accessions were recorded. There was wide variation recorded in traits like, stalk length (5.6 to 11.5 cm), fruit weight (3.62 to 19.36 kg), fruit length (31.2 to 68.2 cm), fruit girth (52.2 to 94.2 cm), rachis length (11.9 to 42.3 cm), rachis diameter (5.1 to 11.0 cm), number of bulbs per fruit (48 to 271), bulb weight without seeds per fruit (0.51 to 5.57 kg), weight of seeds per fruit (0.2 to 1.38), weight of inedible waste per fruit (2.05 to 8.2 kg) etc. The bearing ranges from early to late season; fruit rind colour yellow to blackish green; fruit shape oblong/ ellipsoidal/ irregular; spine shape flat to pointed; spine density sparse to dense; fruit quality poor to excellent;



bulb colour creamy white to deep orange; seeds with shapes ranging from elongate to reniform; seed surface plain or with striations. The accessions like Loutalim-1 and Curtorim-1 were promising for yield and quality traits.

Papaya

Fruits of F_2 crosses of families of 27/16 x 24/18, 21/7 x 21/9, 8/4 x 12/4 and of hermaphrodite plant no.15/10 have been harvested and seeds extracted. The progenies will be raised subsequently.

Aonla

Evaluation of Aonla varieties viz. Krishna, Kanchan, NA-7, NA-10 and Chakaiya is being continued. The trees are eight years old and maximum yield of one graft of Krishna was 200 kg per year whereas that of var Kanchan was around 120 kg. Varieties Krishna and Kanchan are promising in yield and individual fruit quality under Goa climatic conditions.

Storage studies in aonla

An experiment was conducted to study the storage behaviour of Indian gooseberry (aonla) fruits of var Krishna and Kanchan. The harvested fruits were dipped in different concentrations of Calcium nitrate (0.5, 1.0% and 1.5%) and a control batch was maintained without dipping. Then the fruits were packed in ventilated LDPE bags and stored under different storage conditions

(refrigeration, deep freezer and room temperature as control).

Under ambient conditions, the aonla fruits of variety Kanchan dipped in 2% CaNO_3 stored well for 16 days, with 4.58% PLW, and there was 35.71% spoilage; whereas the control (undipped) fruits stored for 12 days with 6.78% PLW.

Similarly, under ambient conditions the aonla fruits of variety Krishna dipped in 2% CaNO_3 stored well for 16 days, with 5.43% PLW, with 12.85% spoilage, whereas the control (undipped) fruits stored for 12 days with 12.61% PLW.

Under refrigerated conditions, the aonla fruits of variety Kanchan dipped in 2% CaNO_3 stored well for 16 days, with 3.95% PLW, and there was 38.57% spoilage after 14 days of storage; whereas the control (undipped) fruits stored for 14 days with 4.81% PLW and 1.42 % spoilage.

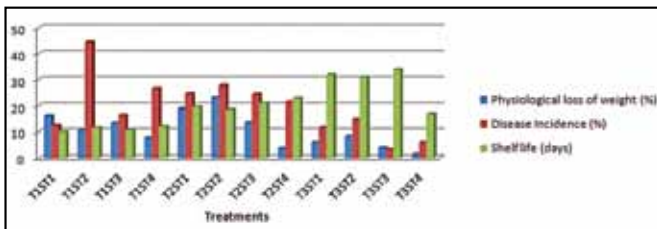
Similarly, under ambient conditions, the aonla fruits of variety Krishna dipped in 2% CaNO_3 stored well for 16 days, with 9.47% PLW, with 12.86% spoilage out of total number of fruits stored, whereas the control (undipped) fruits stored for 12 days with 12.61% PLW. The fruits of both the varieties kept in deep freezer kept well for 34 days, however showed chilling injury on thawing.



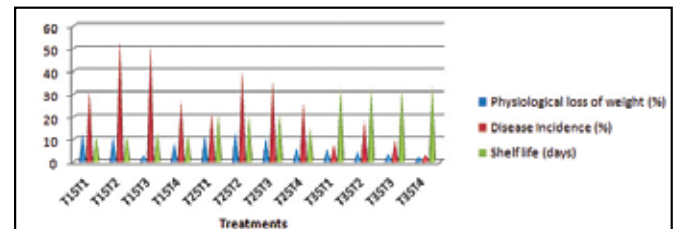
Aonla var Krishna



Aonla var Kanchan



Storage behaviour of Aonla variety 'Krishna'



Storage behaviour of Aonla variety 'Kanchan'

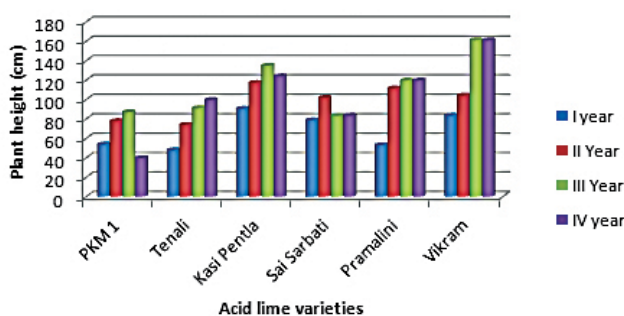
Acid lime

An evaluation trial with six varieties of acid lime viz., Vikram, Pramalini, Kasi Pentla, Sai Sharbati, Tenali and PKM-1 in RBD with four replications was laid out in July, 2012. The vegetative traits recorded during I, II, III and IV years consequently showed that there is a remarkable progress in growth in all the varieties. Kasi Pentla recorded the highest plant height (124.23 cm), no. of branches (2.6) and canopy spread (167.21 cm) during the fourth year.

In addition to this, a separate field was established during July, 2014 with fifty plants each of acid lime varieties, Vikram, Pramalini, Sai Sharbati and Nag Nimbu. Besides these, ten plants each of Pummelo, Sweet orange, Mandarin, Rough lemon and Rangpur lime were also planted in the field. This field is being maintained as a repository of citrus germplasm.

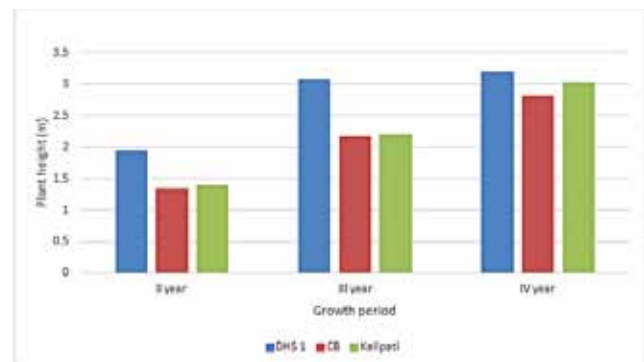
Sapota

An evaluation trial was initiated in 2008 with six varieties of sapota which was lost due to severe fire

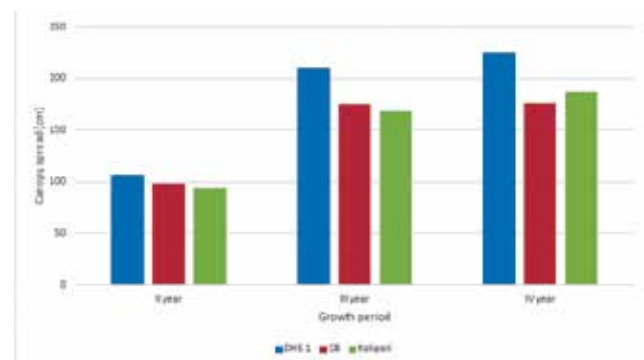


Increase in plant height in acid lime varieties over the past four years

attack. Subsequently, replanting was done during July 2013. The vegetative growth parameters recorded during the year of report shows that, DHS-1 recorded



Increase in plant height in sapota varieties



Increase in canopy spread in sapota varieties

better plant height (3.21 m), canopy spread (2.25 m) and maximum number of branches (2.17).

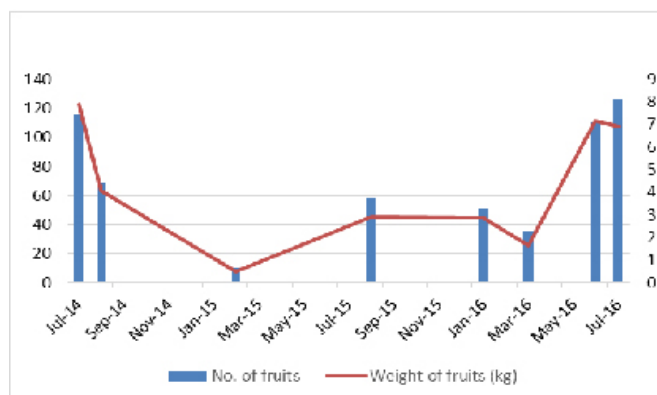
Performance evaluation of Lemon

Performance evaluation of lemon variety Konkan Seedless lemon was carried out in the

field. The plants are nearly five years old; the fruits were harvested in June-July, 2016. The average yield per plant was recorded as 13.5 kg with 342 number of fruits. The yield trend of the lemon plants over the past three years is depicted in graph. The bushes bear fruits during July- August and Jan-Feb during a year.

Pomegranate

An evaluation trial was laid out in RBD with six varieties of pomegranate viz., Bhagwa, Mridhula, Ganesh, Jalore Seedless, G-137 and P-26 in March, 2013 in order to study growth and yield performance of different pomegranate varieties under Goa conditions. After four years of growth, variety G 137 has recorded the maximum plant height of



Performance of Konkan Lemon in Goa over the past three years

182.50 cm.

Performance evaluation of Karonda var Konkan Bold

Vegetative Performance of Pomegranate varieties being evaluated

Variety/ Parameter	Ganesh	Bhagwa	Mridula	P 26	Jalore Seedless	G 137
Plant height (cm)	174.39	136.33	172.36	175.50	162.33	182.50
No. of branches	2.44	2.72	3.00	3.00	2.67	2.56
Canopy spread (cm)	132.75	133.00	140.21	115.50	114.33	140.72

Karonda var Konkan Bold plants are being evaluated for performance under Goa conditions. There was no flowering and fruiting during April-May 2015. Therefore, plants were pruned in January 2016 followed by spray of KNO₃ in February 2016. The bushes those were pruned and sprayed with 3% KNO₃ showed better flowering percentage when compared to bushes only sprayed and pruned. The control bushes did not show any flowering during Jan-Feb 2017.

Performance evaluation of ribbed cherry

Ribbed cherry bears during March- April under Goa climatic condition. Yield observations were recorded in Ribbed cherry. The average fruit yield of Ribbed cherry during the period of report is 1627.13 fruits per plant weighing an average of 4.97 kg. It is highly suitable for value added products like squash and jelly.



Flowering and fruiting in karonda



Fruiting in ribbed cherry

Project: Standardization and validation of Precision Farming Technologies (PFT) for major vegetable crops under climatic conditions of Goa
M Thangam

Precision Farming Technologies (PFT) in horticultural crops are widely practised for the unique advantage of quantum increase in yield per unit area with efficient usage of inputs like water, nutrient, plant protection chemicals etc. It is successfully demonstrated in states like Tamil Nadu, Maharashtra, Karnataka for different horticultural crops. With this background, this project is envisaged to standardize and validate different PFT for major vegetable crops of Goa.

Evaluation of chilli varieties and hybrids under drip and fertigation system

In chilli, four varieties viz., Nisha, Preeti, Aluva (F1 hybrids) and G-4 (OP) were evaluated under drip and fertigation system for morphological and yield traits. Among the varieties evaluated, the earliest flowering was observed in Nisha (24.80 days) followed by Preeti (27.50 days). Days to first harvest (for green chilli) was earliest in Nisha (35.50 days) followed by Preeti (40.50 days). The highest green chilli yield of 385 g/plant was recorded in Preeti followed by Nisha (372.85 g).



General view of Chilli in PFT field

Evaluation of brinjal variety (Ragini) under drip and fertigation system

In brinjal, Ragini (F1 hybrid) is being evaluated under drip and fertigation system as well as

conventional system. In general, flowering and days to first harvest were advanced under drip and fertigation system when compared to conventional system of cultivation. The individual fruit weight was highest under fertigation (85.50 g) when compared to open field (75.55 g). The highest yield of 650 g/plant was recorded under drip with fertigation followed by 425 g/plant under conventional system of cultivation.



Brinjal (Ragini) under drip system

Evaluation of bhendi hybrid (Jai Kisan-62) under drip and fertigation system

In Bhendi, Jai Kisan-62 (F1 hybrid) is being evaluated under drip and fertigation system as well as conventional system. In general, plant characters were better under drip system and other observations are under progress. The earliest flowering and more number of fruits were recorded under drip followed by open field method. Mulched beds with fertigation recorded the highest yield of 0.450 g/plant when compared to 0.258 g/plant under unmulched treatment.



Performance of Bhendi (Jaikisan-62) under mulching with fertigation

Project: Germplasm collection, conservation, evaluation and standardization of production and post harvest handling techniques of commercially important flower and foliage crops
Safeena SA

Identification of suitable cultivars of tuberose (*Polyanthes tuberosa* L.) for commercial cultivation under agro climatic conditions of Goa

Adaptation and acclimatization of different cultivars of tuberose under coastal humid climatic conditions of Goa are to be confirmed for recommendation of commercial cultivation. The data over a period of three years on evaluation of total six cultivars (Mexican Single, Pearl Double, Suvasini, Bangalore local Double, Calcutta Double and Pune local) were compiled and analysed. Data on three seasons of flowering were recorded and bulbs were dug out and cured. On the basis of observations recorded for growth and floral parameters cv. Mexican Single, Suvasini and Pearl Double could be recommended for commercial cultivation.



Performance of cultivars of tuberose

Technology standardization for extension of Vase life in tuberose (*Polyanthes tuberosa*) cv. Pearl Double

Post-harvest experiments were conducted in tuberose variety 'Pearl Double' which resulted in identification of right treatment for enhancing vase-life. Higher quality and longest vase life were obtained by using holding solution containing 8HQS–200ppm + GA₃ 25ppm+ AgNO₃ 50ppm+ Citric acid 50ppm+ Sucrose 3% compared to the other treatments studied.



Vase life in tuberose

Identification of promising local accessions of crossandra and establishment of Crossandra germplasm block

Different types of Crossandra viz., Crossandra local (Big dark orange), Crossandra local dark red (*Ratan aboli*), Crossandra local (light orange), Crossandra local (bright yellow), Crossandra local (dark orange) collected from different talukas of Goa were evaluated during the current season. Significant variation was noticed among local accessions of crossandra used for the study for various morphological and flower quality traits. A germplasm bank is being maintained at the institute to conserve the types of crossandra collected and documented.



Local accessions of Crossandra

Collection and evaluation of different Nerium accessions for high yield, prolonged shelf life and as standards for ornamental purpose.

The present field investigation was initiated to evaluate the performance of different varieties of Nerium (*Nerium oleander* L.) for growth and yield. Different Nerium varieties viz., Single red, Single rose /pink, Single tall white, Single dwarf peach, Double



Different nerium accessions

white, Double red, Single white with yellow centre are being screened for their suitability to be used as specialty cut flowers as well as loose flowers. All the tested Nerium varieties had acceptable vase life of 4 to 10 days with good quality flowers and sturdy stems. The study showed that Nerium types can be used by the local florist industry for diversified uses and to provide more choices to the customers.

Evaluation of different types of Caladium under agro climatic conditions of Goa

At present, different types / varieties of caladium viz., Torch, Rose bud, White Christmas, Aaron, Red frill, Heart delight, Tapestry, Red flash, Pink beauty, Pink cloud, Polka dot, Rose glow, Princess Taro, *C. steudneriifolium* and Dumbo have been collected, evaluated and maintained. The different caladiums studied exhibited a remarkable level of diversity in various leaf characteristics. The information derived out of this study will definitely help people involved in ornamental nursery industry to give appropriate planting recommendations of caladiums for their clients or customers. Caladiums are foliage plants suitable for shady areas in high rainfall zones.



Different types of Caladiums

Evaluation of Asparagus and Ferns for cut foliage production

A block comprising of Ferns and fern allies of Western Ghats was established at Farm B of the institute and regular observations were recorded on growth and yield of cut foliages. Ferns and fern allies viz., Sprenger fern (*Asparagus densiflorus* 'Sprenger'), Lace fern (*Asparagus setaceus* syn. *plumosus*), Compact sprenger fern (*Asparagus densiflorus* 'Sprenger' compacta), Fox tail fern (*Asparagus densiflorus* 'Myers'), Sword fern (*Nephrolepis exaltata*), Creeping fern/Wart fern (*Polypodium scolopendria*), Fish tail fern (*Nephrolepis biserrata furcans*), Button fern (*Nephrolepis cordifolia* 'Duffii'), Maiden hair fern (*Adiantum raddianum*), Leather leaf fern (*Rumohra adiantiformis*), Peacock fern (*Selaginella willdenowii*), Hard fern (*Blechnum orientale*),

Soft fern (*Christella dentate*), Staghorn club moss (*Lycopodiella cernua*), Silverback fern (*Pityrogramma calomelanos*) etc have been collected, maintained and evaluated for their suitability for use as cut foliages or fillers.

Collection and conservation of medicinal and aromatic Plants

The following medicinal plants have been collected, conserved and maintained in the Institute herbal garden (Medicinal and Aromatic Plant block) at Farm A (ATDC block) of the Institute.

Medicinal Herbs conserved include *Artemisia annua*, *Andrographis paniculata*, *Alpinia galanga*, *Aloe vera*, *Bryophyllum pinnatum*, *Catharanthus roseus*, *Centella asiatica*, *Coleus aromaticus*, *Costus igneus*, *Costus speciosus*, *Curcuma longa*, *Cymbopogon citratus*, *Cynodon dactylon*, *Cyperus rotundus*, *Hemigraphis colorata*, *Hedychium coronarium*, *Kaempferia galangal*, *Maranta arundinacea*, *Mentha arvensis*, *Ocimum basilicum*, *Ocimum sanctum*, *Phyllanthus amarus* / *niruri*, *Portulaca oleracea*, *Sida acuta*, *Tridax procumbens*, *Zingiber officinale*, *Withania somnifera* etc.

Medicinal Shrubs conserved are *Adhatoda vasica*, *Caesalpinia pulcherrima*, *Calotropis gigantean*, *Crossandra infundibuliformis*, *Datura metel*, *Graptophyllum pictum*, *Hibiscus rosa-sinensis*, *Jasminum sambac*, *Justicia gendarussa*, *Lawsonia inermis*, *Mimosa pudica*, *Murraya koenigii*, *Mussaenda frondosa*, *Nerium oleander*, *Pedilanthus titymeloides*, *Plumbago indica*, *Psoralea corylifolia*, *Rauvolfia serpentina*, *Ricinus communis*, *Sauropus androgynus*, *Solanum khasianum*, *Tabernaemontana divaricata*, *Tecoma stans*, *Thevetia nerifolia* etc.

Medicinal Trees conserved are *Aegle marmelos*, *Alstonia scholaris*, *Annona squamosa*, *Azadirachta indica*, *Bauhinia variegata*, *Bixa orellana*, *Brownea coccinea*, *Garcinia indica*, *Michelia champaca*, *Moringa oleifera*, *Phyllanthus emblica*, *Polyalthia longifolia*, *Sapindus laurifolius*, *Saraca asoca*, *Terminalia arjuna*, *Tectona grandis*, *Vitex negundo* etc.

Medicinal Climbers under conservation are *Abrus precatorius*, *Adenocalymma alliaceum*, *Asparagus racemosus*, *Cissus quadrangularis*, *Clitoria ternatea*, *Gloriosa superba* etc.



Glory lily
(*Gloriosa superba*)



Serpent wood
(*Rauvolfia serpentina*)

Project : Design of protected cultivation structures for Year round utilization in western region Mathala Juliet Gupta

The recommendations for modifying existing naturally ventilated greenhouse for favorable crop cultivation standardized under the project last year were

- 1) Inner side walls to prevent inflow of rainfall into crop area along both sides of greenhouse
- 2) Gutters on both sides of roof along length
- 3) Horizontal Axial Flow (HAF) mixer fans to maintain uniformity in microclimate
- 4) Fixing ventilating fans across the shortest width of the greenhouse with insect proof vents on all other vents (total ventilation rate 1-3 air changes per min)
- 5) Micro-sprinklers on roof along ridge

The effect of these modifications (except micro sprinklers on roof) on microclimate of an existing double span naturally ventilated greenhouse (DSGH) was evaluated with a tomato crop.

The optimum temperature and humidity suitable for tomato production are 20-35°C and 45-60% R.H. The average temperatures in the greenhouse were found lesser than the ambient in most cases and also well within the optimum temperature range required. But while the average humidity during day time was mostly well within the optimum range, the night relative humidity was exceeding the optimum range. This could be due to the fact that the ventilating fans were kept switched off during night time. But if we could automate the whole operation of fans, HAFs,

thermal net operation, using microcontrollers, we can reduce this overshoot of relative humidity during night time and also minimize electricity requirement by need based operation of the fans etc. Hence, a new project is being proposed for standardizing operation protocols and development of a microcontroller for microclimate management under these modified structures.

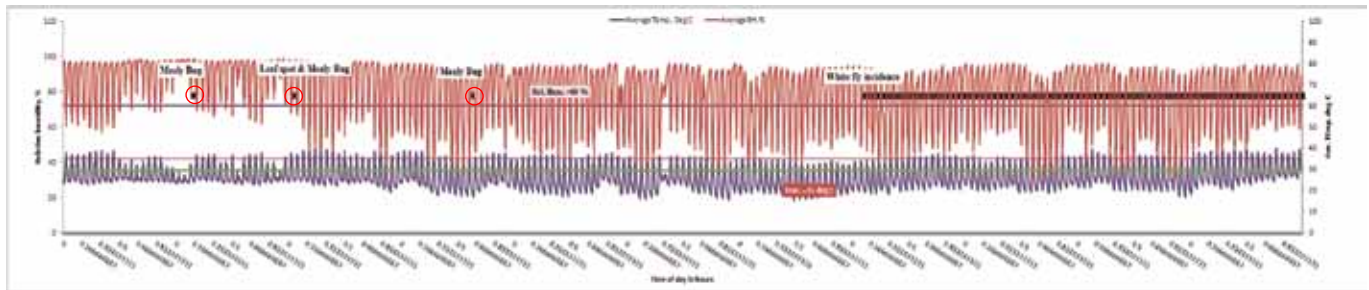
The effect of microclimate on the pests and diseases is summarized in the figure given below. Effect of microclimate on pests and diseases needs to be modelled based on cumulating the previous years data collected. This would help to develop insect and disease management protocols timely in the polyhouse.

The effect of introduction of horizontal axial flow fans and gutters on the microclimate of a single span naturally ventilated greenhouse (SSGH) with cucumber crop was also studied.

The optimum temperature and humidity for a cucumber crop is 15-32°C and 45-60% respectively. The temperature in the initial month of May was above the optimum but it reduced in the subsequent months. Hence if planting was done in month of June this unfavorable temperature condition could have been avoided. But the humidity in the structure could not be controlled within optimum limits due to lack of ventilating fans, hence a protocol based on opening the side vents could be developed or ventilated fans fitted to optimize relative humidity in the structure.

Microclimate inside double span green house after modifications

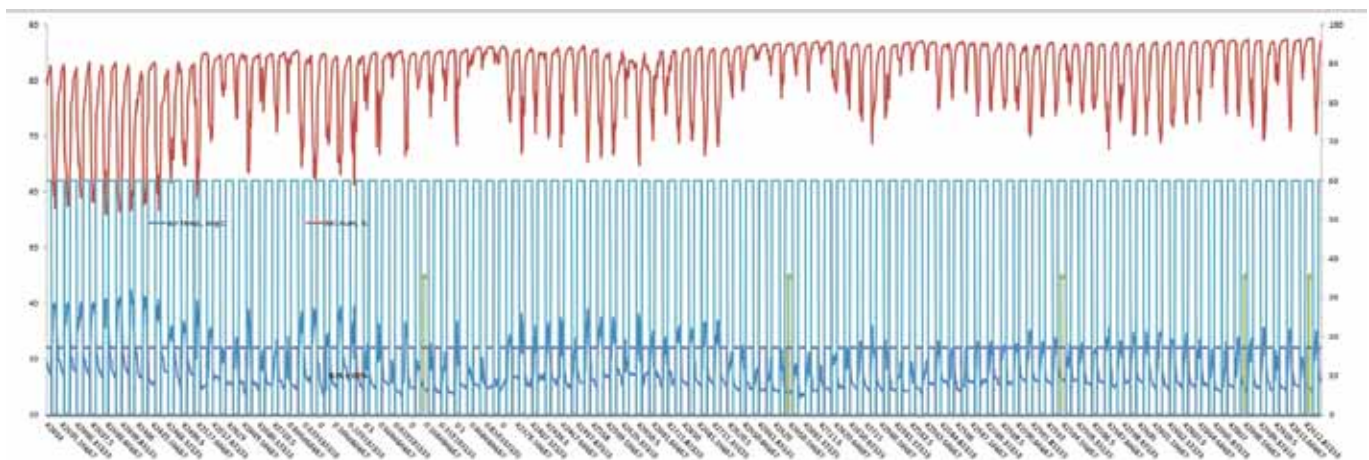
S.No.	Month	Ave. Temp \pm S.D (deg C)		Ave. Rel. Hum. \pm S.D (%)	
		DSGH	Ambient	DSGH	Ambient
Day (8 - 17 Hrs.)					
1.	September	31.27 \pm 3.59a	30.85 \pm 3.48	79.58 \pm 11.24	78.73 \pm 9.79
2.	October	32.38 \pm 3.94	33.13 \pm 4.41	72.98 \pm 13.75	68.48 \pm 14.50
3.	November	32.11 \pm 4.19	34.71 \pm 4.13	61.22 \pm 13.23	50.96 \pm 10.61
4.	December	30.94 \pm 4.43	33.20 \pm 3.92	61.29 \pm 14.82	51.09 \pm 12.40
5.	January	30.17 \pm 4.71	34.19 \pm 4.50	60.66 \pm 14.66	45.42 \pm 10.61
6.	February	32.06 \pm 4.57	35.40 \pm 3.43	63.22 \pm 16.22	49.58 \pm 12.56
7.	March	33.87 \pm 4.00	35.05 \pm 2.90	61.03 \pm 13.69	52.35 \pm 11.48
Night (18 - 7 Hrs.)					
1.	September	24.89 \pm 1.18	24.37 \pm 1.18	95.15 \pm 3.59	93.33 \pm 3.54
2.	October	24.33 \pm 1.58	23.54 \pm 1.63	94.30 \pm 4.25	90.43 \pm 8.30
3.	November	21.95 \pm 2.64	20.82 \pm 2.60	89.37 \pm 6.06	76.65 \pm 8.25
4.	December	21.89 \pm 2.96	20.76 \pm 2.83	86.94 \pm 7.62	76.84 \pm 8.25
5.	January	21.48 \pm 3.02	20.31 \pm 2.78	84.93 \pm 8.23	79.59 \pm 7.98
6.	February	24.06 \pm 2.71	22.72 \pm 2.46	87.31 \pm 8.19	79.92 \pm 7.03
7.	March	24.37 \pm 3.19	24.14 \pm 3.26	85.92 \pm 8.94	80.13 \pm 8.42



Effect of microclimate on biotic stress in modified double span green house

Microclimate inside single span green house after modification

S.No.	Month	Ave. Temp \pm S.D. , deg C		Ave. Rel. Hum. \pm S.D., %
		SSGH	Ambient	SSGH
Day (8:00 to 17:00 Hrs.)				
1.	May	37.42 \pm 2.81	38.019 \pm 2.57	61.92 \pm 8.62
2.	June	31.53 \pm 4.30	28.64 \pm 4.22	78.55 \pm 11.19
3.	July	30.33 \pm 3.36	28.15 \pm 5.41	83.83 \pm 8.08
4.	August	30.30 \pm 2.57	27.39 \pm 1.46	84.43 \pm 7.08
Night (18:00 to 7:00 Hrs.)				
1.	May	28.42 \pm 2.19	28.13 \pm 2.27	84.19 \pm 5.84
2.	June	26.09 \pm 1.82	26.80 \pm 2.48	90.19 \pm 4.31
3.	July	25.71 \pm 1.36	28.24 \pm 5.88	92.75 \pm 2.58
4.	August	25.81 \pm 1.10	26.74 \pm 1.53	93.93 \pm 2.61



Effect of the microclimate on biotic stress in the modified single span greenhouse



Tomato crop in double span greenhouse



Cucumber crop in single span greenhouse

Integrated nutrient management in banana and papaya

For sustainable production of fruit crops in the coastal regions, integrated nutrient management techniques need to be practiced. The soils of west coast regions are deficient in both macro and micro nutrients. Along with the conventional integrated nutrient management practices, an innovative nutrient mixture containing organic materials such as farm yard manure, goat manure, poultry manure and coir pith as the organic base materials were tested in this experiment. This mixture also contained the inorganic fertilizer components and biofertilizers. The field experiments with banana varieties Velchi, Saldatti and Papaya variety Madhu bindhu were constituted with five treatments (T1: Absolute control, T2: RDF alone, T3: RDF +INM mixture, T4: RDF+ Commercially available mixture T5: Organic manure alone) with three replications in FRBD design. These treatments have been imposed in field and study is in progress.



Integrated nutrient management plots of banana



Integrated nutrient management plots of papaya

Seed priming in papaya

Seeds of local papaya were treated with CaNO_3 and KNO_3 at different levels (1%, 1.5% and 2 %) along with the control (water) to analyze the effect of Ca and K ions and their concentration in seed germination and seedling vigour. The least days taken for germination (4.33), the highest germination percentage (82.56), shoot length (14.31 cm), fresh biomass (1.36 g) and dry biomass (0.174 g) were recorded for 1% CaNO_3 treatment. In another experiment, three varieties of papaya (Arka Surya, Arka Prabhat and Madhu bindhu) were treated with CaNO_3 at different levels (1%, 1.5% and 2 %) along with control (water). Arka Prabhat treated with 1% CaNO_3 recorded the least number of days for germination (4.75) and highest shoot length (25.2 cm). The experiment proved the significant effect Calcium ions in low concentration in the papaya seed germination. In order to study the existing soil nutrient status, initial field surveys, soil sample collection and analysis were carried out. The deficiency symptoms were also documented.



Seed priming in papaya with different levels of CaNO_3



Seedlings of three papaya varieties studied



Research Achievements

Animal Science





Project: Preparation/formulation of boar semen extender and pre-insemination fluid for artificial insemination in pigs

EB Chakurkar

Under this project Boar semen extender NBSE was formulated and tested for boar semen preservation. A pre AI fluid has been formulated and used for priming uterine tonicity before AI and tested at institute and also at other institutions in different parts of India.

This was filed for the patent on 11 August, 2016 with permanent serial number No.3037/MUM/2015 which was subsequently published on 17/02/2017 in Patent Journal of India. Boar semen Extender NBSE has been submitted to Agrinnovet Ltd. for commercialization.



Boar semen extender

Details	
APPLICATION NUMBER	15071mm/2015
APPLICANT NAME	Indian Council of Agricultural Research
DATE OF FILING	11/08/2015 13:42:30
E-MAIL (As Per Record)	icrar@icrarindia.com
ADDITIONAL EMAIL (As Per Record)	
E-MAIL (UPDATED ONLINE)	
DATE OF COMPLETE SPECIFICATION	16/08/2015 13:24:25
PRIORITY DATE	NA
TITLE OF INVENTION	EXTENDER FOR PRESERVATION OF BOAR SEMEN
PUBLICATION DATE (IPS IIA)	17/02/2017

Application Status
Status: Application Published

Project: Enhancing livestock performance by using advanced managemental and health interventions at institute livestock farms

EB Chakurkar, Shivasharanappa N, Rajkumar RS, Susitha Rajkumar, Chethan Kumar HB and Gokuldas PP

In this projects the activities like development of feed formulations (Pellet form) in different livestock by using locally available ingredients, collection and testing of clinical, morbid and tissue samples from farms for Brucellosis and other important diseases were carried out. Standardized feeding practices particularly for goats, pigs and dairy cattle for enhanced productivity. Body weight of Konkan kanyal goats improved significantly under stall feeding conditions at the age of 6 months (male-38kg and female 32kg). Mulberry and subabul plantation (180 plantations), CO5 and Cow pea 3 fodder were cultivated at goat unit. Six feed samples were processed for proximate analysis. The institute livestock farms were maintained with significantly lower morbidity and mortality of disease conditions. Regular vaccination, deworming, health checkup, screening for diseases, antibiotic sensitivity assays and fecal examination of parasitic worm load was performed. With this mortality in pigs, goats and poultry was less than 2% during this year.

Evaluation of Konkan Kanyal goats under stall feeding

Stall feeding and complete package of scientific goat rearing particular to Konkan kanyal goat breed



Konkan kanyal goats under stall feeding conditions

was standardized and disseminated. 30 breeding bucks and females were given to farmers for startup which generated revenue of Rs. 2,65,000/-.

Survey and documentation of indigenous cattle breeds of Goa

Initiated the work on survey and documentation of *Shweta kapila*, an indigenous cattle in north and south Goa districts. Questionnaire format for breed registration was developed as per ICAR-NBGAR guidelines and data of phenotypic characteristics was collected along with



Shweta kapila cow

geographical locations. Complete characterization of A2 milk protein gene from indigenous cattle is undertaken by PCR and sequencing.

Hatchery Unit

A semi automatic Incubator cum Hatcher Unit of 5000 eggs capacity was commissioned at this centre under RKVY project. The hatchery unit has air-conditioned egg storage unit, Candling facility and Generator facility. A total of 3000 poultry and quail chicks were produced in the last year and distributed to the various stakeholders.



Hatchery Unit



Natural enrichment in the form of New Duck Pond at CCARI

Duck-Fish Integration

In the integrated culture of fish and duck, both the components are mutually benefited. This combination increases the production of both fish and duck and reduces as much as 60% total input cost in fish culture by way of pond fertilizers and fish feed. The poultry/ducks also get about 30-50% of their food from the pond. The ducks feed on aquatic weeds, insects, molluscs etc., which do not form the food for fish. The ICAR-CCARI has initiated the integrated Duck Carp culture by procuring 100 Chicks of Kuttanad duck from Center for Advanced Studies in Avian Sciences (KVASU), Mannutty, Kerala.

Introduction of New Germplasm

To augment the integrated farming through duck culture, the coastal duck breed of Kerala, "Kuttanad" has been introduced. Further to promote Agro ecotourism, new Ornamental Poultry were been introduced in the current year.



Kuttanad duck

Sample collection and survey

A total of 160 sera, blood, faecal and nasal swabs were collected for disease investigation. Survey and sample collection from Dharbondora, Tatodi, Pratapnagar, Okam, Calangute, Bicholim, Pirna (North Goa) and Pirna, Kolvale, Khola, Canacona (South Goa), Sawantwadi, Nileli (Maharashtra) region was carried out. Information about breed, housing and managerial practices of Konkani Kanyal, Osmanabadi and Telicheri breeds was collected. Baseline statistics of goat husbandry status was analyzed in west coastal states viz., Gujarat Maharashtra, Diu and Daman, Goa, Karnataka and Kerala. The population statistics showed highest number of goats are in Gujarat followed by Kerala. Diu and Daman has meager number of goats. Goat breeds such as Usmanabadi, Surti, Sirohi, Konkani Kanyal, Telicheri are abundantly reared in west coastal India due to their adoptability in the coastal climate.



Sample collection and survey from goat herds in North Goa

Development of multiplex PCR assay, Biochemical and Antimicrobial assays and PFGE methods for characterization of *E. coli* O157:H7 and non O157:H7 from goats

E. coli O157:H7 and non O157:H7 were characterized from diarrheic goats (young ones) by selective isolation in *E. coli* O157 MUG identification agar and Eosin methylene blue agar. Out of 150 rectal fecal swab samples that were plated onto EMB agar, 143 yielded multiple metallic green colonies from which pure single colonies were obtained and streaked onto selective media MUG agar. The secondary growth on the MUG agar yielded 24 colorless, smooth and circular colonies. The identified *E. coli* positive isolates that were inoculated in the phenol red base broth along with the D-sorbitol discs showed maximum percentage to have fermented sorbitol. The susceptibility of the *E. coli* isolates to antimicrobial agents was tested by the disk diffusion on Muller-Hilton test agar.

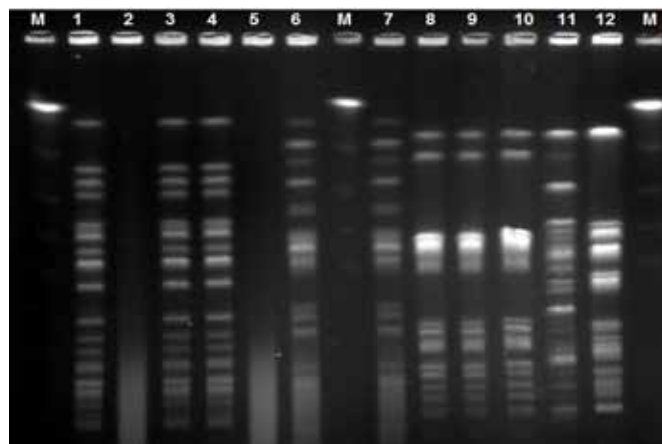


Multiplex PCR assay for *E. coli* virulence genes; *stx1*, *stx2*, *eaeA* and *hyLA*. Lane M: 100bp plus DNA marker, Lane 1-14 positive *E. coli* isolates; *stx1*- 180bp; *stx2*- 225bp; *eaeA*- 384bp; *hyLA*- 534bp

Genomic DNA was isolated from pure bacterial colonies and quantified using a nanodrop spectrophotometer for template in multiplex PCR reaction. Multiplex PCR was standardized by following optimal conditions: reaction volume of 25µl was used, in which 12.5µl included of the Dreamtaq green master mix (Thermo Scientific), 10pmol each of forward and reverse primers, 100ng of the target DNA template and 3.5µl of Nuclease-free water. The thermocycling conditions used were 95°C denaturation for 5mins, 35 cycles of 95°C denaturation for 30 secs, 55°C annealing for 30 secs, 72°C extension for 1 min and the finally 72°C extension for 10 mins. The amplified DNA was separated using gel electrophoresis using agarose concentration at 1.2% and stained with ethidium bromide. The DNA bands were visualized and recorded using the GelDoc A1phaimager fluorescent imaging system.

Pulse Field Gel Electrophoresis

Individual non-O157 *E. coli* isolated was grown on Brain Heart Infusion agar plates for 18 h at 37°C for pulsed-field gel electrophoresis (PFGE) analysis. Isolates were then embedded into 1% agarose gel plugs and were subjected to cell lysis for four hours, subsequently washed five times thoroughly. All isolates



PFGE Characterization of *E. coli* pulsotypes in goats

were then subjected to restriction enzyme digestion with XbaI for three hours and processed according to the PulseNet protocol Gel (Ribot et al., 2006) using CHEF DR III (BIORAD) with electrophoresis conditions suitable for non-O157 *E.coli* (i.e. initial A time-6.76s; Final A time-35.38s; Voltage-6V; run time-20h). After

de-staining, images were obtained using the GelDoc Aplhaimager fluorescent imaging system (Alpha Innotech cooperation) and the PFGE banding patterns were normalized and evaluated using BioNumerics software. Isolates displaying 100% Dice similarity were considered to be the same PFGE subtype.

Project: Epidemiological surveillance of economically important diseases of Dairy animals in the West coast
Susitha Rajkumar and Shivasharanappa N

Screening of milk samples for major mastitis causing pathogens

Mastitis is an important disease of dairy animals. Milk samples from mastitis cases were screened for major mastitis causing pathogens viz. *Staphylococcus aureus*, *Streptococcus sp.*, *E. coli* and Mycotic pathogens. Coagulase positive *Staphylococcus* was isolated from milk samples. Presence of *Staphylococcus aureus* was confirmed by PCR amplification of *nuc* gene. Fifty five

milk samples from subclinical mastitis positive quarters were screened by PCR and 15 were found to be positive for *S. aureus*.

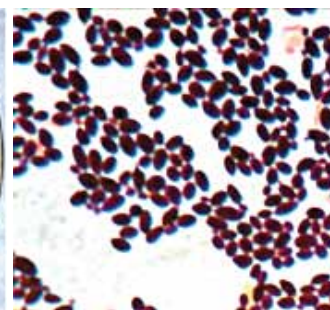
Mycotic mastitis was detected in samples collected from subclinical and clinical mastitis cases. Out of 55 milk samples, yeast colonies suspected of *Candida sp.* was isolated from 4 samples in Sabarauds Dextrose Agar. Growth of yeast pathogens were confirmed by subculture and staining which is indicative of fungal mastitis.



PCR amplified 300bp sized product of *nuc* gene of *Staphylococcus aureus*.



Yeast colonies on Sabarauds Dextrose Agar



Yeast cells from isolates from mastitis milk samples on Gram staining (Light microscopy 100X)

Project: Analysis of rural backyard poultry farming practices in West Coast of India
R Solomon Rajkumar

Comparison of nutritional qualities of eggs improved variety of Chicken with Free-Range Indigenous (desi) and Commercial Chicken

The nutritional quality of eggs from the improved varieties of rural backyard chicken is the most important factors for popularization of the backyard farming. There is a widespread consumer preference to these eggs, as they physically resemble the free-range local (Desi) eggs. Therefore, the current study

has been carried out to evaluate the nutritive quality of the egg from improved varieties of rural backyard chicken (Gramapriya) in comparison with free-range local (Desi) and commercial chicken (White Leghorn). The samples are being submitted to NABL accredited nutrition laboratory at ICAR-Central Institute of Fisheries Technology, Kochi for the analysis of amino acid, fatty acid and cholesterol composition and the results are awaited.

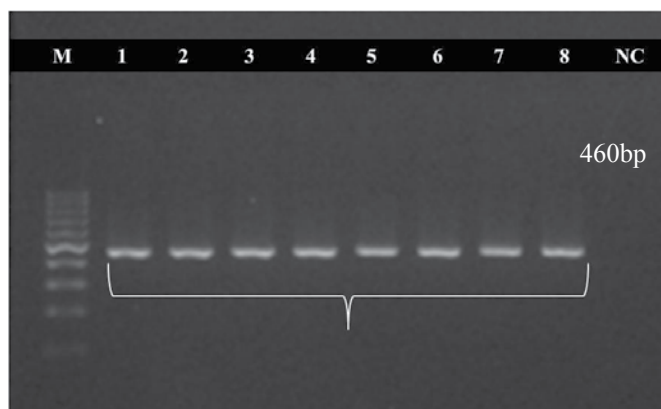
Project: Prevalence of swine associated zoonotic parasitic diseases in Indian West coast
Chethan Kumar HB

The project was undertaken to assess the prevalence of major zoonotic parasitic diseases in swine in Indian West coast. During 2016-17, linkage was established with eight pig farmers of Goa and Maharashtra, one butcher from Goa, and Deonar abattoir of Mumbai Municipal Corporation. A total of 26 fecal samples, 59 diaphragm samples and 45 serum samples from pigs have been collected from Goa and Maharashtra. During slaughter of pigs 182 carcasses (Maharashtra (n = 153) and Goa (n=29)) were also examined visually for the presence of cysticercosis and hydatidosis. The fecal samples were analysed for the presence of gastrointestinal helminth eggs, protozoan cyst, oocyst and trophozoite using sedimentation and flotation techniques. Among them 15 samples were positive for any one gastrointestinal parasite. Prevalence of

Coccidian oocysts (*Eimeria* and *Isospora*) was the highest (57.69%), followed by *Trichuris ova* (3.8%). All the fecal samples were subjected for DNA extraction using QIAamp DNA Stool mini kit and tested for the presence of *Cryptosporidium* using polymerase chain reaction. None of the samples were found positive for *Cryptosporidium*. The 59 diaphragm samples were screened for the presence of *Trichinella* spp larvae using artificial digestion assay. All the samples were found negative. Out of 182 carcasses examined one carcass was positive for hydatidosis in liver in Deonar abattoir, Mumbai. The Hydatid germinal layer and cyst fluid was subjected for DNA isolation, amplified using PCR and sequenced. Through BLAST analysis of the sequence it was found that the hydatid cyst belongs to *E. granulosus* sensu stricto genotype 3.



Pig liver infested with multiple hydatid cysts



PCR amplification of cytochrome c oxidase sub unit 1 gene of Echinococcus granulosus from hydatid cyst. Lane M – 100bp DNA ladder, Lane 1-8: Hydatid DNA, Lane NC - Negative control

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

The project was undertaken to assess the impact of different bio-meteorological factors viz. light intensity, photoperiod, relative humidity and THI in different seasons on overall reproductive response in dairy buffaloes reared under coastal climatic conditions. In the first phase, retrospective analysis of breeding performance in dairy buffaloes along with monitoring and recording of different bio-meteorological factors were initiated. Breeding records of Murrah buffaloes, aged between 4 and 13 years were screened for evaluation of reproductive performance. Mean age at puberty in dairy buffaloes was found to be 37.75 months whereas age at sexual maturity was 39.5 months. Mean gestation period of 310.42 days and apparently longer calving interval of 19.60 months could be observed in the breeding herd. Initial survey work on existing

buffalo production systems and preparation of status report are underway.



Murrah Buffalo

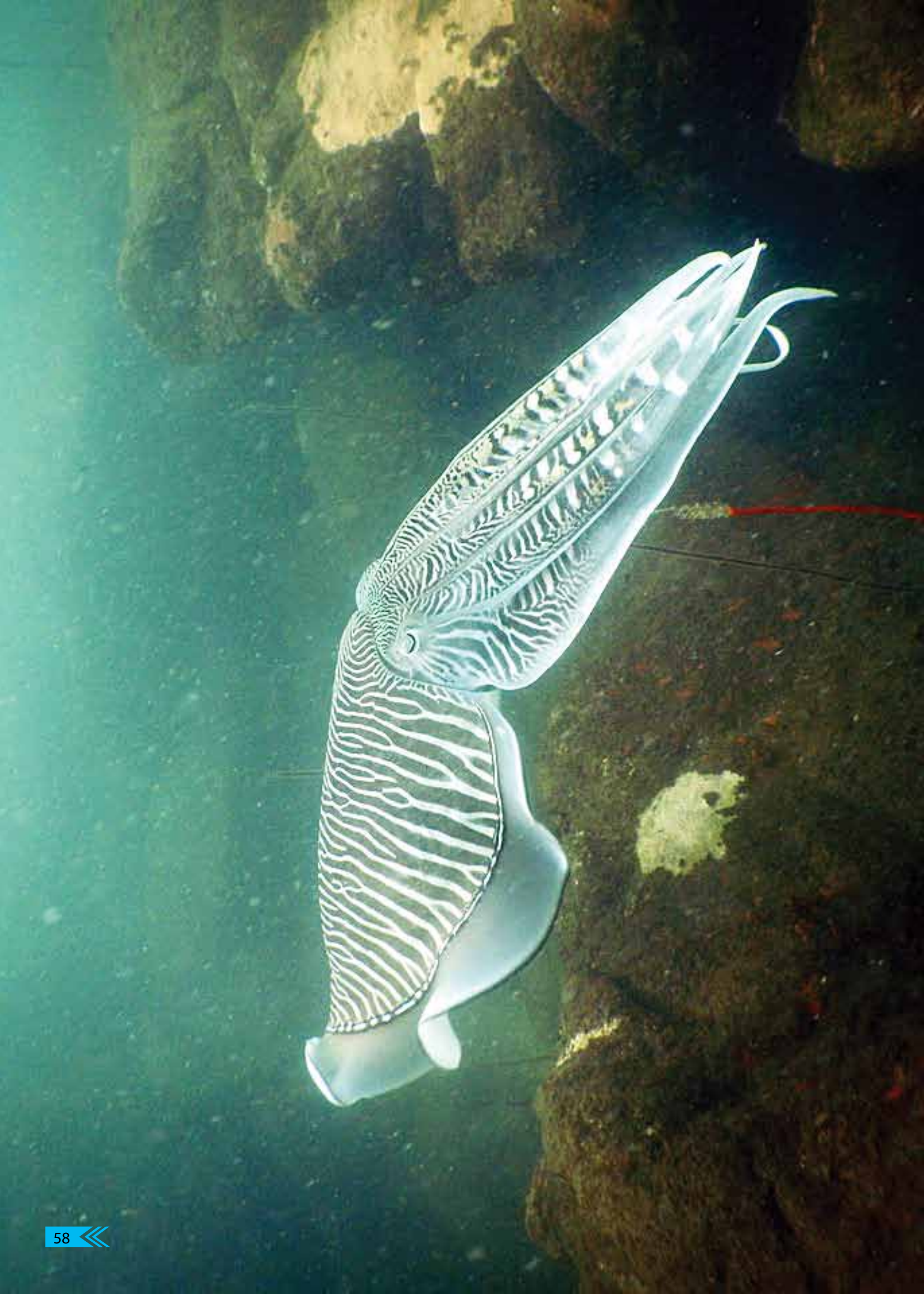
Retrospective analysis of breeding performance in dairy buffaloes reared under coastal conditions

Animal ID	Age (yrs)	Body Weight (kg)	Parity	Age at puberty (months)	Age at sexual maturity (m)	Generation Interval (months)	Gestation period (days)	Inter-calving period (m)	Calving to estrus interval (wk)	Calving-Conception interval (w)
2	13	673.79	5	38	39.5	81.10	309	17.75	21.00	21.00
3	13	846.71	4	46	48.0	79.00	310	13.00	9.00	12.25
5	13	700.50	4	45	46.5	68.40	311	23.00	37.00	37.00
6	12	706.44	4	51	52.0	73.30	308	12.40	6.70	12.00
8	13	722.62	3	43	46.0	88.50	310	20.00	28.00	31.00
14	13	713.68	4	45	46.0	86.00	311	26.50	31.30	31.30
GA-01	12	663.59	3	49	50.5	74.70	310	31.00	28.00	31.00
GA-02	8	307.62	3	22	24.0	59.30	313	24.00	28.50	28.50
GA-03	6	535.28	2	36	38.0	54.50	312	12.00	13.50	17.00
GA-04	6	565.44	2	33	35.0	57.00	311	19.00	33.00	53.00
GA-05	4	533.42	2	24	25.5	45.50	311	17.00	14.00	23.00
GA-06	4	430.30	1	21	23.0	34.00	309	-	16.00	28.00

Research Achievements

Fisheries Science

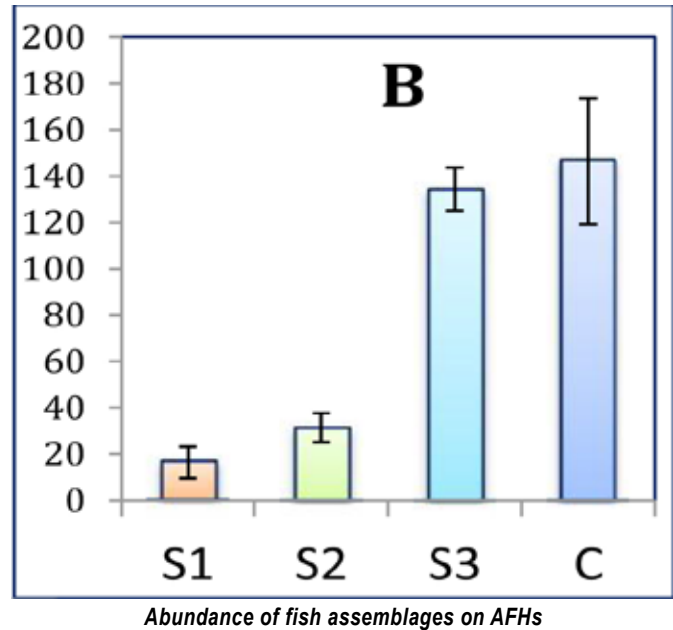




Project : Augmentation of fishery and fish biodiversity in the near shore marine areas of Goa through artificial fish habitats
Sreekanth GB and Manju Lekshmi N

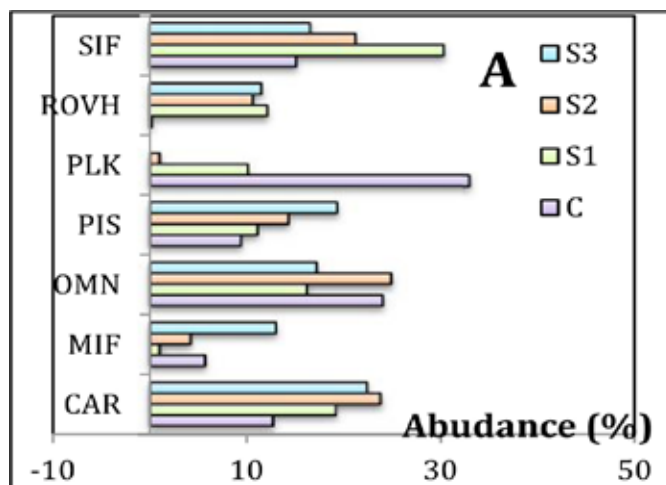
To rejuvenate and replenish the fish communities in Zuari, nine rectangular Artificial Fish Habitats made of RCC (3 types: 1*1*1m, 1*1*0.5m and 1*0.5*0.5m) were constructed and deployed with the participation of fishermen community. A total of twenty divers were conducted during January, 2016 to March, 2017 at the deployed AFHs at three sites (3m, 6m, 9 m) in the mouth of estuary. However, the species identification was successful inspite of the low visibility and 50 species were counted on AFHs and the maximum abundance of *Heniochus acuminatus*, *Halichoeres nigrescens*, *Lutjanus russelli*, *L. fulvus*, *L. lutjanus*, *Pomadasys furcatus*, *Acanthurus blochii*, *P. chubbi*, *P. gibbosus*, *Acanthurus nigroris*, *Chaetodon collare*, *Chromis chromis*, *Sepia pharaonis*, *Uroteuthis duvaucelli*, *Epinephelus coioides* and *Epinephelus erythrurus*. The species diversity and abundance were higher at deeper AFHs. Moreover, density of trophic guilds like piscivores, mobile invertebrate feeders, roving herbivores and carnivores were maximum in deeper AFHs. The attachment of various communities on the AFHs were also analysed and it was found that the communities like oysters, sponges and ascidia were maximum on the deeper AFHs. The favourable habitat characteristics in terms of vertical relief, upper column free of obstacles and deeper shelter habitats must have attracted the communities more towards the deeper AFHs.

There was 30-40% improvement in income by fishing near to AFH sites than fishing from non-AFH sites. The net profit (calculated by subtracting wages, fuel cost, depreciation, administrative and maintenance

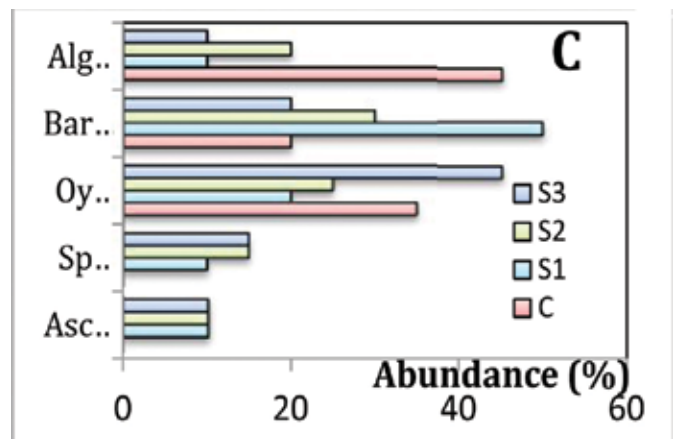


cost from the total value of the catch) from a single fishing operation was estimated to be Rs. 353 in Non-AFH sites compared to Rs. 496 in AFH sites. It yielded an additional increase in income for fishermen by more than Rs.100/fishing. This is on account of the catch of economically important species aggregated on the AFHs (snappers, groupers, cuttlefish, squids).

A total of 62 fish species from 26 families was recorded from the shipwreck in Grande Island, Goa. The most abundant species on the shipwreck were *Pempheris multiradiata*, *Ostorhichus compressus*, *Lutjanus indicus*, *Heniochus acuminatus*, *L. fulvus*, *Epinephelus coioides*, *Pomadasys guoraca*, *Pomadasys furcatus*, *Odonus niger*, *E. erythrurus* and *Monodactylus argenteus*. Species like *Caesio cuning*, *C. caerulea*, *C. striata*, *Chaetodon collare*, *Caesio xanthonota*, *Acanthurus dussumieri*, *Arothron hispidus* and *Apolemichthys xanthurus*. These



Percentage abundance of various trophic guilds (SIF: sessile invertebrate feeders, ROVH: roving herbivores, PLK: planktivores, PIS: piscivores, OMN: omnivores, MIF: mobile invertebrate feeders, CAR: carnivores, S1: 3m, S2: 6m, S3: 9m and C: control)



Percentage abundance of substrate communities on the AFHs

fishes are basically from fish groups like snappers, butterfly fishes. Grunts, Groupers and damselfishes. Fishes from all trophic levels (herbivores, planktivores, carnivores, omnivores) were observed on the shipwreck. This indicated that the shipwrecks can act as artificial fish habitats, attracting assemblages of fish species and leading to enrichment and a greater diversification of the local fish assemblages. Moreover, the high diversity and abundance of the species of fisheries importance

on the wreck site compared to natural reefs indicated that it supports the local fisheries. There were 32 ecologically less resilient fish species and 23 vulnerable fish species observed on the wreck. This underlines that the wreck acts as a refuge for the vulnerable fish species. The higher habitat complexity on the wreck site might have attracted the fish assemblages on the shipwreck.



Project : Development of coastal mariculture in brackish water areas of Goa Manju Lekshmi N and Sreekanth GB

The project is aimed to assess the ecological and economic impacts of the coastal aquaculture in Goa and major focus is on the livelihood improvement. Mussel culture in rack structure was standardized for coastal waters. To popularize and standardise the mussel culture technology in Goa, demonstrations, guidance, scientific advisories and monitoring were carried out. Seed availability was the major constraint for monoculture of mussel in Goa, Multispecies capture based culture with finfish and shellfish was tried in coastal waters and it was found to be a suitable culture system for Goa.

For that, selected traditional aquaculture systems, species and production technology which are socially acceptable and capable of generating a profit without degrading the environment. Integration of finfish and shellfish culture trails and demonstrations in different types of coastal water bodies (open water systems as well as semi-enclosed coastal water systems) were experimented and a comparative evaluation was done on different aquaculture systems suitable for the marginal farmers in coastal areas. A total of four aquaculture systems in coastal areas were selected:

open water system with mussel culture (OWSM), open water system with multispecies culture (OWSMS), semi-enclosed water system with mussel culture (SEWM) and semi-enclosed water system with multispecies culture (SEWMS).

In Multispecies aquaculture system, continuous stocking and harvesting system, finfishes like red snapper (*Lutjanus argentimaculatus*) and pearlspot (*Etroplus suratensis*) were cultured in combination with a shellfish species, Green mussel, *Perna viridis* for a period of eight months. Certain semi-enclosed sluice operated areas are rich with mussel seeds were also stocked in pre-stitched cotton mosquito net bags centered with nylon rope (Length-1m, diameter-14 mm). The bags were hung from the bamboo poles used for fixing the cages. Feeding for the selected candidate species were also standardized for the selected technologies.

Mussels have utilised the plankton available in the water through filter feeding. In finfishes, the carnivorous fishes were fed with chopped discards (ghost crabs, small weed fishes and molluscs etc. depends on body

weight-2% of body weight) and fishes like pearlspot and mullet were utilised the periphyton developed on the split bamboo pieces kept inside the cages.

Economic evaluation was also performed for the different aquaculture systems in coastal waters of Goa on an annual basis and the break-even analysis has been carried out to compute the cost structure of different culture systems from 2013 to 2015. An opinion survey was also conducted to study the effect of different aquaculture technologies introduced in coastal waters of Goa. Among the four different culture systems studied, the semi-enclosed multi-species culture system (SEWMS) was the most productive system. Benefit cost ratio and rate of return were highest for SEWMS. The short payback period was also recorded in SEWMS. Thus, multi-species culture was found to be more profitable than single species culture for the similar culture period. Moreover, in the semi-enclosed system, the productivity and survival of species was higher due to the control of water flow through sluice gates.

Goa is rich in semi-enclosed water bodies which were used for shrimp farming and these can be utilized for multi-species culture. The feedback from the farmers about the dissemination of culture techniques revealed that adequate technical support increases the confidence level of the farmers.

A mass balance trophic model was constructed for the semi-enclosed aquaculture system and has provided some useful information about ecosystem

features of the ecosystem. The estimated ecosystem indices were generally high for the ecosystem in comparison with the values obtained for the major aquatic ecosystems of the world. This ecosystem is very small and is highly productive in which the freshwater is well mixed with the saline water. In this study, seven scenarios were constructed considering the number of cages, number of fish seeds collected and corresponding fishing mortality on the fishery groups.

From the results of the simulations for a period of 10 years, it was inferred that an ideal solution will be a system with maximum area utilisation without hindering the sustainability of the ecological groups. For this, the average values of relative biomass for the fishery groups in each scenario were analysed and an optimal solution was observed with maximum possible number of cages without sacrificing the threshold biomass for the fishery groups. In this scenario, there was maximum utilisation of the area and maintenance of biomass well above the threshold level.

A battery of two cages for red snapper and two cages of pearlspot with 20 mussel ropes was considered as an optimal solution for coastal aquaculture in the semi-enclosed system. The results presented in the simulations are predictions for a period of 10 years and hence, it has to be validated with proper experimental trials. However, it helps to identify optimal solutions for sustainable aquaculture activities along the coastal waters of Goa. With these findings the project was concluded in 2016.



Multispecies aquaculture



Research Achievements

AICRP Projects
Externally Funded Projects





AICRP Projects

Project : All India Co-ordinated Research Project on Integrated Farming Systems (ICAR) Parmesha V

A rice based farming system model (crop-dairy) 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/mong/chili/sweet corn – 0.4 ha), forage grown bunds (Hybrid napier - 0.032 ha), Dairy (24 m²- 2 cross breed cows), FYM unit (10 m²) and kitchen garden (80 m²). The net return from the model was ₹. 1.05 Lakhs during one year and this is excluding the cost of farm employment generated and products recycled within the system. The value of the farm employment generated and value of products recycled within farm was ₹. 0.68 lakh and ₹. 0.32 lakh. Besides the higher net return, the system also has an advantage of the round the year income and positive effect on the soil health, which is reflected on increased nutrient availability and microbial properties.

The rice-chili-dairy was the most profitable of the four systems fetching gross returns of ₹.1.08 lakh whereas, net returns of ₹. 0.75 lakh and net returns and gross returns earned by the rice-cowpea-dairy system were ₹. 0.09 lakh and ₹. 0.15 lakh, respectively, making it the least profitable. The energy analysis among different cropping systems indicated that, rice-chili cropping system has produced higher energy output (33815.2 MJ/ha), energy use efficiency (2.0), energy profitability (1.0 MJ/₹) and human energy productivity (8.2 MJ/labour) over other cropping systems.

Livelihood analysis of integrated farming systems

Out of the total value of the farm produce i.e. ₹ 2.17 lakh, the marketable surplus was around ₹ 1.97 Lakh.

As the unit doesn't have a farm family, the value of marketable surplus is higher. Of all the enterprises, the crop component showed maximum economic returns followed by the dairy enterprise. The value of inputs purchased from market and farm labour engaged is ₹ 0.64 lakh and ₹ 0.72 Lakh, respectively. The value of inputs generated and recycled within farm is ₹ 0.32 Lakh. The benefit:cost ratio was calculated and found to be 0.94 excluding the farm employment generated.

Evaluation of the plantation crop based upland integrated farming system

The different enterprises in the upland IFS models are Cashew (Bhaskara) + Pineapple (Giant kew) in an area of 0.25 ha, Coconut (Benaulim) + Pine apple (Giant kew)+ Noni + Tapioca in an area of 0.23 ha, Arecanut (Mangala)+ Banana (G-9) in 0.22 ha, Piggery (48.00 m²), Poultry (56.96 m²), Compost unit (42.7 m²), Direct catch pits - 6 nos.(10.89 m² each). Among different horticulture based cropping systems, cashew + pineapple has recorded higher net return (₹ 0.18 lakh) followed by arecanut + banana (₹ 0.17 lakh). The piggery enterprise has produced higher net return (₹ 0.34 lakh). The total net return from the above model was ₹ 0.89 lakh during one year. The % contribution of piggery to the net return was found considerably high (38%). The value of recycled products with in the farm was ₹ 0.28 lakh. The benefit cost ratio from the system was 1.25.



Rice based lowland integrated farming system



Arecanut + Banana intercropping system

Coconut based cropping systems for different agro-climatic regions

Post-experimental nutrient data was recorded in the plot and the potassium levels in the soils were found to be low. Pre experimental average coconut yield in the experimental plot was 47 nuts /year/ palm during July, 2014 to June, 2015. Coconut yield per palm during the year after intercropping was 57 nuts/ palm/ year. Heliconia cv Guyana and Crossandra (Canacona Local Red) performed best under coconut shade so



Performance of Heliconia cv Guyana as intercrop in coconut

far. Other intercrops are in the pre-bearing stage. Heliconia flower yield obtained per plot of 16 m² over the first four months of harvest was 40 stems/month. Crossandra flower yield obtained per plot of 16 m² over the first month of harvest was 80.5 g/month.

Establishment of mother blocks and production of quality planting material in Arecanut

Observations were recorded in the seedlings at the new block. Growth, morphology, leaf angle, flowering and yield data were recorded on the six years old open pollinated progenies of Hirehalli Dwarf plants. Digimizer 4.0 image analysis software was used to measure leaf angle. Correlation and regression coefficients were developed to identify the dwarf stature based on phenotypic traits.

About twenty two palms of old block planted during 2011 started flowering and fruiting. More plants (15 no.) were added to the new block. Third new block is being developed at Farm C. Followed by land clearing and levelling works, pits were made to accommodate 75 plants.

Nutrient status of soil samples in coconut experimental plots

Treatment	pH	EC (ds/m)	OC (%)	N (kg/ha)	P ₂ O ₅ (kg/ha)	K ₂ O (kg/ha)
T ₁ - Coconut + Black pepper + Papaya + Drumstick	5.92	0.04	1.07	222	11	103
T ₂ - Coconut + Black pepper + Heliconia	6.15	0.06	1.11	216	13	100
T ₃ - Coconut + Black pepper + Banana + Lemon	5.94	0.08	1.34	200	9	110
T ₄ - Coconut + Black pepper + Passion fruit + pine apple	6.09	0.03	1.03	232	12	103
T ₅ - Coconut + Black pepper + Annona	6.23	3.42	0.74	233	10	129
T ₆ - Coconut + Black pepper + Crossandra	6.04	0.06	1.28	234	13	116
T ₇ - Coconut Monocrop	6.15	0.09	0.89	195	10	109

During season 2016, three new accessions from Tiswadi taluka having bold apples and nuts were identified and added to germplasm collection. The characteristic features of the mother trees of these accessions were studied.

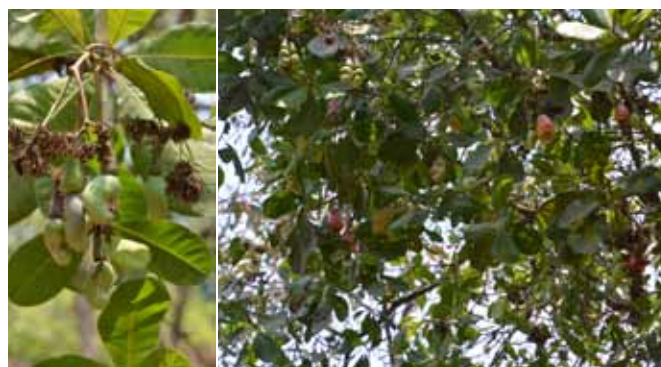
Subsequently, a total of 97 germplasm accessions of cashew representing the following different groups is being maintained at Goa Centre.

- Jumbo nut types : 17 accessions
- Bold nut types : 40 accessions
- Medium nut and high yielders : 13 accessions
- Other high yielders irrespective of nut size : 23 accessions
- Dwarf canopy types : 3 accessions
- Very compact canopy type : 1 accession

Total germplasm collection : 97 accessions

Characterization of selected local bold nut cashew genotypes

The results on characterization of 14 genotypes (Valpoi-1, Valpoi-2, Valpoi-3, Bardez-3, Bardez-9, Tiswadi-7, Tudal-1, Tudal-3, Mayem-1, BKL-1, BKL-2, FMGDI-1, Tiswadi-3 and Goa-1 as check) revealed that the accession Valpoi-2 showed vigorous growth with maximum tree height of 4.64 m with collar girth of 59.47cm followed by Valpoi-3 with corresponding values of 4.58 m and 57.6 cm respectively, both of which started flowering from 2012 along with other accessions namely, Valpoi-1 and Tiswadi-3 with medium vigorous growth habit. Bardez-8/98 recorded the highest nut yield of 4.22 kg/tree with medium bold nut of 7.63 g and mean apple weight of 63.49 g, followed by Bardez-9 with 3.94 kg/tree as compared to 3.03 kg/tree of raw nut yield in check. Valpoi-2, Bardez-9 and Tiswadi-3 continued to record higher nut weight in the range of 10.88 g – 11.51 g. Valpoi-3, Bardez 8/98, Mayem-1 and BKL-2 recorded the mean nut weight of less than 8 g but were on par with check (7.78 g). All other accessions recorded the mean nut weight in between 8.13 (Valpoi-1) and 9.27 g (FMGDI-1). Shelling percentage significantly varied from 27.61 (Bardez-9) to 31.43 as compared of 30.36% shelling in Check variety. Among the accessions, apple weight varied from 61.6 g in Mayem-1 to 93.68 in Tiswadi-3.



Arjun-1/17: Developing nuts in cluster and matured apples on the tree canopy



Batim-6/17: having bold nuts and juicy apples

Cashew accessions newly collected during 2016-17

Sl. No.	Accession	Approx. age (yrs)	Average nut weight (g)	ZAverage shelling percent age	Apple characters		
					Average apple weight (g)	Colour	TSS (°B)
1	Batim-1/17	15	10.27	28.88	102.33	Yellow	9.82
2	Batim-6/17	26	11.59	28.68	132.25	Yellow	10.6
3	Arjun-1/17	35	11.57	28.22	95.80	Red	10.6

Hybridization and selection

Performance of 1st set of Hybrids (6th harvest)

Vigorous growth in hybrids H-31/05, H-22/05 and H21/05 continued by recording the higher tree height, canopy spread and collar girth. Among the precocious hybrids, H-31/05 was observed to be severely affected by Tea Mosquito Bug (TMB) and leaf webber, because of which nut yield was adversely affected.

Raw nut yield varied from 3.12 kg/tree (H-5/05) to 9.27 kg/tree (H-21/05) with mean nut weight of 7.62 g and shelling percentage of 28.35 in the former, and 8.32 g nut weight and 29.02 % of shelling in the latter respectively. Nut yield performance in H-31/05 (8.86 kg/tree) was severely affected by the heavy incidence

of TMB unlike that (12.45 and 14.56 kg/tree) in the previous years. Other hybrids such as H-11/05 (6.42 kg/tree, 7.42 g nut weight and 28.22% shelling), H-12/05 (8.12 kg/tree, 7.90 g nut weight and 28.90 % shelling) and H-22/05 (6.25 kg/tree, 9.24 g nut weight and 29.78% shelling) recorded consistent performance.

Higher apple weight was recorded in H-22/05 (94.85 g), H-21/05 (80.35 g) and H-12/05 (80.05 g) with moderate levels of juice contents (68.0, 69.8 and 66.4%) and Total soluble solids (12.6,12.6 and 11.6 °B) respectively.

Second set of 34, third set of 53, fourth set of 81 and fifth set of 28 hybrid seedlings planted in the field for evaluation are in the juvenile stage.

Hybridization work

Hybridization work was continued during flowering season, for producing the 6th set of hybrid progenies. A total of 194 hybrid seed nuts of the following parental combinations were produced and the nuts have been sown for raising seedlings.

Parental combinations	No. of seeds obtained
KN-2/98 x Valpoi-2	38
Valpoi-2 x KN-2/98	17

Tis-3 x KN-2/98	29
39/A X Valpoi-7	21
51/A x Valpoi-2	24
T-11 x T-15	14
Valpoi-7 x Tis-3	45
Valpoi-7 x Valpoi-2	5
Valpoi-2 x T-11	1
Total	194

Growth performance of cashew hybrids during 2016-17

Hybrid	Growth during current season				TMB Incidence and growth
	Height (m)	Collar girth (cm)	Canopy Spread (m)		
			N X S	E X W	
H- 5/05	4.1	55.2	2.9	3.2	Low TMB
H- 14/05	4.3	59.8	2.8	3.1	Low TMB
H- 11/05	4.4	68.3	3.9	4.3	High TMB
H- 12/05	4.6	64.7	4.1	4.3	Low TMB
H- 13/05	4.3	68.2	3.9	4.5	Low TMB
H- 21/05	5.2	80.2	4.5	4.7	Low TMB, Vigorous & precocious
H- 22/05	5.4	85.2	3.9	4.2	vigorous
H- 23/05	4.8	75.5	4.0	4.8	High TMB
H- 27/05	4.4	72.5	4.2	4.6	High TMB
H- 29/05	4.2	66.3	3.9	4.1	High TMB
H- 30/05	3.5	55.4	2.5	3.7	Slow growth
H- 31/05	5.9	92.0	5.9	6.5	High TMB, vigorous

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

M. Thangam

Under this national programme, multilocation trails are carried out in brinjal (varietal and resistant trial) and chilli (varietal trial) at Goa centre.

In varietal trial, the observations on days to first flowering, number of fruits per plant, yield per plant, individual fruit weight *etc* are being recorded and the trial is under progress.

Brinjal (Round) IET (2016)

Eight lines in brinjal IET were being evaluated for yield and yield contributing traits during 2016-17. The earliest flowering was noticed in 2016/BRRVAR-7 (32 days) followed by 2016/BRRVAR-2 (34 days). The individual fruit weight ranged from 46.20 g (2016/BRRVAR-7) to 120.80 g (Kashi Taru/IVBL-9 (C).



View of AICRP trial in Institute



Brinjal (Round) IET

Brinjal (Long) IET

Brinjal Long IET

Eight varieties along with two checks viz., Kashi Taru and Pb. Sadabahar were evaluated for different traits under Goa condition. The earliest flowering was recorded in 2016/BRLVAR-2 (34 days) followed by 2016/BRLVAR-3 (36 days). The other observations in respect of yield per plant, number of fruits per plant, individual fruit weight are being recorded, as trial is in progress.

Brinjal (Long)AVT-I (2016)

Seven test varieties including two check varieties are being evaluated for yield and other traits under Goa condition. The earliest flowering was recorded in resistant check variety Kashi Taru/IVBL-9 (C) (28 days) followed by test variety 2015/BRLVAR-5 (32 days).



Brinjal (Long) AVT

Brinjal Long AVT-II

Eight lines are being evaluation for different fruit and yield characters. The earliest flowering was recorded in Krishi Taru/IVBL-9 (C) (33 days) followed by 2013/BRLVAR-1 (40 days). The individual fruit weight ranged from 38.42 g (2013/BRLVAR-6) to 206.80 g (2013/BRLVAR-1).



Brinjal (Long) AVT-II

Brinjal Bacterial Wilt IET (2016)

Seven test varieties along with three resistant checks viz., Arka Nidhi, Arka Kusumakar and SM-6-6 with one susceptible check Pusa Purple Long are being evaluated for incidence of bacterial wilt and other

yield traits under Goa condition. The earliest flowering was recorded in 2016/BRBW-6 (28 days) followed by test variety 2016/BRBW-2 (34 days). The incidence of wilt ranged from 0 to 83 per cent with varying degree in different varieties under evaluation. The lowest incidence was recorded in resistant check SM-6-6 (0 per cent) and the highest incidence was noticed in susceptible 2016/BRBW-4 (83 per cent) at 30 days after transplanting.

Brinjal (Long)AVT-II (2016)



Brinjal (Bacterial wilt) IET

Seven varieties including two checks viz., Kashi Taru and Pb Sadabahar are being evaluated for yield and other yield contribution traits under Goa condition. The earliest flowering was recorded in check variety Kashi Taru/IVBL-9 (C) (29 days) from transplanting followed by another test 2014/BRLVAR-2 (32 days). The other observations in respect of yield per plant, number of fruits per plant, individual fruit weight are being recorded.

Chilli-IET (2016)

Seven varieties including two checks viz., Kashi Anmol and LCA-334 are being evaluated for yield and other yield contribution traits under Goa condition. The earliest flowering was recorded in test variety 2016/CHIVAR-7 (34 days) followed by another test variety 2016/CHIVAR-6 (38 days). The other observations in respect of yield per plant, number of fruits per plant, individual fruit weight are being recorded.

Chilli-AVT-II (2016)

Nine varieties including two checks viz., Kashi Anmol and LCA-334 are being evaluated for yield and other yield contribution traits under Goa condition. The earliest flowering was recorded in test variety 2014/CHIVAR-4 (29 days) followed by check variety Kashi Anmol (32 days). The other observations in respect of yield per plant, number of fruits per plant, individual fruit weight are being recorded.

Project : ICAR-All India Co-ordinated Research Project on Pigs
EB Chakurkar

Breeding policy is followed as per the technical program of AICRP where experimental animals are crossbred 75% (Aognda goan XLWY). 1:3 ratio of boar and breeding female is maintained. Each breeding animal is raised in individual pen and are fed with concentrate mixture. Artificial Insemination is strictly followed for breeding.

The production of pork and pork products is a household activity through the traditional knowledge in most of coastal areas of our country. Availability of higher quantity of pork for preparing the products will help to make the activity self-sustainable. The activity may become self-sustained over a period of time only when there is use of advance techniques. Suitable breed, crossbreeding of local pig breed, controlled

breeding using synchronization and AI, standard balanced feeding, comfortable housing of pigs will lead to improved pig production and benefit the growers. AICRP on pig Goa centre is attempting to provide these knowhow to the pig growers of the region through trainings and demonstrations.

Herd strength of cross bred (75% ranges between 136 to 280. Mean litter size at birth was 8.06 ± 0.89 and litter weight 8.01 ± 0.78 (Kg). Litter size at weaning was 7.7 ± 0.48 where as litter weight at weaning was 55.73 ± 4.51 (Kg). Pre weaning mortality rate was 4.54% where as post weaning mortality was 4.01%. Preweaning growth was 155.9 ± 8.86 gms/day where as post weaning growth was 314.35 ± 7.41 gms/day. Weight at 10 months age was 90.45 ± 2.73 (kg).



Collection of serum samples from North and South Goa and Submission of monthly report of disease incidence or outbreak in livestock from Goa

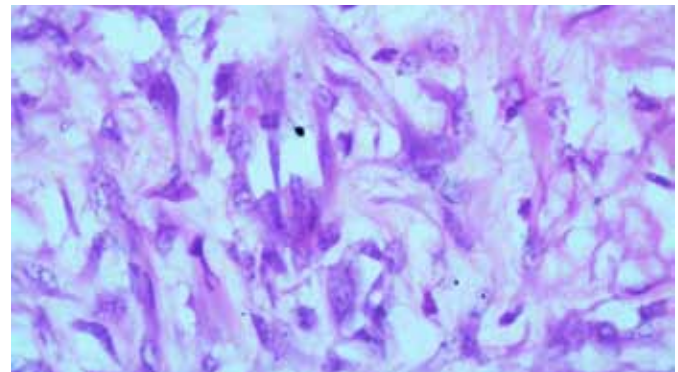
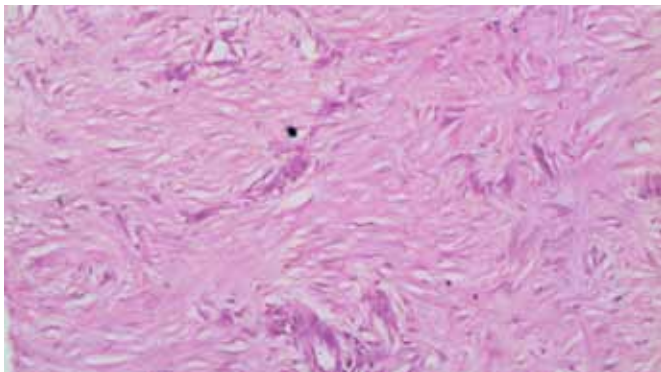
Total 211 sera samples from cattle, pigs and goats collected from North and South Goa for sero-epidemiological investigation along with geographical coordination. These samples were sent to ICAR-NIVEDI, Bengaluru for disease diagnosis mainly IBR in cattle, Brucellosis and PPR in goats and CSF in pigs. The sero-prevalence of Infectious bovine Rhinotrachitis (IBR) was tested by ELISA and it was found with the prevalence rate of 19.79% (19/96) in dairy cattle from Goa. Brucellosis in goats was reported with the prevalence of 2.83% (03/106). Rapid assay for detection of Bovine papilloma viruses (BPV-1 and BPV-2) in dairy cattle was developed and sequence was published. Monthly disease outbreak report from April 2016 to March 2017 sent to ICAR-NIVEDI for epidemiology information.

Sero epidemiology of IBR in cattle from Goa during 2016-17

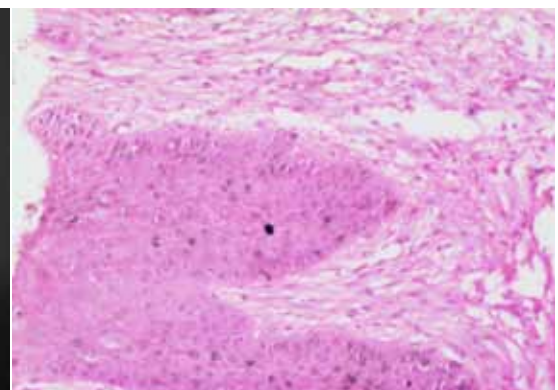
Village	Tahasil	No of sera collected	IBR positive
Ibrahampur	Pernem	34	8
Surla	Bicholim	10	2
Maem	Bicholim	14	4
Narao	Tiswadi	8	1
Salem	Bicholim	6	1
Pirla	Quepem	18	3
Dessua	Salcete	2	0
Betqui	Ponda	4	0
		Total 96	19

Diagnosis of nodular tumor at neck region of dairy cattle by histopathology

Subcutaneous fibro sarcoma was diagnosed after surgical removal of nodular mass and histopathological examination.



Subcutaneous Fibrosarcoma in bull with mitotic figures diagnosed during histopathological examination



Bovine papilloma virus (BPV-1, 301bp) and BPV-2 (164bp) in dairy cattle was diagnosed by PCR assay targeting B2L gene

Histological section of warts showing papillary projection of skin cells with numerous mitotic figures.

Project : ICAR-All India Co-ordinated Research Project on rice
Manohara KK

36 and 32 lines received from Indian Institute of Rice Research, Hyderabad, were tested under salinity situation in farmers' field at chorao island under Initial Variety Trial and Advance Variety Trial, respectively.

Coastal Salinity Tolerant Variety Trial (CSTVT) - Advance Variety Trial (AVT-I)

Thirty two rice genotypes received from All India Co-ordinated Rice Improvement Project were evaluated under coastal salinity situation in farmers' field at Chorao Island of North Goa district. The soil EC ranged from 1.54 (July) to 6.81 dS/m (November) and soil pH from 6.34 to 6.91. The experiment was carried out in Randomized Complete Block Design with three

replications. Data on all the yield and yield related parameters was recorded during the various growth stages of the crop.

Top five entries with respect to grain yield are DRRH 106 (Hybrid) (3225.00 kg/ha) followed by TR-13-069 (3041.67 kg/ha), TR-09-27 (3005.56 kg/ha), GOA R 2015-IR 87848-301-2-1-3-B (2858.00 kg/ha) and FL-478 (2625.00 kg/ha).

Our entry KS-12 (IET No. 25055) promoted to AVT-II of the national varietal testing programme.

Initial variety trial failed due to submergenc of the trial immediately after the planting. Hence, data could not be recorded.

Mean performance of top five entries in CSTVT-AVT-1 trial

Entry	Days to 50% flowering	Plant height (cm)	Grains per panicle	Grain yield (kg/ha)
DRRH 106 (Hybrid)	89.00	92.03	207.90	3225.00
TR-13-069	102.00	105.40	184.80	3041.67
TR-09-27	93.00	98.30	211.20	3005.56
GOA R 2015-IR 87848-301-2-1-3-B	108.00	99.90	201.90	2858.00
FL-478	86.00	95.90	211.20	2625.00
Goa dhan – 2 (Local check)	108.00	163.00	161.70	2463.89
Mean	110.34	108.89	179.99	1732.33
SE	2.53	5.64	23.47	415.08
CD @ 5%	5.17	11.51	47.93	847.71
CV (%)	2.29	5.18	13.04	23.96

Project : All India Co-ordinated Research Project on Arid Legumes (ICAR)
Manohara KK

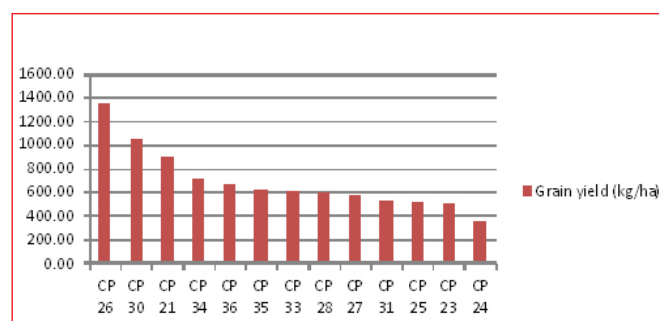
Advance Variety Trial

11 lines of Cowpea were evaluated during rabi season of 2015-16 under residual moisture condition of rice fallow area. The trial was laid out in Randomized



Field view of Cowpea trial during rabi season of 2016-17 at institute farm

Complete Block design with two replication with plot of 5.4 square meter for each of the treatment. The line CP – 29 recorded highest seed yield (1801.85 kg/ha) followed by CP – 21 (1098.14 kg/ha) and CP – 24 (1042.14 kg/ha).



Grain yield of cowpea entries in advance variety trial.

Externally Funded Projects

Project : Stress Tolerant Rice for Poor Farmers of Asia and South Asia (STRASA)
Manohara KK

Salinity Tolerant Breeding Network Trial (STBN)

The trial comprised of 66 rice entries of which 60 are test entries and six are check varieties (Pusa-44, CSR-10, CSR-27, CSR-36, CST-7-1 & Goa Dhan-2(LC)). The trial was laid out during kharif, 2016 in augmented design with four blocks. Each block consisted of 15 test entries and 6 check varieties. The trial was laid out in farmers' field at Choroa village of North Goa district representing coastal salinity. The soil EC ranged from as low as 0.64 dS/m in the month of August to 12.98 dS/m in the month of May. Soil pH ranged from 6.34 to 6.91. High rainfall and river water ingress due to high tide, resulted in the partial to complete submergence of the crop after one week of planting for about 14 days. The data on all the yield and yield related parameters viz., days to 50% flowering, plant height, number of tillers per hill, number of productive tillers per hill, panicle length, filled grains per panicle, per cent fertility, 1000 seed weight and grain yield were recorded during the various growth stages of the crop.

Analysis of variance revealed significant differences among the entries for all the characters studied. Days to fifty per cent flowering ranged from 92.00 days (KR 15003) to 128.00 days (CR3899-134-2-6-4) with a mean of 110.60 days, plant height ranged from 84.80 cm (CSR-10) to 151.90 cm (Local check, Goa Dhan 2) with a mean

height of 108.18 cm, number of tillers ranged from 3.20 (CR 3900-193-9-9-10) to 7.60 (CR3881-4-1-6-3-4-1) with a mean value of 5.31, productive tillers ranged from 3.00 (CR3878-245-1-9-2) to 7.40 (CR3881-4-1-6-3-4-1) with a mean of 5.16, panicle length ranged from 18.80 cm (KR-15014) to 28.93 cm (Goa Dhan-2) with a mean length of 23.65 cm, filled grains per panicle ranged from 52.00 (CR3903-161-1-3-2) to 168.00 (CR3879-3-1-6-1-3-1) with a mean of 117.75, per cent fertility ranged from 37.00% (CR3903-161-1-3-2) to 93.00% (CR2838-1-S-2B-9-1) with a mean of 78.32%, test weight ranged from 16.90g (RP-320-4-3-2-1) to 34.25g (Local check, Goa Dha 2) with a mean of 24.05g and grain yield ranged from 61.82 kg/ha (CR 2850-S-2B-12-1-2-1) to 3130.91 kg/ha (CR3881-M-3-1-5-3-1-1) with a mean yield of 1385.48 kgs.

With regard to grain yield, highest grain yield was recorded by CR3881-M-3-1-5-3-1-1 (3130.91 kg/ha) followed by CSR-C27SM-117 (2425.25 kg/ha), JK-95 (2356.36 kg/ha), CSR-2748-4441-66 (2280.00) and CSR-2748-4441-133 (2258.18 kg/ha). Of the entries which recorded higher grain yield, only one entry CR3881-M-3-1-5-3-1-1 (3130.91 kg/ha) recorded significantly higher grain yield compared to best check variety CSR-36 (1933.97 kg/ha), rest all are numerically superior to best check.

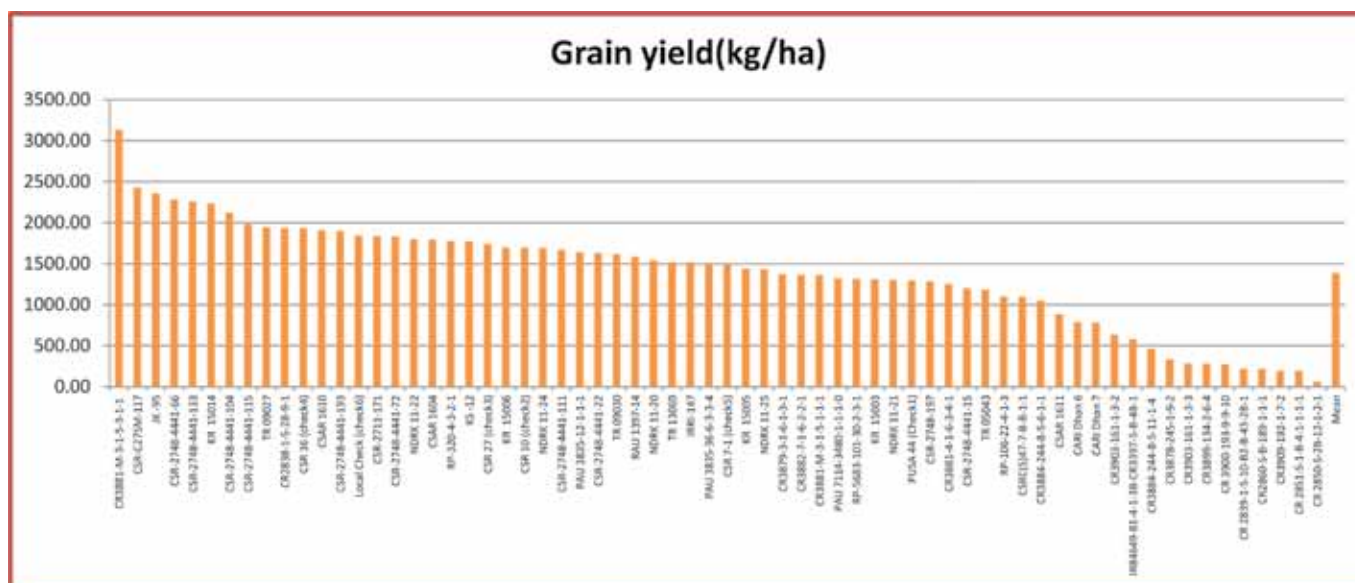
Mean performance of entries/lines for yield and its contributing characters of the 66 STBN lines with CD and CV values

Designation	DFF	PHT (cm)	NPT	TW (g)	GY(kg/ha)
CR3881-M-3-1-5-3-1-1	99	119.17	6.40	28.60	3130.91
CSR-C27SM-117	99	94.00	4.60	26.20	2425.45
JK -95	110	101.17	5.60	21.40	2356.36
CSR-2748-4441-66	104	101.17	5.40	27.20	2280.00
CSR-2748-4441-133	104	96.67	6.60	29.10	2258.18
Pusa-44 (Check)	106.75	95.15	4.15	23.00	1294.92
CSR 10 (Check)	95.25	84.80	6.05	25.10	1691.82
CSR 27 (Check)	99.50	108.85	3.95	25.88	1741.05
CSR 36 (Check)	106.25	104.35	5.10	27.10	1933.97
CSR 7-1 (Check)	114.75	96.35	5.65	27.35	1483.64
Goa Dhan-2 (Local check)	105.75	151.90	4.15	34.25	1840.89
Mean	110.60	108.18	5.16	24.05	1385.48
SE	1.2	1.49	0.1	0.49	83.03
CD	3.91	18.32	1.63	2.43	689.81
CV (%)	8.81	11.91	16.28	16.81	48.79

DFF: Days to 50% flowering
TW: Test weight

PHT: Plant height
GY: Grain yield

NPT: Number of productive tillers per hill



Grain yield of the entries in STBN trial



Field view of STBN trial, Kharif 2016, at farmers' field, choroa Island



Selection of promising lines

Project : Agro-morphological characterization and DNA finger printing of rice landraces of Goa (DST&E)
Manohara KK

Agro-morphological characterization and diversity analysis

The project aims at collection, conservation, evaluation and characterization of traditional rice landraces of Goa. The data collected on important agro-morphological characters were analysed and diversity was worked out using Shannon diversity, principal component analysis and cluster analysis.

Descriptive statistics

The first order statistical measures i.e. maximum, minimum, sum, mean, Standard Deviation (SD) and Coefficient of Variation (CV) were worked out for all the observed parameters. The largest coefficient of variation was observed for straw yield with CV of 29.08% followed by grain yield (27.24%), grains per panicle (17.84%), number of productive tillers per hill (16.78%). Days to maturity and days to 50% flowering

showed the lowest variation of 1.96% and 2.31%, respectively.

Shannon diversity index

Among the qualitative traits scored, leaf auricle, leaf collar, leaf ligule, ligule shape, ligule colour, curvature of main axis of panicle, presence of secondary branches in the panicle and lemma colour were found to be invariants. Moderate diversity observed for four characters with H index ranging from 0.50 (attitude of branches in panicle) to 0.70 (leaf blade pubescence). Remaining 15 characters showed high diversity with H index ranging from 0.78 to 1.00.

Principal Component Analysis

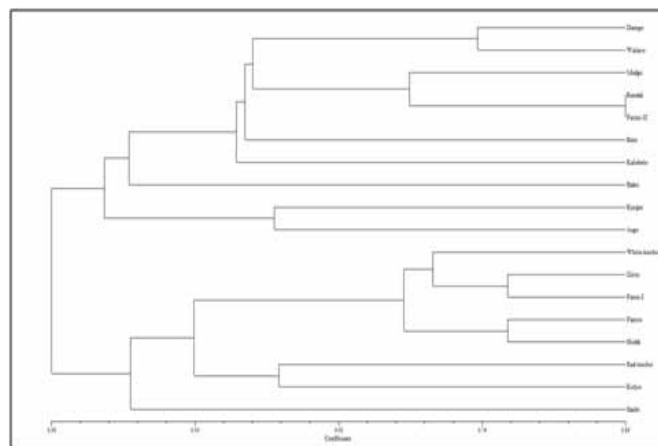
Principal component analysis (PCA) using 16 quantitative traits produced four principal components (Eigen value > 1) which cumulatively accounted for

80.43 % of the total phenotypic variance. The first PC explained 34.35 % of the total variance and the traits with high positive loadings were plant height, flag leaf width, flag leaf length, straw yield per plant and panicle length. The PC2 explained an additional 14.4 % of the total variance. The traits such as days to 50% flowering, days to maturity, grains per panicle and

straw yield per plant showed high positive loadings. PC3 explained % of the total variance. The characters grain yield per plant, grain length to width ratio, harvest index, grains per panicle contributed more to the total variance in PC3 where as in PC4 harvest index, panicle length, grains per panicle contributed more to the total variance.



Diversity in panicles of landrace collections



Clustering of 18 landraces using UPGMA method

Eigen values of four major principal components and factor loading (Eigen vectors) for different morphological and yield attributing characters

	PC1	PC2	PC3	PC4
Eigenvalue	5.50	3.73	2.27	1.37
Per cent variance	34.35	23.32	14.17	8.59
Cumulative per cent of total variance	34.35	57.66	71.84	80.43
Eigen vectors / coefficient vectors				
Days to 50 per cent flowering	0.189	0.374	-0.256	0.184
Days to maturity	0.175	0.390	-0.244	0.171
Plant height (cm)	0.378	0.061	-0.100	-0.251
Number of productive tillers	-0.285	0.197	0.213	-0.222
Panicle length (cm)	0.266	0.058	0.099	0.395
Grains per panicle	0.165	0.229	0.275	0.373
Percent fertility (%)	-0.268	-0.121	0.225	-0.148
Test weight (g)	0.231	-0.408	-0.060	0.033
Grain length (mm)	0.248	-0.365	-0.112	-0.089
Grain width (mm)	0.176	-0.394	0.002	0.041
L/B ratio	-0.025	0.151	0.432	-0.267
Flag leaf length	0.337	-0.171	0.220	-0.055
Flag leaf width	0.339	0.041	0.117	-0.111
Grain yield per plant (g)	0.202	0.070	0.535	0.084
Straw yield per plant(g)	0.299	0.196	0.211	-0.333
Harvest Index (HI, %)	-0.186	-0.207	0.297	0.540

Project: Amelioration and management of coastal saline soils for rice production in Goa (DST&E)

G R Mahajan

Effect of salinity tolerant bacterial application on the rice plant growth and yield (var. Korgut)

During primary investigations under controlled condition (pot experiment) *Bacillus methylotrophicus* strain STC-4 was found to improve the rice plant growth and soil biological activity. During the evaluation, the application of the *Bacillus methylotrophicus* strain STC-4, two times at sowing and 7 days after sowing, could result in grain and straw yield of 1.19 and 1.615 t/ha, respectively as compared to control with corresponding values 0.91 and 1.578 t/ha. The grain yield difference between the transplanting nursery treated seedling and field application of *Bacillus methylotrophicus* strain STC-4 was insignificant. This result has practical utility as the field application of the microbial inoculants depends on the rainfall and waterlogging and also adds to labor cost. Further, combined application of *Bacillus methylotrophicus* strain STC-4 with farmyard manure and recommended doses of fertilizer improved the rice grain and straw yield over untreated control and nursery treatment. Highest grain and straw yield of 1.317 and 2.51 t/ha, respectively was recorded in treatment with combined application of recommended dose of fertilizer and *Bacillus methylotrophicus* strain STC-4.

Nursery management practices to improve rice seedling growth and vigour to tolerate salinity stress in field

Different nursery management practices (reduced seed density, seedling age, application of fertilizer nutrients, manure and salinity tolerant microbe fortification) were evaluated to produce healthy and vigorous rice seedling to tolerate salinity stress. These practices were evaluated for two different salinity tolerant varieties viz. CSR-27 and Korgut. The seedling vigour index (SVI) was insignificant in CSR-27, however it was significantly ($p < 0.05$) different in Korgut (local). The significantly higher SVI of 2226 was observed with a nursery management practice – 25 g m⁻² seed density, 50-30-15 kg N-P₂O₅-K₂O/ha, 10 t/ha and two times application of *Bacillus methylotrophicus* strain STC-4, whereas the SVI was lowest in the control treatment with 75 g/m seed density. This result is of practical significance to coastal areas as higher shoot length is necessary for survival when transplanting in flooded fields and robust root helps in quick recovery.

Project: Characterization and development of low-cost interventions for management of the degraded coastal saline soils (ICAR Extramural)

G R Mahajan

Characterization of coastal saline soils of west coast of India

The descriptive statistics of the soil chemical properties of the coastal saline soils (number of soil samples 240) of the coastal districts of Maharashtra and Goa revealed that, there is a co-existence of the acidic soil reaction (<7.0) and high soil salinity (electrical conductivity (Mean EC_{1:2.5} = 13.55 dS/m and E_c = 24.66 dS/m). This is a unique characteristic of these soils unlike high pH and high EC in the soils affected with secondary salinization. Due to fallowing and heavy salinity tolerant vegetation cover the soil carbon status of these soils is high (1%) with an appreciable soil organic carbon stock of 20.11 t/ha up to a depth of 0.15 cm. These soils are deficient with respect to soil available nitrogen (218 kg/ha) and sufficient in soil available phosphorus (43.40 kg/ha), potassium (1469 kg/ha) and sulphur (50.38 kg/ha). Thus, the soils are fertile but not productive. The

correlation matrix of salinity levels and soil biological activity revealed depressive effect of the salinity levels on dehydrogenase ($r = -0.66$, $p \leq 0.05$), urease ($r = -0.69$, $p \leq 0.05$) and basal soil respiration ($r = -0.72$, $p \leq 0.05$).

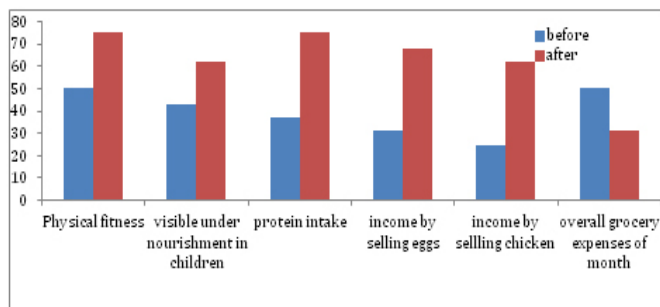


Project: Integrated Farming System for improvement of nutrition and livelihood of farm women under different agro-ecosystems (ICAR- CIWA Collaborative)
Vishwanath Reddy

Two villages were selected for detailed socio-economic survey work where we selected village Surla (dominated by crop based farming) and another village Ibrahimpur (dominated livestock farming).

Intervention of backyard poultry

The selected marginal farmers were randomly selected from the Ibrahimpur village and distributed 'Vanraja' chicken for rearing as a backyard poultry. The impact of the same on farmer's nutritional and socio-economic life was studied using a predesigned questionnaires schedule and present graphically.



Farmers perceived impact of backyard poultry

Distribution of bypass-fat feed to milk farmers

In Ibrahimpur village where farmers were livestock based facing problem in milk production. Mastitis and weaker health of cow after parturition caused reduced milk yield of cattles. Hence, bypass fat was distributed among farmers and their perception and impact on milk yield was recorded. Overall impact on perception revealed increase in milk yield, fat content of milk and income.

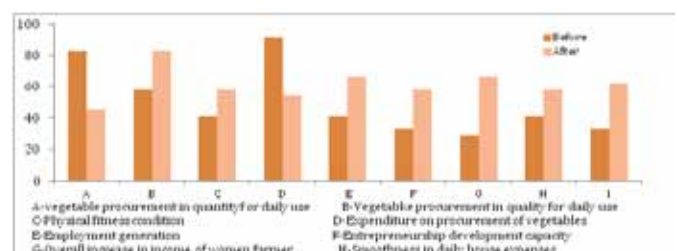


Distribution of By-pass fat to the farmers

Distribution of vegetable seeds

An effort was made to identify the major bottlenecks in the adoption of recommended kitchen gardening techniques. Further, proper guidance was given for kitchen garden related management practices and its perceived impact on farmers was recorded.

Women were made aware about the nutrition in their daily diets and alternate ways to generate this nutrition from crops using integrated farming systems. Farm women's moral and confidence level found increased. There were few upcoming women entrepreneurs and this numbers seems to be increasing as the result of the increased confidence level in the farm women. Therefore, a location specific farming system model is required to support essential household requirements of quality food and income for having shelter, performing rituals and maintaining a status in society along with lesser drudgery prone activities.



Farmers perceived impact of kitchen garden



Distribution of agricultural inputs to farmers

Screening under microplot conditions for identifying novel genetic stocks for salinity tolerance at seedling stage

With an objective of identifying new sources for salinity tolerance among our germplasm collection, screening of the rice germplasm under microplot was taken up during the kharif season of 2016 to confirm our previous findings.

Second year screening for the seedling stage salinity stress tolerance under micro-plot conditions was taken up during the kharif season. The experiment comprised 59 germplasm including 20 landraces, 23 wild rice, 8 advanced breeding lines and 6 improved cultivars. FL-478 and IR-29 used as tolerant and sensitive check, respectively. Genotypes were exposed to salinity stress of 12 ds/m (electrical conductivity). Scoring was done according to the SES system of evaluation given by IRRI, Philippines.

Genotypes Korgut, KS-17 and WR-18 were found to be highly tolerant (HT) with SES score of 2-3 and the genotypes KS-4, KS-12, KS-16-1, KS-19-2 and Kagga were found to be tolerant (T) with SES score of 3. Eight of the genotypes shown in the below table fallen in the group of highly tolerant (SES score 1) and tolerant (SES score 3) category.

Hybridization and generation advancement

With an objective of developing mapping populations for identifying genes/QTLs conferring tolerance to salinity stress, new cross combinations were attempted involving high yielding salinity sensitive and low yielding tolerant lines. The crosses

were initiated in 2014 kharif and during the current year (kharif 2016), F₄ generations belonging to 10 different cross combinations were advanced by following single seed descent (SSD) method.



Field view of F₄ population during Kharif, 2016

F₄ mapping populations and their population size

Sl. No.	Crosses	Segregants
1	Naveen x KS - 16 - 1	780
2	Naveen x KS - 19 - 2	541
3	MTU 1010 x KS - 16 - 1	293
4	Karjat - 3 x KS - 19 - 2	289
5	Chandan x KS - 17	286
6	Karjat - 3 x KS - 17	279
7	Pusa - 44 x KS - 17	267
8	Naveen x Shidde	256
9	MTU 1001 x Shidde	212
10	MTU 1001 x KS - 17	180

SES scoring of the genotypes at seedling stage salinity screening

Genotypes	Pedigree/source	SES score	Tolerance
Korgut	Landrace	2-3	Highly tolerant
KS-17	Selection from Korgut	2-3	Highly tolerant
WR-18	Wild rice	2-3	Highly tolerant
KS-12	Selection from Korgut	3	Tolerant
KS-16-1	Selection from Korgut	3	Tolerant
KS-19-2	Selection from Korgut	3	Tolerant
KS-4	Selection from Korgut	3	Tolerant
Kagga	Landrace from Karnataka	3	Tolerant

Evaluation of cross pathogenicity of sequenced strains of *R. solanacearum* on different hosts

Ten *R. solanacearum* strains (6 strains of solanaceous crops, 4 strains of potato) were sequenced under the network project. Cross pathogenicity of the isolates was conducted on different hosts.

GRS Mep2 (IISR) is pathogenic on tomato; weakly pathogenic on brinjal; weakly pathogenic on ginger. GRS Sik (IISR) is pathogenic on tomato; weakly pathogenic on brinjal; pathogenic on ginger. BRS (IIHR) is pathogenic on tomato and brinjal; non pathogenic on ginger. UTT25 (IARI) is pathogenic on tomato; weakly pathogenic on brinjal- Goa cultivar; non pathogenic on ginger. Rs-09-161 (ICAR-Goa) is pathogenic on tomato and brinjal; non pathogenic on ginger. Rs-10-244 (ICAR-Goa) is pathogenic on tomato and brinjal; non pathogenic on ginger.

Standardization of detection of *R. solanacearum* by LAMP

LAMP PCR was standardized to detect the bacterium directly from soil and plant tissues. The detection technology was validated using the field soil samples collected from Taleigao. Soil samples collected from the region surrounding wilted plants and apparently healthy plants of brinjal from different fields was used in the validation. LAMP-PCR with dye is the best method (77.5% detection) to detect *R. solanacearum*. When the studies of the previous two seasons were combined, it is observed that LAMP PCR in water bath with agarose gel detected *R. solanacearum* from 83.80% soil samples. The next best method was LAMP PCR in water bath with dye (69.01%) and plating on selective medium (68.31% positive).

Identification and validation of effectors of *R. solanacearum*

R. solanacearum, mutants of *hrcV* and *hrpB* genes were developed. Based on the whole genome sequences, two type III effector genes (*RipAM* and *RS15E*) of *R. solanacearum* were selected, cloned into destination vector to produce the pRCG-Pep-*RipAM* and pRCG-Pep-*RS15E* respectively. This was transformed to wild type *R. solanacearum* (Rs-09-161) and mutants to study the translocation of effector. pRCG-Pep-Effector was transferred to the wild type, *HrpB*- mutant and *HrcV*- mutant of *R. solanacearum*. Proteins secreted by the wild type, *HrpB*- and the *HrcV*- mutant in the culture supernatant and intracellular are collected. Western blot analysis of the precipitated proteins with anti-HA primary and secondary antibodies is in progress.

Study on the role of Type VI genes in *R. solanacearum* colonization

From the genome analysis, type VI SS genes (*TssM*, *TssL*, *TssH*, *Hcp*, *VgrG3* and *Omp*) were identified and the mutants were developed. Validation of these mutants for their role in colonization and virulence is being studied. *R. solanacearum* mutants of *TssM* and *Hcp* are confirmed through various methods and the mutants were tested on tomato and brinjal to see disease reduction if any. Other three mutants of *R. solanacearum* (*TssH*, *VgrG3*, *TssL*) were developed and are in the process of confirmation.

Transcriptome profile of resistant and susceptible brinjal varieties challenged with *R. solanacearum*

Resistant and susceptible brinjal varieties were used to develop the complete transcriptome data to identify the differentially regulated genes when the pathogen infects the plant. Plants were challenge inoculated with *R. solanacearum* and control without inoculation was also maintained.

De novo assembly of the transcripts was done using Trinity, CD-HIT-EST, TGICL and Evidential gene modules. Finally, Evidential Gene run with default parameters lead to 43,846 Unigenes. The transcriptome structural annotation was performed using TransDecoder tool. 43,846 Unigenes submitted to TransDecoder, and it detected 32,310 (73.68%) Unigenes with ORFs, with 12,704 (28.97%) presenting complete ORFs. The functional annotation performed using BLASTx. BLASTx resulted to annotation of 34,530 while 9316 Unigenes had no significant BLAST hits.

SSRs were identified with the MISA, SSR identification pipeline and a total of 11,062 SSRs were identified in the Unigenes. Gene Ontology IDs mapped by BLAST2GO using Gene ontology database. GO sequence distributions, helps in specifying all the annotated Unigenes comprising of GO functional groups. The GO sequence distributions analyzed for all the three GO domains, i.e., biological processes (8659), molecular functions (9210) and cellular components (6551).

Differential Gene Expression analysis performed using DESeq. DESeq results filtered based on positive and negative log₂ fold change as up and down. Significant unigene DGE statistics indicated several up regulated and down regulated transcripts in compatible and non-compatible interactions.

Evaluation of bacterial wilt resistant brinjal lines for bacterial wilt management

Two hundred and seventy one F₆ lines of brinjal were screened for bacterial wilt resistance in greenhouse condition with *R. solanacearum* challenge inoculation. Both the resistant and susceptible parents were included in every batch of screening. The lines which recorded less disease and with good fruit preference (as per previous season-F6 data) were selected for field evaluation. As a first batch, 17 bacterial wilt resistant lines along with the parents are being evaluated in the field for disease, yield characters. Plant characters were recorded as per the standard descriptors.

Evaluation of various strategies for the management of bacterial wilt in brinjal

Evaluation of root stocks for bacterial wilt resistance

Results of two times evaluation indicated that all the root stocks exhibited some degree of wilt infection. Based on the scale Surya, S-4, S-22 are moderately resistant and can be used as root stocks.



Field evaluation of brinjal plants grafted on S-4

Based on our previous findings, we used S-4 as root stock for grafting Agassaim and Taleigao brinjal. The grafts and seedlings were planted in the sick plot. Observations were recorded on the incidence of wilt and yield. Results indicated that 4% and 9% wilt was recorded in S-4+ Taleigao grafts and S-4 + Agassaim grafts. Whereas in the seedlings of Taleigao and Agassaim recorded 79% and 95% wilt.

Field evaluation of brinjal grafts for bacterial wilt management

Two highly preferred and bacterial wilt susceptible cultivars of brinjal (Agassaim and Taleigao) were grafted on three root stocks (Surya, S-4, Wild brinjal). The grafts and the seedlings were planted in two field trials, one at



Brinjal grafts in field

ICAR farm and other at farmer's field under polythene mulch. Results indicated that lowest wilt incidence was recorded in the treatment where wild brinjal was used as root stock. The plants grafted on other root stocks (S-4 and Surya) recorded unusually higher wilt incidence in both the trials. One of the reasons we found was that the graft union was touching the soil in some of these plants. The seedlings were completely wilted in the beginning of the crop cycle and hence no yield was obtained from seedlings.

Evaluation of tomato grafts in the polyhouse for bacterial wilt incidence

Based on the encouraging results of tomato grafts in the control of bacterial wilt during previous studies, popular tomato varieties/ hybrids used in polyhouse cultivation were grafted on wild brinjal and Surya for evaluation in the polyhouse. Plants were not affected by bacterial wilt for most part of their cycle. However, sudden wilting was recorded although the roots were free from the pathogens and further studies are in progress.

Training and demonstration of grafting technology to farmers: were conducted at Salgini and at Institute on the management of bacterial wilt in brinjal.

Field evaluation of soil application of lime for the management of bacterial wilt in brinjal

Four different levels of lime (4, 6, 8, 10 t/ha) were applied before planting. After stabilization, susceptible local cultivar of brinjal Agassaim was planted. In each lime level, treatment with bio-agent and without bio-agent was maintained. Bio-agents were applied during nursery and while planting. The experiment is in progress.



Brinjal fruits in the bacterial wilt resistant lines

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

R. Ramesh

Promising antagonistic bacterial strain for crop health management in the coastal region

A rhizobacterium (*Bacillus methylotrophicus* Strain RCh6-2b) has been identified as one of the promising bio-agent in suppression of various plant pathogens (*Macrophomina phaseolina*, *Rhizoctonia solani*, *Sclerotium rolfsii*, *Phytophthora capsici* and *Ralstonia solanacearum*) during the screening and field experiments. The strain was identified and deposited in the national repository of NBAIM, Mau with the accession number NAIMCC-B-01889. Being a good rhizosphere colonizer, broad spectrum pathogen inhibition ability and secretor of antimicrobial compounds with longer shelf life in the formulation, the strain is a promising biological agent in plant health management under coastal ecosystems. A proposal of microbial registration has been submitted to NBAIM, Mau.

Characterization of promising bacterial bio-agents

Antibiotic resistant profile of the promising antagonistic bacteria was carried out. RCh6-2b and RP7 are sensitive to all the antibiotics tested. STC-4 is resistant to nalidixic acid. RCh23-b is resistant to ampicillin, tetracycline, erythromycin and nalidixic acid. XB102 is resistant to ampicillin and spectinomycin. Further production of growth promoting and antimicrobial substances produced by RCh6-2b, STC-4 and RP7 were tested. Results indicated that all the three stains are positive to phosphate solubilisation, ACC deaminase production and Chitinase production; and negative to Siderophore production and IAA production.

Standardization of synthetic medium for promising bio-agents (RCh6-2b and STC-4)

Based on the results of previous studies, efforts were taken to simplify the composition and method of synthetic medium preparation. Based on the standardization with different combinations, four types talc formulation was prepared and evaluated for shelf life. Results indicated that drastic reduction in the population was observed over a period of time and hence the experiment was stopped.

Another composition was standardized and the results indicated better growth and sporulation in the medium. Talc, alginate and liquid formulations of RCh6-2b and STC-4 were prepared from the bacteria grown in synthetic medium and standard semi-synthetic medium. Results indicated that the population is above 8 Log CFU/g in talc and alginate formulations and above 7 Log CFU/ml in liquid formulations till

five months in both RCh6-2b and in STC-4. There is no difference between the population from the standard semi-synthetic medium and the new standardized medium. The experiment is in progress.

Evaluation of talc formulation of *B. methylotrophicus* (RCh6-2b) for its viability

Talc based formulation was prepared and the population in the formulations was studied over a period of time. Population in the talc formulation is maintained 8.0 to 9.0 Log CFU g⁻¹ in A1 and A1+A2 after 810/780 days. Spore population of *Bacillus sp.* (RCh6-2b) in different talc formulation after 27 months indicated that most of the population is from the spores in the formulation.

Bacterium grown in medium containing glycerol

Population of *Bacillus sp.* (RCh6-2b) in different liquid formulation (A, B and C) indicated that the population is above 8.0 Log CFU mL⁻¹ after 720 days (A), 315 days (B) and 420 days (C). Spore population of *Bacillus sp.* (RCh6-2b) in different liquid formulation after the same period indicated that most of the population is from the spores in the formulation.

Bacterium grown in modified medium without glycerol

Population of *Bacillus sp.* (RCh6-2b) in different liquid formulations (A, B and C) indicated that the population is above 8.0 Log CFU mL⁻¹ after 720 days (A and B) and 660 days (C).

From the various studies and available information, liquid formulations (A and B) were prepared in the modified medium (without glycerol on growth medium) and stored with glycerol (2%). Results indicated the population of bacterium in the formulations was above 8.0 Log CFU mL⁻¹ after 210 days (B) and 720 days (A).

Evaluation of emulsion formulation of *B. methylotrophicus* (RCh6-2b) for its viability

An emulsion formulation of RCh6-2b was prepared wherein 24 hour old culture (100 ml) of *Bacillus* grown in modified medium with A1+A2. The bacterial growth was added with 100ml of emulsion mix. Results indicated that the population of bacterium in the emulsion was 9.0 Log CFU mL⁻¹ till 345 days.

Evaluation of alginate formulation of *B. methylotrophicus* (RCh6-2b) for its viability

Sodium alginate formulation of RCh6-2b was prepared according to the standardized method. The bacterial population in the formulation was 10.0 to 11.0

Log CFU g⁻¹ till 660 days. Spore population of *Bacillus sp.* (RCh6-2b) in the formulation after the same period indicated that most of the population is from the spores in the formulation. Further, seven more batches of the sodium alginate formulation was prepared and being evaluated for shelf life. Results at various days of storage indicated that the bacterial population in the formulation was 10.0 to 11.0 Log CFU g⁻¹ in case of RCh6-2b and over 9.0 Log CFU g⁻¹ in case of STC-4.

Standardization of fermenter biomass of *B. methylotrophicus* (RCh6-2b) for mass production

Various parameters and fermenter conditions were standardized to produce biomass of *B. methylotrophicus* (RCh6-2b). Talc and liquid formulations were prepared from this biomass as per the standardized protocols. The bacterial population in the formulation was above 9.0 Log CFU g⁻¹ till 630 days in talc formulation. In liquid formulation, the population in A and B type was above 9.0 Log CFU mL⁻¹ till 660 days.

Evaluation of talc formulation of bacterial bio-agents (RCh6-2b and STC-4) for its growth performance and disease management in vegetables

The seed treatment and soil application of RCh6-2b and STC-4 were found to enhance the growth performance of brinjal, tomato and cucumber. Plant height was higher in soil application+ seedling drench treatments and soil application treatments for brinjal and tomato. Overall growth performance was higher for cucumber in Soil application and not much difference in the growth parameters was observed among the treatments.

Similarly formulations (talc and alginate) of RCh6-2b and STC-4 were also found to be effective in disease management in brinjal (bacterial wilt) and chilli (*Fusarium* wilt).

Field evaluation promising bacterial bio-agents for disease suppression and growth promotion in chilli

Based on the results from greenhouse experiments, RCh6-2b, STC-4, Tv1 (talc and alginate formulations) were evaluated in various combinations in three field experiments and in two demonstration plots. Either nursery application or seedling drench while planting and both nursery application + seedling drench during planting are being evaluated in two experiments. The plants were monitored for the incidence of root rot and wilt. Initial observations indicated that application of talc formulation of the two promising bacterial strains reduced the incidence of soil borne diseases in chilli; improved plant growth and yield in the field evaluation. The experiments are in progress.

Evaluation of bacterial bio-agents for foot rot management in black pepper

Two field experiments (Torla, Shiroda; Narve, Bicholim) were initiated with the following treatments. All the formulations were applied in soil while planting and repeated after one month. Plant height was taken at regular intervals and the plants were monitored for the incidence of foot rot. The experiments are in progress.

Field evaluation of bacterial bio-agents for disease suppression and growth promotion in cowpea

Cowpea seeds were treated (10g/100g seeds) with the talc formulation of RCh6-2b, STC-4, RP7RCh23-b, XB102. RCh6-2b alginate formulation (2beads/ seed) was applied in the soil while sowing. Germination, disease incidence, yield parameters were recorded. Results indicated that there was no disease incidence in the crop. However, severe incidence of aphids was recorded. Spraying of the respective bio-formulation reduced the aphid population significantly. Grain yield and dry biomass was higher in the bio-agent treatments compared to control.



Field evaluation in chilli

Project: ICAR-Collection and conservation of pickling type of mango germplasm in Goa Region
A R Desai

Seven accessions Tiswadi, Ponda, Bardez and Cancona were identified, samples and sap were collected for pickling quality analysis.

The immature fruits (before the formation of stone) of this genotype are used for pickling purpose. The fruits are washed & filled in ceramic / porcelain container over which raw common salt is filled till the fruits are completely covered by the salt and a

flat wooden plank with a heavy weight is kept on salt surface and covered with the lid. In the process the water content of the tender fruits is flushed out and the shrunken fruits remain in the salt solution. Such whole fruits are taken out and pickled with / without stuffing with spices; such pickling termed as "Amlī" in local language. Generally the elongated shaped fruits are used for "Amlī" type pickling considering the shelf life of the shrunken dehydrated fruits.



Collection of Pickling mango accessions from Goa region

Characteristic features of pickling mango accessions from Goa region

S.No	Accession name	Location	Aprx. age of tree	Remarks
1	PM – 1/Tis	Tiswadi	10 yrs	Small fruit type, suitable for whole fruit pickling.
2	PM – 2/Timoz	Tiswadi	--	Big size fruit, late bearing.
3	PM – 3/ Korde	Priol	>30 yrs	Big fruit, late bearing, flesh is crisp.
4	PM – 4/ Aldona-1	Naik Vado Aldona	>80yrs	Medium sized elongated fruits, mid season bearing, sour fruits suitable for pickling at both tender stage & mature fruit stage.
5	PM – 5/ Aldona-2	Naik Vado Aldona	>60yrs	Medium sized round type fruits, mid season, suitable for pickling at mature stage.
6	PM-6/ FD-1	Gaondongri	>60-70yrs	Elongated fruits, suitable for whole fruit pickling, mid – late season bearing.
7	PM – 7/ FD-2	Gaondongri	>60yrs	Elongated fruits, suitable for whole fruit pickling, mid – late season bearing.

Project: Agricultural education in smaller states: an empirical study of Goa and Puducherry (ICAR Extramural)
R. S. Rajkumar

The objectives of the project are as follows:

- To evaluate institutional set up in agriculture, veterinary and fisheries education including school and vocational education in the state of Goa and Puducherry.
- To assess the trend in supply-demand of trained human resources in agriculture, veterinary and fisheries sector in Goa and Puducherry.
- To evolve a prospective human resource development strategies in agriculture, veterinary and fisheries sector in the state of Goa and Puducherry.

During this project, surveys were conducted to obtain a profile of the institutions in agriculture, veterinary and fisheries education including Colleges and Government departments in the state of Goa and Puducherry. Information on the qualitative and quality issues of education was discussed through focus group meetings and personal discussions with faculty and staff of these colleges. Distribution of human resources into different categories – employment by type, employment by nature, unemployment, higher education, staying out of labour force, migration (geographical and occupational).

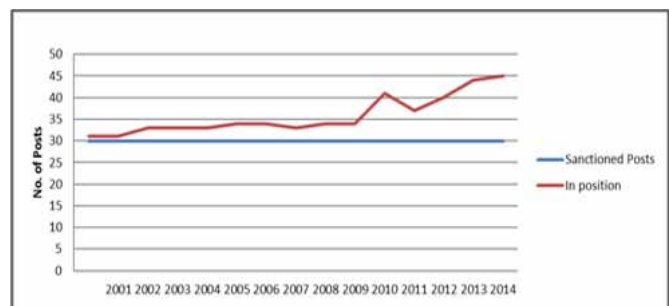
Migration of agricultural, veterinary and fisheries graduates to other occupations will be analysed. Data on the intake of graduates and post-graduates were conducted over the last 15 years (2000 to 2015) from all agriculture, veterinary and fisheries colleges including vocational colleges from Goa and Puducherry.

Data was collected from the line departments, cooperative societies and agro and allied institutes regarding the requirement for the agriculture, veterinary and fisheries graduates and the vacancy positions. Based on the annual growth rate, the expected demand and supply of graduates and post-graduates is estimated for the years 2020 and 2030.

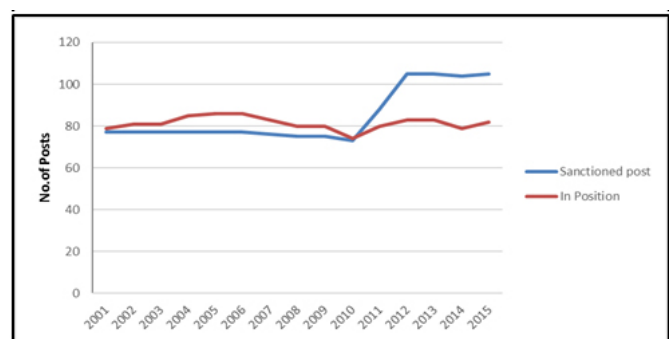
Besides educational institutions were also surveyed as an employer point of view. Study was conducted to obtain a profile of the current deployment of

agricultural personnel, an assessment of the employers on the current shortages and skill gaps, emerging skill needs and the quality of the alumni of the agricultural education institutions employed by them. Appropriate statistical analysis was carried out to measure demand – supply of human capital requirement in agriculture, veterinary and fisheries sectors. A prospective human resource development strategy in agriculture, veterinary and fisheries sectors in the state of Goa and Puducherry was evolved.

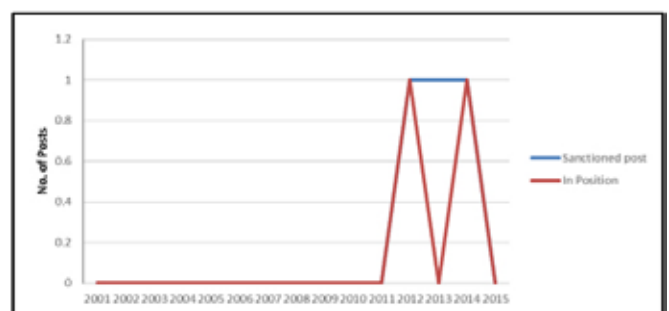
Some of the salient observations are depicted in the following graphs.



Current status demand – supply of assistant agriculture officers (75 % direct and 25 % promotion) in the state of Goa



Current status of Veterinary Officers, Assistant Director and Deputy Director posts in Department of AHVS, Government of Goa



Current status of Assistant Superintendent of Fisheries, Government of Goa

Project : ICAR-Seed Project
a) Seed Production in Field Crops
Manohara KK

Seed production details

The objective of the project is to take up quality seed production in major field crops which are of importance in Goa and adjoining regions. The local demand for the seed and also the target fixed by the council was taken into account for producing the seeds. Keeping in view of the above points, seed production was undertaken in rice during kharif season and that of seed production in Cowpea and Green gram was during rabi season. Detail of seed production is given in the table

Breeder seed production

Breeder seed production in the rice varieties which are released recently by the State Variety Release Committee for cultivation in the coastal saline soils of Goa were taken up during the rabi season of 2016-17.

Breeder seeds (1q each) of the varieties Goa dhan 1 and Goa dhan 2 produced during the rabi season of 2016-17 in the institute field.

Details of seed production

Crop	Varieties	Quantity seed produced
Rice	Karjat-3	7 Q (TLS)
	Jyothi	7 Q (TLS)
	Vytilla	1 Q (TLS)
Cowpea	Goa Cowpea-3	2 Q (BS)
Green gram	TM-96-2	0.3 Q (TLS)
	IPM-2-14	0.2 Q (TLS)

TLS : Truthfully Labelled Seed
BS : Breeders seed



Karjat - 3



Jyothi



Goa Cowpea - 3



Visit of monitoring team to seed production plots

b) Seed Production in Horticultural Crops V Arunchalam

Quality planting materials numbering 3510 covering eight horticultural crops were generated. Details of planting material production 2016-17 is given below:

Crop	Propagule	Number sold
Banana	Sucker	296
Coconut	Seedling	536
Black pepper	Rooted cutting	253
Arecanut	Seedling	2156
Curry leaf	Sucker	60
Wax apple	Air layer	73
Lemon	Air layer	48
Mango	Graft	88

Coconut

Self-pollination is attempted in selected cultivars of coconut to produce true to type seedlings for planting nucleus seed gardens. Hybridization is attempted to evolve high yielding dwarf statured progenies in coconut.

Arecanut

A new hybrid (Mangala(VTL-3) x Goa Butki Supari) was generated by hybridization.



Black pepper mutant

CS of Dwarf areca fruit

Black Pepper

A mutant of black pepper with modified leaf tip was identified, characterized and conserved.

Revenue

An amount of Rs. 89331/- was generated during the year.

c) Seed Production in ornamental fisheries Manju Lexshmi N

Under the National Megaseed project, breeding and seed raising methods of both egg layers and live bearers of many fresh water ornamental fishes namely gold fish (normal, shubunkin, redcap, black moor, silver), koi carp, gourami, (blue, yellow, pearl), angel, sword tail, guppy varieties and molly were standardized after repeated trails. Live feeds like Spirulina, infusoria were produced and fed to young ones and adults. The broodstock of gold fish, angelfish, black molly, koi carp, blue gourami and guppy were

developed in the Fishery Science Section for the ensuing breeding season. Propagation was started for aquatic plants like Ceratophyllum, Cabomba, Hydrilla and Vallisnaria etc. A formulated feed was available for the ornamental fishes which have good demand even in retails shops. Indigenous fresh water ornamental fishes of Goa were collected and maintained in ICAR hatcheries. Nearly 200 to 300 ornamental fish seeds are produced every year with app. Rs. 80000/- as revenue during 2016-17.

Ornamental fish seed sale (2016-2017)

Item	Particulars	Number sold	Rate (Rs.)	Revenue (Rs.)
Fish seeds	Guppy, molly, platy etc	1700	10/-	17000/
Fish seeds	Koicarp, gouramies, gold fish, sword tail etc	790	15/-	12000/
Aquatic plants	Plants and miscellaneous	220 piece	10/-	2200/
Feed	Ornamental fish feed	28 Kg	200/kg	5600/
Total Revenue (Rs.)				36800/

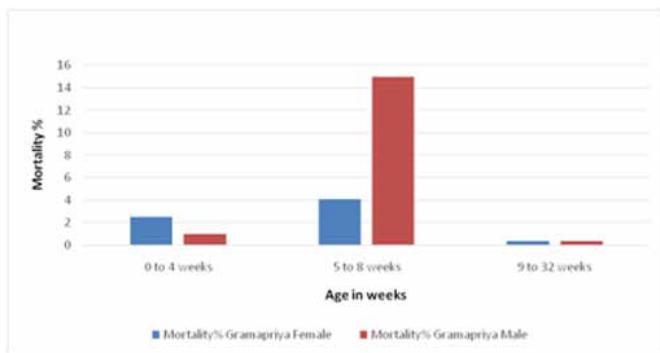
Project : ICAR-Poultry Seed Project
R Solomon Rajkumar

The activities of the project started with the procurement of Parent stock of Gramapriya day old chicks supplied by the ICAR-Directorate of Poultry Research, Hyderabad.

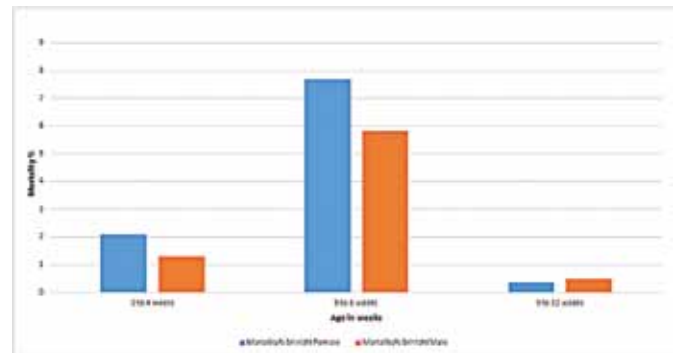
The second batch (Total 1008 birds) of Parent stock (Gramapriya and Srinidhi) day old chicks were procured from ICAR-DPR, Hyderabad. The chicks were cage brooded and reared under intensive system with strict biosecurity and best managerial practices. One batch of Parent Rearing had been completed. The growth performance and the mortality pattern of the Gramapriya and Srinidhi Parent stock are depicted

below. Further, the Indian Council of Agricultural Research has sanctioned civil works for the construction of Brooder cum Grower House (2200 Sq. feet area) and the Parent house (3000 Sq. feet area) at this PSP center. The civil works is under progress.

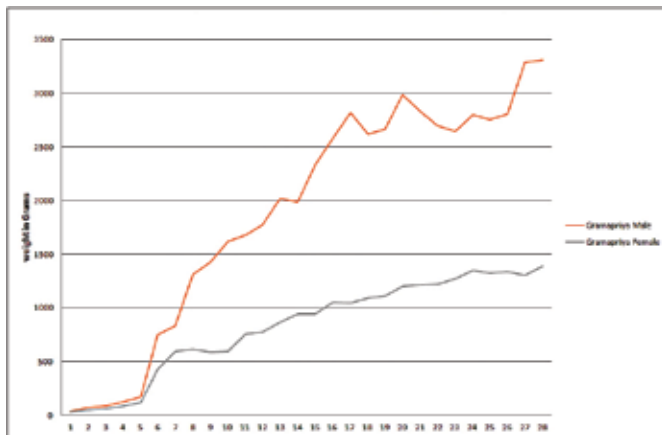
Breeds Reared : Gramapriya, Srinidhi
 No of Batches Reared : Two
 No of Parents reared in each batch : Gramapriya- Female: 403 Male: 101
 Srinidhi - Female: 403 Male: 101
 Date of procurement : 19-08-2016



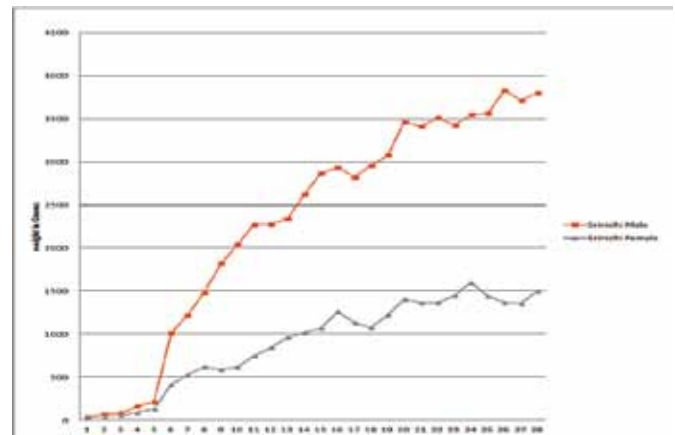
Mortality % in Gramapriya parent stock (0-32 weeks)



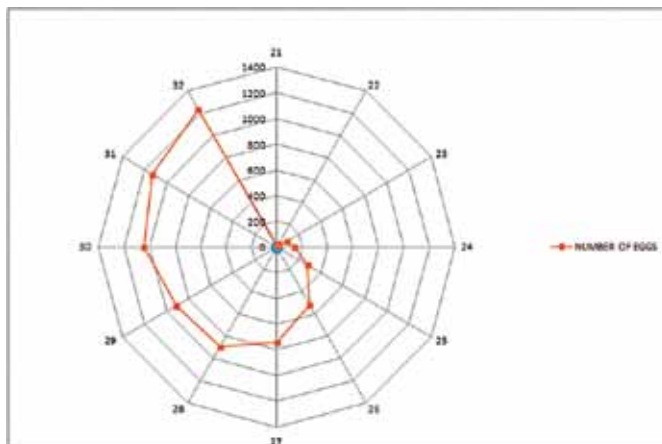
Mortality % in Srinidhi parent stock (0-32 weeks)



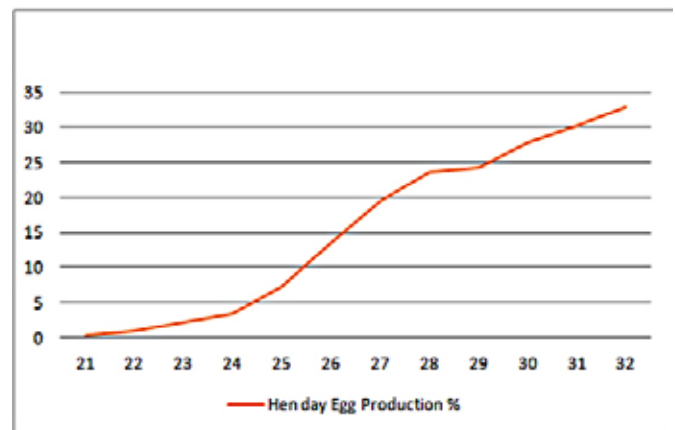
Growth rate of Gramapriya male and female (parent stock) - 0-31 weeks



Growth rate of Srinidhi male and female (parent stock) - 0-31 weeks



Weekly egg production (21-32 weeks)



Hen day egg production %

The genetic diversity of kokum was studied to record the natural variability existing in the population. This shall aid in developing DUS guidelines for registering unique kokum types available in nature. In the current year, sexual variation was estimated in more than hundred trees of *Garcinia indica* from nine different populations geographically distributed in Goa. To determine the extent of variation among and within the populations, several floral traits were studied to assess the sexual dimorphism in floral traits, during November to January (2016-17).

Diversity in kokum flowers

Reproductive parts of kokum revealed some differences and similarities. Flowers are either male or female or bisexual which occur separately on different plants (dioecious or hermaphrodite) or appear together

on the same plant (monoecious/andromonoecious/trioecious). The male buds are short and roundish (0.2 mm to 0.5 mm), whereas, the female buds are oval in shape and vary in size (0.5 mm to 1.63 mm).

Female flowers are solitary and occur in single or occasionally in clusters developed at the both terminal and axillary buds. Primary parts of the flowers in kokum comprised four sepals and four petals which were different in size, color and rarely in number.

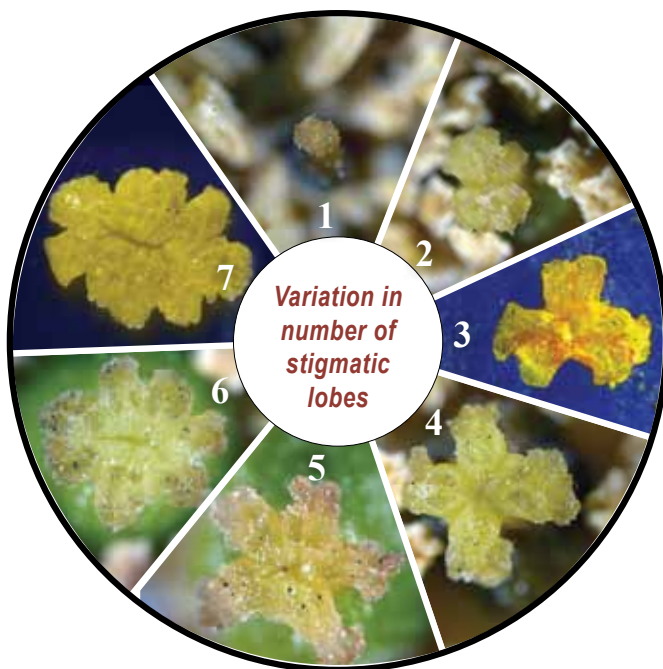
Many stamens, both filamentous and sessile anthers, are observed in both male and female flowers in different locations. The number of anthers, ovary locules and stigmatic lobes varied from 20 to 60, 4 to 9 and 1 to 7 respectively. There was enormous variation in all aspects of flowering in kokum, invariable to location and population.



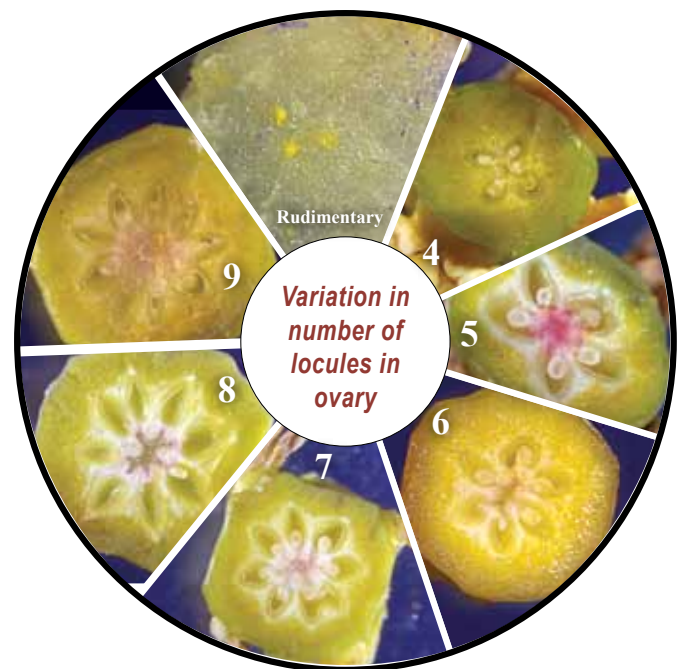
Female flower

Bisexual flower

Male flower



Variation in number of stigmatic lobes



Variation in number of locules in ovary

Project : Establishment of protected structures for high value flower and vegetable crops for training and demonstration (RKVY)
M. Thangam

Evaluation of gerbera under polyhouse

Thirteen varieties of gerbera were evaluated under naturally ventilated polyhouse for cut flower production. The flower stalk length was highest in Dune (82.50cm) followed by Malibou (79.50cm). The lowest stalk length was recorded in Shimmer (48.50cm). With respect to flower diameter, Dana Ellen recorded the highest value (12.50 cm) and smallest flower was observed in Shimmer (8.95 cm). The average flower production per plant ranged from 35.50 (Pre Intense) to 52.25(Malibou) per year.



Dana Ellen-Dune-Goliath



Pre Intense-Malibou

Evaluation of capsicum hybrids under polyhouse

Two commercial capsicum hybrids viz., Orobelle, Bombi and Indra were planted under naturally ventilated polyhouse for coloured capsicum production. The cumulative yield per plant was highest



View of capsicum cultivation under polyhouse

in Orobelle (2.15kg) followed by Indra (1.85kg). The average individual fruit weight ranged from 155g to 270g.

Evaluation of Orchid varieties under polyhouse

Six varieties of Orchids viz., Sonia (Purple), 5N (White), Charming white (White and Red), Sonia Earsakul (Red, Purple and White), Mona Red DC-0666 (Red) and Airy Red Bull (Red) were planted for an evaluation trial under shade net house. The highest spike length was recorded in Airy Red Bull (62.50cm) followed by Sonia Earsakul (58.50cm). The highest number of florets was recorded in Sonia Earsakul and Charming White (45.50) followed by 13.25 in Airy Red Bull.



View of orchid polyhouse and Sonia Earsakul



Project: Conservation of traditional varieties of vegetable crops and entrepreneurship development for its seed production (RKVY)
M.Thangam

Collection and conservation of germplasm in major vegetable crops

The following number of collections were evaluated for yield and production of nucleus seed for conservation. Red Amaranthus (32), Green Amaranthus (4), Chillies (15), Okra (13), Pumpkin (3), Broad bean (1), Cucumbers (7), Snap melon (5), Vegetable cowpea (15), Brinjal (8), Bottle gourd (6), Ridge gourd (6) and Snake gourd (2).

Evaluation of Amaranthus accessions for yield and seed production

Thirty six accessions of amaranthus comprising of red, green and white types is being evaluated for yield and other traits. The earliest flowering was noticed in Amar 14-76 Warkhand (32 days) which is not a desirable

traits for leafy type amaranthus. Amaranthus accessions like Amar 10-44 Gulem, Amar 12-58 Arlem took 55 days for first flowering. The highest leaf length was recorded in Amar 04-2015 Karmali (18.25cm) followed by Amar 5-25 Bendurdem (12.20cm).



Diversity in Amaranthus for leaf characters



View of local collections in vegetable crops

Project: Demonstration of Precision Farming Technologies (PFT) in banana, pineapple and papaya in farmers' fields of Goa (RKVY)
S. Priya Devi

Field trials of banana and pineapple have been laid out with dripline and fertigation facilities. Demonstration trial with high density planting of TC plants and conventional suckers of local banana varieties like TC Grand Naine, TC Velchi, TC Saldatti, Velchi, Saldatti, Savarboni, Amti and Raspali is under progress in village Gaondongrim, canacona Taluka. In the same village, pineapple suckers of var Giant Kew have been planted in trenches, and cultivated with drip and fertigation. The beneficiary farmer has harvested fruits of main crop to a tune of 454 kg, amounting to Rs 25,352/-. Similarly,

demonstration plot on banana has been laid out in Aldona village with varieties like TC Grand Naine, TC Velchi, TC Saldatti, Velchi, Saldatti and Myndoli. Out of 230 plants, 100 have yielded and the bunches are being sold in Mapusa market by the farmer for Rs. 40-50 per dozen, thereby fetching nearly Rs. 32,000 so far. The harvests are in progress. Advanced technologies like, tissue culture plants, drip irrigation, nutrients through fertigation, bunch covers, plant protection measures, use of Trichoderma etc have been taken to these farms. The farmers have started reaping the harvests of pineapple and banana.



Demonstration plot of banana in Canacona



Demonstration plot of pineapple in Canacona

Project : Empowering farmers of Goa for adoption of low cost polyhouses through training and demonstration (RKVY)
Mathala Gupta

Varietal trials of tomato varieties of Abhinav (F1 Hybrid) of Syngenta, GS 600 (F1 Hybrid) of Gold Seeds and Heemsohna (F1 Hybrid) of Syngenta with grafted and transplanted seedlings were conducted under modified double-span greenhouses. The survival rate of Heemsohna was 77.08% (Grafted) and 43.75% (transplanted); Abhinav, 47.92% (Grafted) and 81.25% (transplanted) and GS 600, 56.75% (Grafted) and 68.75% (transplanted). Staggered sowing dates for tomato was also tried under the same greenhouse, but the experiment was not successful.

Staggered sowing experiment of Cucumber variety Kian (F1 Hybrid) of Nunhems Seeds was conducted under single span naturally ventilated greenhouse from May 25, 2016 to August 31, 2016.

Severe leaf blight lead to the failure of the experiment. Hence it was concluded that staggered sowing was not advisable within the same structure.



Staggered sowing of cucumber (Kian)



Tomato under polyhouse

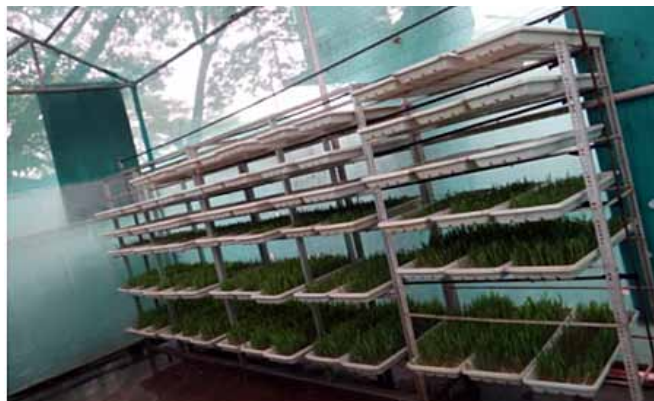
Project : Training, demonstration and research on hydroponic green fodder production (RKVY)
E B Chakurkar

As green fodder is an integral part of the dairy ration, in the situations, where conventional green fodder cannot be grown successfully or progressive modern dairy farmers with elite dairy herd can produce hydroponics fodder for feeding their dairy animals. Hydroponics green fodder is a viable option for fodder scarcity and is a very promising technology for sustainable livestock production in India.

The hydroponics fodder is produced in greenhouses, which can be hi-tech or low cost devices. The hi-tech greenhouse is associated with a control unit and may be with or without air conditioner. The control unit regulates input of water and light automatically through sensors.

Under this project, total of 51941 kg biomass was produced from 14296 kg maize seeds and it was analysed for chemical composition. The protein content of hydroponic green fodder was 13.57 % as

compare to 10.67 % of conventional green fodder. Training and demonstration programme was organised for farmers, students etc. Total of seven training and demonstration programme were conducted for more than 300 participants from Goa and neighbouring states.



Hydroponics green fodder unit

Project : Feed blocks for dairy animals for effective utilization of locally available resources and higher productivity (RKVY)
E B Chakurkar

Feed blocks for dairy animals are been made from locally available resources for dairy animals from locally available resources.

Under this project feed block unit was constructed. Feed block making machine was procured from IARI, New Delhi, along with feed and fodder mixture and crusher for making feed blocks. Karad grass and feed ingredient were purchased from locally available suppliers. 1800 blocks were prepared from two variant karad grass and paddy straw mixed with concentrate feed mixture. Currently trial is been initiated to dairy animals in institute dairy unit.

Feed block technology can help ours farmers in balanced feeding of dairy animals apart from this it has multiple advantages like bulk storage of the roughages can be reduced by eight times, easy transportation, much less space for storage, feed blocks can be stored for a long period of time, easy handling and reduce feeding cost as locally available feed ingredient can be utilised.

As it prevents selective eating by animals, there in reduction in wastage of feed stuffs, particular crop residues. The milk and fat content of milk is increased. There is easy handling of feed material and is a labour saving feeding management.



Feed blocks

Significant Scientific Accomplishments

Varieties released
Intellectual Property Rights
Technology Evaluation
Ongoing Research Projects
Awards and Recognitions
Publications





Varieties Released

Two rice varieties and three cashew varieties were released for Goa State on 23rd January, 2017 through State Variety Release Committee (SVRC)

RICE

Goa dhan-1 (KS-12)

A high yielding salinity tolerant rice variety released for cultivation in coastal saline soils of Goa which accounts for 25-30% (12,000-15,000 ha) of the total cultivated area of rice crop in the state. It is a white kernelled semi-tall variety having short-bold type of grains. The yield potential of the variety under stress is 23-26 q/ha with yield advantage 33-35% over the national check variety CST 7-1.



Goa dhan-2 (KS-17)

A high yielding salinity tolerant rice variety released for cultivation in coastal saline soils of Goa which accounts for 25-30% (12,000-15,000 ha) of the total cultivated area of rice crop in the state. It is a red kernelled tall variety having long-bold type of grains. The yield potential of the variety under stress is 26-28 q/ha with yield advantage of 45-50% over the national check variety CST 7-1.



CASHEW

Goa cashew -2 (Tiswadi-3)

This is an early season variety (Mid February – April) selected for its jumbo nut size (10.20-11.80 g) and bigger apple size (105.50 g) with moderate nut yield of 8-10 kg/tree at the age of 10th year, recording 105-110 nuts/kg. The variety has got a high shelling percentage (28.82 - 29.55 %) with kernel weight of 2.42 g with W 180 – W 210. The cashew apple is cylindrical, yellowish orange, weighing 105 g with 68.20 – 72.00 % juice contents of 10.80 – 12.2 °B.



Goa cashew-3 (Ganje-2)

This is a Mid season (March –May) high yielding variety (12-15 kg/tree) with bold nuts (8.20 g) recording 130-140 nuts/kg, and bigger, yellow apples (94.00 g) with higher juice contents (69.17 %) of TSS 12.2 ° B. This bears in bunches. The variety has got a high shelling percentage (29.50 %) with kernel weight of 2.16- 2.28 g with W 210 – W 240.



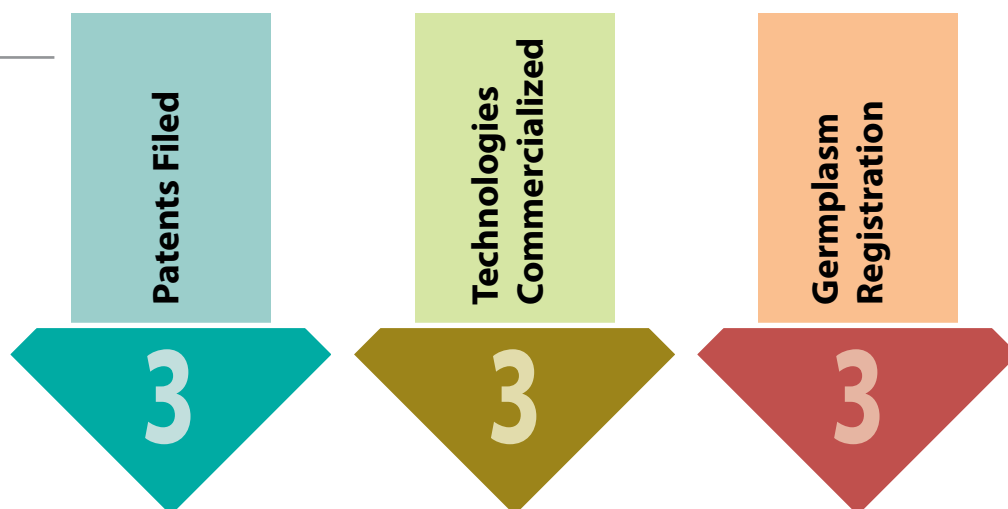
Goa cashew-4 (KN-2/98)

This is a long season high yielding variety (12-15 kg/tree) with bold nut size (8.25 g) and higher shelling percentage (29.59) bigger sized (107g) red apples. This variety has bunch bearing characteristic. Maturity of fruits starts from mid February and continues till the end of May. It records 120-125 nuts/kg having kernel weight of 2.68 g with W 210 – W 240.



Intellectual Property Rights (IPR) Cell

Accomplishments



Patents filed

An application for provisional patent for the technology entitled "Process for preparing Cashew Apple Crunch" and resultant food product thereof" was recorded by the Indian Patent Office on 8th April, 2016 ("Priority Date") vide application serial No. 201621012413. Filing of complete specification is under process with the authorized patent attorney viz, Inventillect Consultancy Services Pvt. Ltd., Pune.

An application for provisional patent for the technology entitled "Process for preparing nutmeg taffy and resultant food product thereof" was recorded by the Indian Patent Office on 8th April, 2016 ("Priority Date") vide application serial No. 201621012414. Filing of complete specification is under process with the authorized patent attorney viz. Inventillect Consultancy Services Pvt. Ltd., Pune.

Patent application on "Extender for preservation of boar semen" was filed at Indian Patent Office on 10th August 2016 with permanent serial number No.3037/MUM/2015 which was subsequently published on 17/02/2017 in Patent Journal of India.

Technologies Commercialized

Commercialization of the Institute's technologies viz. NBSE Boar Semen Extender, Cashew Apple Crunch and Nutmeg Taffy have been initiated and under process in consultation with Agrinnovate India Ltd., New Delhi.

Germplasm Registration

An application for the registration of the microbial germplasm viz. *Bacillus methylotrophicus* strain RCh6-2b was submitted to NBAIM, Mau on 15-04-2016.

An application for the registration of the Red Amaranth Genetic Stock for high betacyanin content AtR18 (IC-0598190) has been submitted to NBPGR, New Delhi on 6th August, 2016 Betacyanin content of IC-598190 was 329.4±75 mg/g fresh weight, when compared to Arka Arunima (166.9±37 mg/g fresh weight) during 2016-17

Application for registration of "Khola Chilli" as farmers' variety has been submitted to PPV&FR Authority, New Delhi.

PPV&FRA Awards

Khola/Canacona Chilli Cultivators Group, South Goa was awarded with the prestigious Plant Genome Savior Community Award by Govt. of India through PPV&FRA under the section 45 of PPV&FR Act, 2001. The awards were conferred by Sri. Radha Mohan Singh, Hon'ble Union Minister for Agriculture & Farmers' Welfare, Govt. of India on 21st December, 2016 at B.P. Pal Auditorium, Pusa, New Delhi. This honour was conferred for conservation and preservation of Khola/Canacona Chilli, a medium pungent landrace with bright red colour. IPR Cell of the Institute facilitated the application process to the PPV & FR Authority, New Delhi on behalf of the farmers.

Sri. Prabhakar Keni, a progressive farmer from Cuncolim, South Goa was awarded with 'Plant Genome Saviour Farmers' Recognition Reward 2014' by Govt. of India through PPV&FRA under the provision of section 45 of PPV&FR Act, 2001. Shri Keni conserves Cashew, Coconut, Arecanut, Mango, and Jackfruit along with spice/condiment crops such as Black pepper, Nutmeg and Vanilla. Two promising local selections in Cashew viz. Balli-2 and KN – 2/98 are originally identified from his farm. He has also developed a unique technique for the propagation of cashew, mango, nutmeg and jackfruit.



Events / Programmes organised

A visit of Inspection committee along with field-level interactive meeting for monitoring activities of Khola Chilly cultivators' Group with respect to the application submitted to PPV&FR Authority, New Delhi, for Plant Genome Savior Community Award (2015-16) was organised on 7th July, 2016.

The Institute organized a Felicitation Ceremony for the recipients of 'Plant Genome Saviour Farmers Award' on 10th January, 2017. Dr. N.P. Singh, Director, ICAR-NIASM, Baramati was the Chief Guest for the event. The awardees Shri Ratnakar Velip, President of Khola/Canacona Chilli cultivators Group along with the representative group members and Shri. Prabhakar Keni, a progressive farmer from Cuncolim South Goa were felicitated by the hands of Chief Guest for receiving Plant Genome Saviour Community Award 2013-14 and 'Plant Genome Saviour Farmers Recognition Award, 2014 respectively.

ITMU/ IGIC Meetings

Four (4) meetings of Institute Technology Management Unit (ITMU) were convened during the period (dates: 19-4-2016, 23-06-2016, 28-09-16, 11-11-2016) and one (1) Institute Germplasm Identification Committee (IGIC) was held on 23-06-16.



Technology Evaluation

Performance Evaluation of Process Machinery Developed for West coast

Three process machineries viz. i) Arecanut decorticator and ii) two types of pepper threshers were evaluated

and performance evaluation reports were given to the farmer innovators. These machineries will help in on-farm value addition in Western coast as they have been developed for crop varieties specific to the Konkan belt and their performance was rated as good.



Name	: Arecanut Dehusker
Function	: For dehusking arecanut
Dimensions	: 380 X 240 X 248 in (Lx W x H)
Material	: Mild Steel except hammers -3" (6 nos.) which are made of nylon 66 in the dehusker
Power Source	: 2 HP Single Phase motor
Capacity	: 72.5-90 kg/hr

Name	: Pepper Decorticating Machine-Horizontal type (PDC 001)
Function	: Threshing of Pepper (separating pepper berries from spike)
Dimensions	: 39 X 24 X 37 in (Lx W x H)
Material	: Powder coated body with steel threshing parts
Power Source	: 0.5 HP Single Phase motor
Capacity	: 113.22-130.41 kg/hr



Name	: Pepper Decorticating Machine-Vertical Type (PDC 003)
Function	: Threshing of Pepper (separating pepper berries from spike)
Dimensions	: 12 X 16 X 38 in (Lx W x H)
Material	: Powder coated body
Power Source	: 0.25 HP Single Phase motor
Capacity	: 14.98-30 kg/hr

Ongoing Research Projects

Institute projects

S. No.	Project Title	PI	Co – PI	Duration
Natural Resource Management				
1.	Development and evaluation of soil and water conservation measures for sustainable production of major horticultural crops in Goa.	Sujeet Desai		2008 – 19
2.	Site-specific nutrient management through rapid nutrient detection techniques in important crops of west coast of India	GR Mahajan		2016 - 19
3.	An economic analysis of agricultural sustainability in western coast of India	Reddy V		2015-17
4.	Study of nutrient management and cropping system on greenhouse gas emission through infoRCT model in west coast of India	Paramesha V	Bappa Das	2016 - 19
5.	Calibration and validation of simulation and statistical crop yield model for major field crops of west coast of India	Bappa Das	Paramesha V	2016 - 19
Crop Science				
6.	Breeding high yielding salt tolerant rice varieties for coastal saline soils	Manohara KK		2010 – 20
7.	Bio-ecology and management of economically important insect pests under coastal ecosystem	R Maruthadurai		2016 - 19
8.	Monitoring and study on the incidence of diseases and insect pests in protected cultivation	R Ramesh	Maruthadurai R	2015-17
Horticultural Science				
9.	Allele mining of banana genome sequences for genetic improvement	V Arunachalam		2014 -17
10.	Collection, evaluation of genetic resources and management of fruit and spices	AR Desai	S Priya Devi Maneesha SR V Reddy	2011 – 19
11.	Survey, collection, evaluation and management of under utilized fruits of coastal region	S Priya Devi		2013 -18
12.	Standardization and validation of Precision Farming Technologies (PFT) for major vegetable crops under climatic conditions of Goa	M Thangam	Safeena SA	2013 – 17
13.	Germplasm collection, conservation, evaluation and standardization of production and post harvest techniques of commercially important flower and foliage crops	Safeena SA	M Thangam	2010 – 17
14.	Design of protected cultivation structures for year round utilization in Western region	Mathala Juliet Gupta		2011-17
15.	Development of good agricultural practices through integrated nutrient management for sustainable fruit production in coastal regions of India	Maneesha SR	GR Mahajan	2015-18

Animal Sciences				
16.	Preparation / formulation of boar semen extender and pre insemination fluid for artificial insemination in pigs	EB Chakurkar		2014 - 17
17.	Enhancing livestock performance by using advanced managemental and health interventions at Institute livestock farms	EB Chakurkar	Gokuldas PP Shivasharanappa N Rajkumar S Susitha Rajkumar Chetan Kumar HB	2015 - 18
18.	Analysis of rural backyard poultry based livelihood alternatives in west coast of India	RS Rajkumar		2015 - 18
19.	Epidemiological surveillance of economically important disease of dairy animals in west coast	Susitha Rajkumar	Shivasharanappa N	2015-18
20.	Patho - epidemiology and health interventions of goat diseases in west coastal India	Shivasharanappa N	Susitha Rajkumar	2015-18
21.	Prevalence of swine associated zoonotic parasitic diseases in Indian west coast	Chethan Kumar HB	Rajkumar S	2015-17
22.	Seasonal modulation of reproductive performance in dairy buffaloes with special reference to west coast region	Gokuldas PP	Bappa Das	2016 - 19
Fishery Sciences				
23.	Augmentation of fishery and fish biodiversity in the near shore marine areas of Goa through artificial fish habitats	GB Sreekanth	N Manju Lekshmi	2013 - 17
24.	Diversification of species and aquaculture practices in coastal waters off Goa through potential species identification	N Manju Lekshmi	GB Sreekanth	2016 - 19

AICRP CENTRES

S. 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
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

AICRP VOLUNTARY CENTRES

S. No	Project Title	PI	Co-PI (s)
1.	All India Co-ordinated Rice Improvement Project	Manohara KK	
2.	All India Co-ordinated Research Project on Arid Legumes	Manohara KK	

EXTERNAL FUNDED PROJECTS

S. No.	Project Title	PI	Co-PI (s)
Foreign Aided			
1.	Stress Tolerant Rice for Africa and South Asia (STRASA)	Manohara KK	
DBT			
2.	Augmentation of rural pig production for socio economic upliftment of rural poor in Goa through artificial insemination	EB Chakurkar	
ICAR			
3.	Integrated Farming System for improvement of nutrition and livelihood of farm women under different agro-ecosystems	V Reddy	GR Mahajan
4.	Network Project on Transgenics in Crops (Functional genomics): Genetic Mapping of Salinity Tolerant Genes in Rice	Manohara KK	
5.	Collection and conservation of pickling type of mango germplasm in Goa region	A R Desai	
5.	Outreach project on <i>Phytophthora</i> , <i>Fusarium</i> and <i>Ralstonia</i> diseases of horticultural and field crops	R Ramesh	
6.	Production and formulation technology refinement of bacterial bio- agents for soil borne plant disease management under coastal ecosystem	R Ramesh	
7.	Extramural project on Characterization and development of low-cost interventions for management of the degraded coastal saline soils	GR Mahajan	Bappa Das
8.	Agricultural education in smaller states: an empirical study of Goa and Puducherry	RS Rajkumar	
9.	Seed production in agricultural, horticultural crops and fisheries (Mega seed project)	Manohara KK	V Arunachalam N Manju Lekshmi
10.	Poultry seed project	RS Rajkumar	
DST, SERB			
11.	Phenotyping for salinity stress of crop plants through thermal hyperspectral remote sensing	Bappa Das	Manohara KK
DSTE, Goa			
12.	Amelioration and management of coastal saline soils of Goa	GR Mahajan	
13.	Agro-morphological characterization and DNA fingerprinting of rice land races of Goa	Manohara KK	
PPV&FRA, GoI			
14.	Development of descriptors for kokum (<i>Garcinia indica</i> Choisy)	S Priya Devi	
RKVY			
15.	Establishment of protected structures for high value flower and vegetable crops for training and demonstration	M. Thangam	S Priya Devi
16.	Conservation of traditional varieties of vegetable crops and entrepreneurship development for its seed production	M Thangam	S Priya Devi V Arunachalam
17.	Development of comprehensive e-agriculture portal for information and knowledge sharing in Goa	M Thangam	S Priya Devi
18.	Demonstration of Precision Farming Technologies (PFT) in banana, pineapple and papaya in farmers' fields of Goa	S Priya Devi	
19.	Empowering farmers of Goa for sustainable adoption of low-cost protected cultivation structures through training and demonstration	MJ Gupta	M Thangam
20.	Feed blocks for dairy animals for effective utilization of locally available feed resources and higher productivity	EB Chakurkar	
21.	Training, demonstration and research on hydroponics green fodder production	EB Chakurkar	

Awards and Recognition



Dr. Safeena S. A

- Best Oral Presentation Award for the paper entitled "Value addition of tuberose spikes (*Polianthes tuberosa* L.) by tinting with edible dyes" in National Symposium on Advances in Agriculture Through Sustainable Technologies and Holistic Approaches held during 15-17 February, 2017 at the International Centre, Dona Paula, Goa.



Dr. Susitha Rajkumar

- Best oral presentation for paper entitled "Genetic characterization of *Mycoplasma gallisepticum* isolates from Indian Poultry flocks". in III AAHP Convention and National Symposium on Poultry Health and Welfare, Riding the wave to the Future. 20-21 October 2016 organized by AAHP and ICAR-CCARI at Goa.



Shri. Sreekanth G B

- Prestigious Young Scientist Award in the section of "Animal, Veterinary and Fisheries Sciences" during the 104th Indian Science Congress during 3-7 January, 2017 at Sri Venkateswara University, Tirupathi, Andhra Pradesh.



Mrs. Manju Lekshmi N

- Best Oral Presentation Award for the paper entitled, "Ecological evaluation of coastal aquaculture systems in Goa" in the National Symposium on Advances in Agriculture Through Sustainable Technologies and Holistic Approaches to be held during 15-17 February, 2017 at the International Centre, Dona Paula, Goa.



Dr. Chethan Kumar

- Best Poster Presentation Award for the paper entitled "A Development of lateral flow assay for the serodiagnosis of Japanese encephalitis in swine" in XIV annual conference of IAVPHS held during 21-22 November, 2016 at Udaipur, Rajasthan.
- Best Poster Presentation Award for the paper entitled "Human brucellosis: A study on seroprevalence and potential risk factors among the occupational high risk groups Brucellosis 2016 " in International Research Conference held during November 17-19, 2016 at New Delhi.



Ms. Maneesha S R

- Peerless poster award in the National conference on fruit breeding for Tropics and Subtropics: An Indian perspective, on "Analysis of Simple Sequence Repeats (SSR) polymorphism in mango (*Mangifera Indica* L.) varieties of Goa" held during 26-29 April, 2016 at ICAR-IIHR, Bengaluru, Karnataka.



Dr. Bappa Das

- ISCA Young Scientist Award by Indian Science Congress for the Section of Agricultural & Forestry Section for the Ph.D. research work on "Evaluation of different uni-and multi-variate techniques for water-deficit stress phenotyping of rice through spectroscopy" presented in 104th Indian Science Congress held during 3-7 January, 2017 at SV University, Tirupathi, Andhra Pradesh.
- Institute Merit Medal for Outstanding Academic Performance in Doctor of Philosophy presented in 55th Convocation held at ICAR-IARI, New Delhi

IARI INOVATIVE FARMER AWARDEE 2017

- Shri Babu Narhari Komarpant, a progressive farmer resident of Devbag Palolem Cancona South Goa received the prestigious IARI Inovative Farmer Award 2017 at the hands of Shri Paroshottam Rupala- Central Union Minister of State for Agriculture, Farmers Welfare and Panchayat Raj, Government of India. His name was nominated from ICAR-CCARI, Goa



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Research Articles

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- Gaitonde S and Ramesh R (2016). Screening plant products for *Ralstonia solanacearum* inhibition and characterization of antibacterial compounds in *Garcinia indica*, *Tamarindus indica*. *Proceedings of National Academy of Sciences, India Section B: Biological Sciences*. 1-12. DOI: 10.1007/s40011-016-0755-6.
- Jayesh S. Anerao, Vikas Jha, Lina Korgaonkar, Priya Devi S, Nitin Desai, 2016. Dissecting genetic diversity in *Garcinia xanthochymus* using ISSR and RAPD markers. *J. Plant Breed. Genet.* 04 (03) 2016. 69-76
- Madhu BP, Singh KP, Saminathan M, Singh R, Shivasharanappa N, Sharma AK and Manjunatha V (2016). Role of nitric oxide in the regulation of immune responses during rabies virus infection in mice. *Virus Disease* 27(4): 387-399.
- Mahajan GR, Manjunath BL, Singh NP, Ramesh R, Verma RR, Latore AM, Ruenna D'Souza, Barnes Natasha, Kulkarni R (2016) Effect of organic and inorganic sources of nutrients on soil microbial activity and soil organic carbon build up under rice in west coast of India. *Archives of Agronomy and Soil Science*. 63(3): 414-426.
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- Manju KP, Manimekalai R, Naganeeswaran SA, Arunachalam V and Karun A (2016). Microsatellites mining in date palm (*Phoenix dactylifera* L.) and their cross transferability across Arecaceae family. *Plant Omics Journal* 9(3): 191-197.
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**Papers and
abstracts
in
Conferences/
Workshops**

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- Arunachalam V and Prabhu DC (2016) Colchiploidy and sexual seedling for pre-breeding banana. In: 1st International Agrobiodiversity Congress during 6-9 November, 2016 at NASC Complex, New Delhi
- Arunachalam V and Das B (2016) Prediction of coconut yield in Goa state of India. In: 3rd International symposium on coconut research & development (ISOCRAD 3) during 10-12 December, 2016 at ICAR-CPCRI Kasaragod.
- Chetan Kumar HB, Shivasharanappa N, Susitha R, Rajkumar RS and Chakurkar EB (2016). Prevalence of parasites with special reference to zoonotic importance in pigs of west coastal region of India. In: XIV Annual conference of IAVPHS and National symposium on Innovative approaches to promote food safety and reduce the risk of zoonotic diseases in context of climate changes during 21-22 November, 2016 at Udaipur, Rajasthan.
- Das Bappa (2017). Evaluation of different uni- and multi-variate techniques for water-deficit stress phenotyping of rice through spectroscopy. In: 104th Indian Science Congress during 3-7 January, 2017 at Sri Venkateswara University, Tirupati.
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- Maruthadurai R (2017) Seasonal Occurrence of Aphid, *Aphis odinae* (Van der Goot) (Hemiptera: Aphididae) and its predators in Cashew. In: National symposium on advances in agriculture through sustainable technologies and holistic approaches during 15-17 February, 2017 at Goa.
- Maruthadurai R and Singh NP (2016) Occurrence and infestation of buprestid *Belionota prasina* (Coleoptera: Buprestidae) on Cashew *Anacardium occidentale*. In: 3rd National meet of Entomologists during 7-8 October, 2016 at Bengaluru.
- Mohan NH, Nayak L, Gokuldas PP, Debnath S, Paul M, Ramamurthy VV and Sarma DK (2016) Relationship between fibre morphology and tensile properties of pig hair fibre. In: Annual

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Patil VS and Safeena SA (2016) Storage Studies in Dutch Rose Dry Flowers. In: 7th Indian Horticulture Congress during 15-18 November, 2016 at New Delhi.

Priya Devi S, Thangam M, Porob SA and Singh NP (2016) Genetic diversity of Jackfruit in Goa state. In: 1st International Agrobiodiversity Congress during 6-9 November, 2016 at NASC Complex, New Delhi.

Priya Devi S, Maneesha SR, Sheijal AP and Singh NP (2016) Storage studies in Indian gooseberry (*Embelica officinalis* Gaertn.) in Goa. In: National conference on Innovative food processing technologies for food and nutritional security during 29-30 September, 2016 at ICAR-CIPHET, Ludhiana.

Ramesh R, Asolkar T and D'Souza, M (2016) Resistant root stocks and varieties in the management of bacterial wilt in brinjal. In: National symposium on "challenges to plant pathologists under changing disease scenario" during 5-7 October, 2016 at Goa University, Goa.

Ramesh R, Dasari N, Menon S, Meena SN, Gaonkar T and Mahajan GR (2016). *Bacillus methylotrophicus* STC-4 a promising PGPR for coastal region. In: National symposium on Challenges to plant pathologists under changing disease scenario during 5-7 October, 2016 at Goa University, Goa.

Reddy KV and Singh NP (2016) Analysis of farmers' perception about agro-ecosystem in south west coast of India. In: 4th International Agronomy Congress during 22-26 November, 2016 at IARI, New Delhi.

Reddy KV (2016) Pulses for Nutritional Security and Health. In: Conference on Pulses for Sustainable Agriculture and Human Health during 31 May-1 June, 2016 at New Delhi, India.

Safeena SA., Thangam M, Priya Devi S and Singh NP (2016) Genetic diversity of traditional loose flower crops under coastal humid ecosystem of Goa. In: 1st International Agrobiodiversity Congress during 6-9 November, 2016 at NASC Complex, New Delhi.

Safeena SA, Thangam M and Singh NP (2017) Ornamental Coleus: A promising ornamental plant for landscaping shady areas. In: National symposium on advances in Agriculture through Sustainable Technologies and Holistic Approaches during 15-17 February, 2017 at Dona Paula, Goa.

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Singh NP and Paramesha V (2016) Improving farmers prosperity in coastal ecosystems of India through integrated farming system. In: 4th International Agronomy Congress during 22-26 November, 2016 at IARI, New Delhi.

Sreekanth GB (2017) Fish communities refuge shipwrecks than natural reefs along southwest coast of India. In: 104th Indian Science Congress during 3-7 January, 2017 at Sri Venkateswara University, Tirupathi, Andhra Pradesh.

Sreekanth GB, Manju Lekshmi N and Singh NP (2016) Effect of an artificial fish habitat on fish community structure in a coastal ecosystem. In: 1st International Agro Biodiversity Congress from 6-9 November, 2016, at NASC Complex, New Delhi

Shivasharanappa N and Chakurkar E B (2016) Status of Goat farming in Goa. In: State level meeting on 'Preparation of comprehensive strategies for goat production for the states of MH and Goa' on 25 November, 2016 at Pune, Maharashtra.

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Susitha Rajkumar, Reddy M R and R Somvanshi (2016). Genetic characterization of Mycoplasma gallisepticum isolates from Indian Poultry flocks. in IIIAHP Convention and National Symposium on Poultry Health and Welfare, Riding the wave to the Future. 20-21 October 2016 organized by ICAR-CCARI at Goa

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Popular / Technical Articles

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Chakurkar EB, Shivasharanappa N, Chetan Kumar HB and Susitha R (2016) Zoonoses: creating awareness and their prevention. Goa vet Bulletin (April, 2016).

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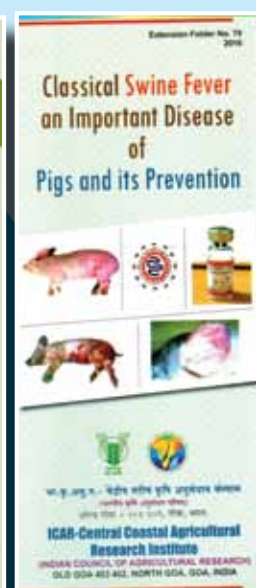
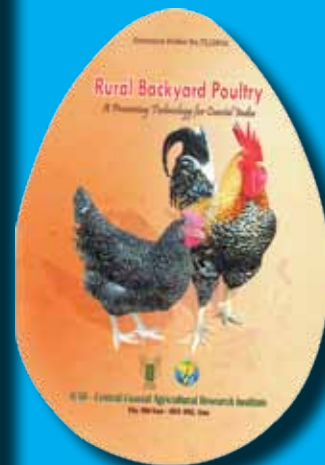
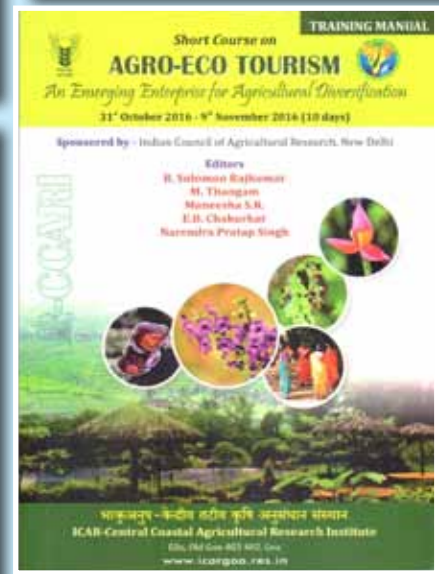
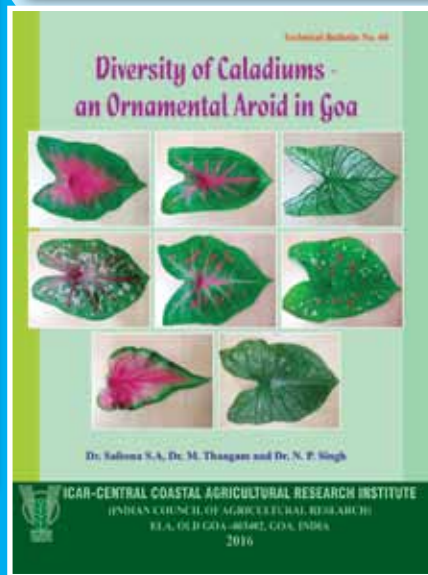
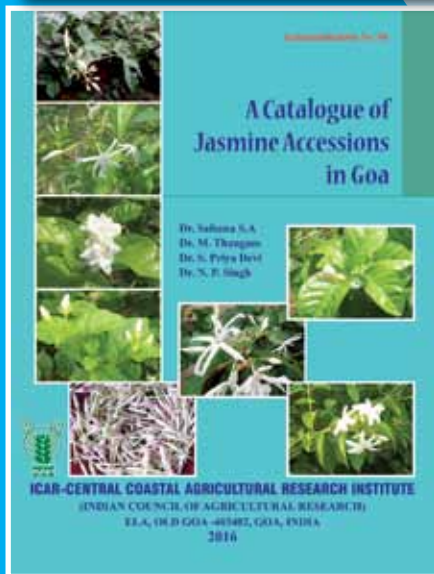
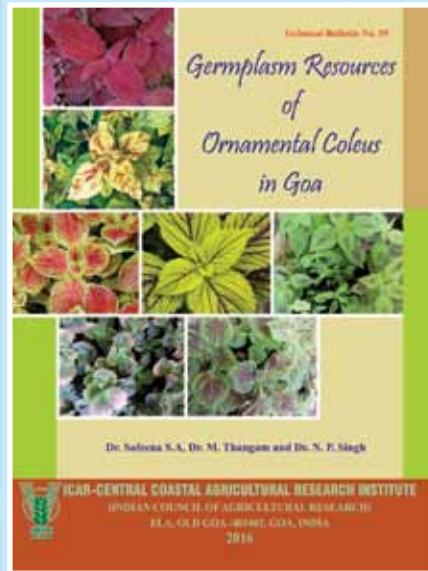
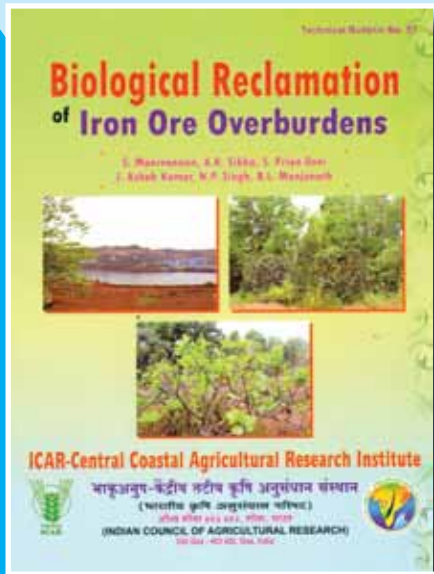
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Shivasharanappa N, Susitha R, Chetan Kumar HB, Chakurkar E B and Sanjay U (2016) PPR (Peste Des Petits Ruminants) Disease in Goats and its prevention, Goa Vet, July 2016.

Institute as Publisher

Publications	Authors/ Editors
Reports	
Annual Report (2015-2016) pp.1-124	NP Singh, R Ramesh, M Thangam, Manohara KK, Shivasharanappa N, Mahajan GR and Sreekanth GB
Training Manual on Short course on Agro- Eco- Tourism (2016) pp. 1- 141	RS Rajkumar, M Thangam, Maneesha SR, Chakurkar EB and Singh NP
Instruction Material on Precision farming technologies in fruit crops (2016) pp. ----	S Priya Devi, Shejal A Porob and M Thangam
Technical Bulletins	
ICAR-Central Coastal Agricultural Research Institute in Print Media (2015 - 2016) Technical Bulletin No 56 pp 1- 45	NP Singh
Biological reclamation of iron ore overburdens Technical Bulletin No 57. pp 1- 28	S Manivannan, AK Sikka, S Priya Devi, Ashok Kumar J, Singh NP and. Manjunath BL
A Catalogue of Jasmine Accessions in Goa Technical Bulletin No 58. pp 1- 42	Safeena SA, Thangam M, Priya Devi S and Singh NP
Germplasm resources of ornamental coleus in Goa Technical Bulletin No 59. pp 1- 26	Safeena SA, Thangam M, and Singh NP
Diversity of caladiums- an ornamental aroid in Goa Technical Bulletin No 60. pp 1-26	Safeena SA, Thangam M, and Singh NP
Weather trends of last fourteen years (2002-2015) Technical Bulletin No 61. pp 1-44	GR Mahajan, Bappa Das, Manjunath BL, Reddy V, Manivannan S, Verrma RR and Singh NP
Extension Folders	
Rural backyard poultry- A promising technology for coastal India, Extension Folder No.75	RS Rajkumar, Chakurkar EB, Sanjay Udharwar and Singh NP
Low cost cages for capture based aquaculture in coastal waters, Extension Folder No. 76	Manju Lekshmi N, Sreekanth GB and Singh NP
Package of practices for cultivation of <i>Jasmine sambac</i> Extension Folder No 77	Safeena SA, Thangam M, and Singh NP
PPR Disease in Goats and its prevention Extension Folder No 78	Shivasharanappa N, Susitha Rajkumar, Chethan Kumar HB, RS Rajkumar
Classical Swine Fever an Important Diseases of Pigs and its Prevention Extension Folder No 79	Susitha Rajkumar, Shivasharanappa N, Chethan Kumar HB, EB Chakurkar
News Letter	
Vol. XVII. No.1 January- April, 2015, pp1-12	GR Mahajan, Sreekanth GB and Manju Lekshmi N
Vol. XVII. No.2 May- August, 2015, pp1-08	GR Mahajan, Sreekanth GB and Manju Lekshmi N
Vol. XVII. No.3 September - December, 2015, pp1-14	GR Mahajan, Sreekanth GB and Manju Lekshmi N
Vol. XVIII. No.1 January- April, 2016, pp1-14	GR Mahajan, Sreekanth GB and Manju Lekshmi N





Education and Training Human Resource Development





Education and Training

Education	
M Thangam	Acted as member of FRC for Ph. D. Scholar as Vice Chancellor nominee at Dept. of Botany, Goa University.
	Acted as External Examiner for final viva-voce examination of Ph.D. students of Tamil Nadu Agricultural University, Coimbatore.
R Ramesh	Acted as External Examiner for conducting the pre-colloquium of PhD Scholar, Dept. of Applied Botany, Mangalore University.

Lectures delivered by the Scientist			
Date	Lecture Topic/Programme	Participants	Venue
V Arunachalam			
02-07-2016	Propagation and nursery management of plantation crops	Students	ICAR-CCARI
29-07-2016	Biodiversity and ecosystems	Teachers and students	Don Bosco College of Engineering Fatorda, Margao
31-10-2016	Spices, plantation, medicinal and aromatic plants in Agro-ecotourism models	Trainees	ICAR-CCARI
20-03-2017	Propagation and nursery management in fruit production	Officials and progressive farmers	ICAR-CCARI
M Thangam			
24-06-2016	Kitchen Gardening	Progressive Farmers	KVK, North Goa
29-10-2016	Vegetable Production	Farmers and other participants	KVK, North Goa
R Ramesh			
19-04-2016	Diseases of chilli and their management	Farmers	ICAR-CCARI
30-06-2016	Diseases of black pepper and their management	Farmers and extension personnel	Sanquelim, Goa
08-11-2016	Biological agents for effective disease management in crop plants	Participants of the short course on Agro-eco tourism	ICAR-CCARI
21-12-2016	Diseases of mango and their management	Farmers	ICAR-CCARI
22-03-2017	Diseases of mango, papaya and banana and their management	Farmers, Agricultural officers during RKVY Training	ICAR-CCARI
AR Desai			
31-10-2016	Basic Components of Agro-Eco Tourism: Future Prospects as a potential Agri-enterprise.	Participants of the short course on "Agro-eco tourism"	ICAR-CCARI
20.12.2016	Improved commercial mango varieties and high density planting in mango	Extension functionaries	ZAO, Mapusa Goa
S Priya Devi			
14-01-2017	Up-scaling homestead value addition of jackfruit	Food Processors	Goa Chamber of Commerce, Panaji
24-02-2017	Scope of Packaging in increasing commercialization of Innovative Processed Agricultural Produce of Goa'	Food processors and packers	Goa Chamber of Commerce, Panaji

21-03-2017	Precision farming in banana, pineapple and papaya under Goa conditions	Farmers	ICAR-CCARI
Mathala Juliet Gupta			
10-08-2016	Introduction to Protected Cultivation Structures in Training Programme on "Nursery management in Horticultural Crops	Farmers	ICAR-CCARI
07-11-2016	Post-Harvest management and Value Addition in Horticulture Crops.	Participants of the short course on "Agro-eco tourism	ICAR-CCARI
21-03-2017	Engineering Inputs for Precision Farming in Fruit Crops	Farmers, Agricultural officers during RKVY Training	ICAR-CCARI
Safeena SA			
22-04-2016	Value addition to flowers	Youth and women	Issorcim, Vasco, Goa
28-04-2016	Floriculture	Students	St. Xaviers College, Mapusa
02-07-2016	Important flower plants and its cultivable practices	Farmers	ICAR – CCARI
04-07-2016	Sexual propagation in Horticultural crops and Vegetative propagation techniques by cuttings (Stem, leaf and root cuttings)	Trainees	ICAR – CCARI
27-07-2016	Vegetative propagation techniques by Layering and Budding	Trainees	ICAR – CCARI
06-08-2016	Methods of plant propagation in horticultural crops	Farmers	ICAR – CCARI
18-08-2016	Floriculture	Students	ICAR – CCARI
26-08-2016	Medicinal Plants of Goa	Teachers and Students	Our Lady of Divar High School, Divar
29-10-2016	Flower cultivation	Farmers	ICAR – CCARI
01-11-2016	Traditional flower crops as potential components for AET	Trainees	ICAR – CCARI
14-12-2016	Propagation techniques in Floriculture Crops	Trainees	ICAR – CCARI
R Maruthadurai			
03-11-2016	Integrated pest management for insect pests in AET cropping systems	Trainees	ICAR -CCARI
22-03-2017	Management of important pests of fruit crops of Goa	Agricultural officers and Farmers	ICAR -CCARI
GR Mahajan			
16-03-2017	Importance of soil testing in soil fertility management	Farmers and officials	FTC, Department of Agriculture, Old Goa
16-03-2017	Nutrient deficiency in plants: Identification and management	Farmers and officials	FTC, Department of Agriculture, Old Goa
17-03-2017	Interpretation of the soil test results and calculation of nutrient requirement	Farmers and officials	FTC, Department of Agriculture, Old Goa
21-03-2017	Soil testing, macronutrient deficiencies and nutrient management in fruit crops	Trainees	ICAR –CCARI
Susitha Rajkumar			
05-11-16	Animal Health Management in Agro-Ecosystem	Participants of the short course on "Agro-eco tourism	ICAR-CCARI

Shivasharanappa N			
28-07-2016	Bacterial diseases of dairy cattle	Trainees	ICAR -CCARI
17-08-2016	Important pig diseases and their management	Trainees	ICAR -CCARI
31-10-2016	Organic animal husbandry practices: basic principles and standards	Participants of the short course on "Agro-eco tourism"	ICAR -CCARI
Sreekanth GB			
24-08-2016	Indigenous ornamental fishes of Goa and its potential in ornamental sector	Farmers	ICAR- CCARI
23-10-2016	Ornamental fisheries and its scope in Goa	Farmers	TERI, Panaji Goa
17-02-2017	Indigenous ornamental fishes of Goa	Farmers	ICAR-CCARI
23-03-2017	Oyster and mussel culture	Farmers	Fisheries Training Centre, Dhauji, Old Goa
Manju Lekshmi N			
05-05-2016	Seafood value addition and ornamental fish breeding and rearing	Trainees	State Fisheries Training Center Dhauji
03-06-2016	Setting up of ornamental fishery unit, diseases, economic viability	Trainees	State Fisheries Training Center Dhauji
23-08-2016	Scope of value addition in fisheries and product preparations	Trainees	ICAR- CCARI
Gokuldas PP			
18-04-2016	Reproductive management in pigs	Trainees	ICAR- NRC on Pig, Rani
28-07-2016	Gynaecological problems and treatment in dairy cattle	Trainees	ICAR – CCARI
17-08-2016	Estrus detection and control of estrus in pigs	Trainees	ICAR – CCARI
28-09-2016	Shelter and housing for Goats and 'Reproductive management in Goats'	Trainees	ICAR – CCARI
03-03-2017	Reproductive management in pigs	Trainees	ICAR – CCARI
Chethan Kumar HB			
28-07-2016	Viral and Parasitic diseases in dairy cattle and deworming schedule	Farmers	ICAR – CCARI
18-08-2016	Hygiene of Piggery	Farmers	ICAR – CCARI
07-11-2016	Introduction to food safety management in AET models	Participants of the short course on "Agro-eco tourism"	ICAR – CCARI
28-07-2016	Viral and Parasitic diseases in dairy cattle and deworming schedule	Farmers	ICAR – CCARI
Paramesha V			
18-08-2016	Organic Farming	Students	ICAR – CCARI
13-01-2017	Integrated farming systems	Students	ICAR – CCARI
21-03-2017	Horticulture based integrated farming systems	Farmers, Agricultural officers during RKVY Training	ICAR – CCARI

Maneesha SR			
24-06-2016	Importance of Kitchen garden	Farmers	ICAR – CCARI
27-06-2016	Vegetative propagation techniques through grafting in different fruit crops	Students	ICAR – CCARI
02-07-2016	Importance of Kitchen garden	Farmers	ICAR – CCARI
04-07-2016	Orchard management	Students	ICAR – CCARI
06-08-2016	Grafting techniques in Horticultural crops	Farmers	ICAR – CCARI
18-08-2016	An introduction to Horticulture	Students	ICAR – CCARI
29-10-2016	Fruit cultivation	Farmers	ICAR – CCARI
02-11-2016	Canopy Management in fruit crops under AET	Trainees	ICAR – CCARI
21-03-2017	Role of micro nutrients in production of fruit crops	Farmers and Officials	ICAR – CCARI
Sujeet Desai			
15-03-2017	Soil and water conservation	Students	Sri Navadurga Higher Secondary School, Madkai, Ponda

Human Resource Development

Training and Capacity Development

Date	Name	Programme	Venue
May 23 – August 23, 2016	Sujeet Desai	Professional Attachment Training	ICAR-IISWC, Dehradun
June 1 - 10, 2016	SK Marathe	Competency Enhancement programme on soft skills and personality development for Technical Officers of ICAR	ICAR-NAARM, Hyderabad
July 18-23, 2016	Madina Sollapuri	Computer Application	ICAR-IASRI, New Delhi
July 21-22, 2016	Agostinho Fernandes Vikrant Gupta	Implementation of NIC's E-Procurement solution through CPP portal	ICAR-NDRI, Karnal
Aug 2-4, 2016	Paramesha V	Training on "Carbon sequestration and greenhouse gas measurement in IFS Models of AICRP on IFS	ICAR-IIFSR, Modipuram
Aug 8-13, 2016	Rahul Kulkarni	Use and maintenance of advanced instruments in soil and plant analysis	ICAR-IISS, Bhopal
Sep 7-16, 2016	Maruthadurai R	Techniques in Insect molecular biology and toxicology	ICAR- Sugarcane Breeding Institute, Coimbatore
Sep 19-24, 2016	Vinod Ubharhande	Refresher course on farm management	ICAR-IIFSR, Modipuram
Sep 19-24, 2016	Prakash Parwar	Dairy farm and milk processing plant management	ICAR-NDRI Regional Station, Bengaluru
Nov 1-21, 2016	Sujeet Desai	Winter School on Advanced Technologies in Watershed hydrology to mitigate climate change impact on soil and water resources	ICAR-IISWC, RC, Udhagamandalam
Dec 19-30, 2016	EB Chakurkar	Management Development Programme on Leadership Development	ICAR-NAARM, Hyderabad
Dec 23-Jan 12, 2017	Viswanatha Reddy K	CAFT Training on Advances in Statistical Modeling and Forecasting in Agriculture	ICAR-IASRI, Pusa, New Delhi
Jan 4-10, 2017	Lizette Noronha	Enhancing efficiency and behavioural skills	ICAR-NAARM, Hyderabad
March 14-21, 2017	Omar D'Souza	Protected cultivation of vegetable and hybrid seed production under protected structures	ICAR-IIHR, Bengaluru
March 23-25, 2017	Vinod Pagi Tushar Mangraj	Implement ERP FMS MIS	ICAR-CIFE, Mumbai

Participation in Conference / Seminar/ Symposia/ Workshops

Date	Name	Programme	Venue
April 2-6, 2016	NP Singh Manohara KK	51 st Annual Rice Research Group Meeting	Indira Gandhi Krishi Vishwa Vidyalaya, Raipur.
April 27-29, 2016	Maneesha SR	National conference on fruit breeding for Tropics and Subtropics: An Indian perspective	ICAR-IIHR, Bengaluru.
April 28-29, 2016	NP Singh	XXIII Annual Review Meeting of AICRP on Weed Management	Jain irrigation Systems, Jalgaon, Maharashtra.
May 6-7, 2016	NP Singh	Annual Review Meeting of AICRP on Management of Salt Affected Soils and Use of Saline Water in Agriculture	ICAR-CSSRI, Karnal

May 10-13, 2016	M Thangam	34 th group meeting of AICRP on Vegetable Crops	ICAR-IARI, New Delhi
May 18-22, 2016	V Arunachalam	25 th Annual group meeting of AICRP-Palms	ICAR-CPCRI Kasaragod
May 23-24, 2016	NP Singh RS Rajkumar	Annual Review Meeting of AICRP-Poultry and Poultry Seed Project	NOFRI, Gangtok, Sikkim
June 6, 2016	Safeena SA	44 th PSC Meeting of National Medicinal Plant Board	Ayush Bhawan, New Delhi
June 13-14, 2016	NP Singh GR Mahajan	One day brainstorming session on Coastal saline soils-Problems, Solutions and future research strategies	Kharland Research Centre, Panvel
July 7-8, 2016	R Ramesh	AMAAS review workshop	NASC Complex, New Delhi
July 22-23, 2016	AR Desai	National Seminar on Plantation based cropping systems for improving livelihood security	ICAR-CPCRI, Kasaragod
Aug 2, 2016	NP Singh EB Chakurkar R Ramesh GB Sreekanth GR Mahajan Manohara KK Shivasharanappa N	Group discussion on Collaborative research initiatives between ICAR-CCARI and ICAR-NIASM	ICAR-NIASM, Malegaon, Baramati
Aug 17-18, 2016	Manohara KK	11 th annual review meeting of ICAR seed project	GBPUA&T, Pantnagar
Aug 20, 2016	Reddy V	Review workshop on Integrated Farming Systems for improvement of nutrition and livelihood of farm women under different agro-ecosystems.	ICAR-CIWA, Bhubaneswar
Sep 29-30, 2016	S Priya Devi	National Conference on Innovative Food Processing Technologies for Food and Nutritional Security	ICAR-CIPHET, Ludhiana
Oct 5-7, 2016	R Ramesh	National symposium on "challenges to plant pathologists under changing disease scenario"	Goa University, Bambolim, Goa
Oct 7-8, 2016	Maruthadurai. R	3 rd National meet of Entomologists	ICAR-IIHR, Bengaluru
Oct 20 -21, 2016	Shivasharanappa N Gokuldas PP RS Rajkumar EB Chakurkar Chetan Kumar HB Susitha Rajkumar	III AAHP Convention and National symposium on Poultry health and welfare	Fidalgo, Panjim, Goa
Oct 24, 2016	GR Mahajan	Extramural research project review meeting	Krishi Bahavan-II, New Delhi
Oct 27-28, 2016	Shivasharnappa N Gokuldas PP	IPR awareness workshop	Saligaon Goa
Nov 6 -9, 2016	V Arunachalam M Thangam Manohara KK GB Sreekanth S Priya Devi Safeena SA Maneesha SR	1 st International Agro biodiversity Congress	NASC complex, New Delhi.

Nov 15-18, 2016	AR Desai Mathala J Gupta	7 th Indian Horticultural Congress 2016	ICAR-IARI, New Delhi
Nov 21-22, 2016	Chethan Kumar	XIV Annual Conference & National Symposium on Innovative approaches to promote food safety and reduce the risk of zoonotic diseases in Context of climate changes	Udaipur, Rajasthan
Nov 22-26, 2016	GR Mahajan Paramesha V	4 th International Agronomy Congress	ICAR-IARI, New Delhi
Dec 10-12, 2016	V Arunachalam	3 rd International symposium on coconut research and development (ISOGRAD 3)	ICAR-CPCRI, Kasaragod
Dec 19-21, 2016	Manohara KK	Review meeting of ICAR Network Project in Transgenic crops	New Delhi
Dec 20-23, 2016	Paramesha V	IV Biennial workshop of AICRP on IFS	SKUAS&T, Jammu
Dec 21, 2016	Gokuldas PP	Agro-biodiversity Exhibition held in conjunction with the PPV&FRA award ceremony at on 21st December, 2016	ICAR-IARI, Pusa, New Delhi
Dec 22-26, 2016	Reddy V	4 th International Agronomy Congress	ICAR-IARI, Pusa, New Delhi
Dec 24-25, 2016	EB Chakurkar	Director's Conference	NASC Complex, New Delhi
Dec 27-29, 2016	AR Desai	Annual Group Meeting of AICRP (Cashew)	Regional Research Station Vriddhachalam, TNAU
Jan 3-7, 2017	Sreekanth GB Bappa Das	104 th Indian Science Congress	Sri Venkateswara University, Tirupati
Jan 18, 2017	Manohara KK	Review meeting of half yearly progress of foreign aided project	Krishi Anusandhan Bhavan, New Delhi
Jan 24, 2017	R Ramesh	Workshop of nodal officers of ICAR on KRISHI portal and Research Data Repository	NASC Complex, New Delhi
Feb 10, 2017	Gokuldas PP	Stakeholders' workshop on Prospective Human Resource Development strategies in Agriculture, Veterinary and Fisheries sector in Goa and Puducherry	ICAR- CCARI, Old Goa
Feb 15-17, 2017	V Arunachalam Maruthadurai. R Safeena SA Shivasharanappa N Gokuldas PP Manju Lekshmi N	National Symposium on Advances in Agriculture Through Sustainable Technologies and Holistic Approaches	The International Centre, Dona Paula, Goa
Feb 16-18, 2017	Mathala J Gupta	ISAE 51 st Convention and Symposium on Agricultural Engineering for Sustainable and Climate Smart Agriculture	College of Agricultural Engineering and Technology, CCSHAU, Hisar, Haryana.
Feb 22, 2017	V Arunachalam	Tutorial session on Parallel Computing Garuda -NKN (National Knowledge Network)	NIAS, Benagluru
March 15-17, 2017	EB Chakurkar Parmesha V Rahul Kulkarni	Krishi Unnatti Mela 2017	ICAR-IARI, New Delhi



Transfer of Technology

ICAR-KVK
Technology Dissemination
Mera gaon mera gaurav
Training-cum-awareness programmes





ICAR- KRISHI VIGYAN KENDRA, North Goa

In order 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 major extension activities implemented during the current year are given below.

Trainings under taken: - 60 Nos. (1,272 Participants)

Processing technology of pickle, fingerlings, Fruit Processing, Income Generating Activities, Vermicomposting, Feed and Fodder technology, Grafting and nursery management, CSRB Management, Mass production of Trichoderma, Capacity building programme for rural youth, Managerial practices adopted in rearing of backyard poultry, Kitchen Garden, Bag making, Fish Processing, Mushroom



Cultivation, Apiculture, Scientific Management of Goat, Milk Processing, Post Harvest Technology in Coconut, Scientific Management of Dairy, Disease management in chilli, Grafting In Brinjal, Integrated Pest Management in Vegetables.

Extension activities under taken:- 671 Nos. (19,574 Participants)

Diagnostic visits, Advisory Services, Kisan Ghosthi, Farmers visit to KVK, Celebration of Important Days – Vanmohatsav, Swatchhta Pakwada, Soil Health Day, Exposure visits, Exhibition, Lectures Delivered as Resource Person, Scientists visit to farmers field, Meeting/Workshop with Extension Personnel, Farmers Group Meeting, Method Demonstrations, Animal/Plant Health Clinic.



A. On Farm Trials		No. of Trials
1)	Assessment of bacterial wilt management in brinjal	10
2)	Assessment of hybrid napier fodder varieties	03
3)	Assessment of improved poultry varieties	05
B. Frontline Demonstrations		No. of Demonstrations
1)	Management of Weevil in sweet potato	10
2)	Demonstration on clean milk production in dairy animal	12
3)	Demonstration on feeding of bypass fat in dairy cattle (04 months)	05
4)	Popularization of Artificial Insemination in Pigs	07

Technology Dissemination

Demonstration on new high yielding varieties of rice and pulses:

New rice varieties which are developed / identified for different rice ecologies of Goa, were displayed for demonstration in the institute farm during kharif season of 2016 for showcasing to the farmers. The varieties included in demonstration are Karjat-3, KS-12, GRS-1 and Sabhagidhan.

Karjat-3, a high yielding rice variety, identified as replacement for Jaya in the rainfed shallow lowland ecology; KS-12 and GRS-1, newly developed salinity tolerant rice lines as replacement for widely cultivated traditional rice variety Korgut in the coastal saline soils; and Sabhagidhan, variety developed for drought prone areas, is a replacement for Jyothi in the upland areas. Information on the details of the variety, their cultivation practices and suitability of the variety were briefed to the farmers during their visit to the field.



Rice demonstration field

During Rabi season 2016-17, demonstration on cowpea variety Goa cowpea-3 and green gram varieties TM-96-2 and IPM 2-14 was taken up at the institute farm.



Farmers visit during field day

Training programme on Nursery management in horticultural Crops

A 21 days training programme on nursery management in horticultural crops was conducted at the institute, Old Goa from 2nd July, 2016 to 16th August, 2016 for B.Voc (Agriculture) trainees from RCPR School of Agriculture, Savoi Verem, Goa. The



objective of this programme was to develop the nursery management skills of trainees through practical experiences and hands-on-training to various nursery activities. The Course director of this training programme, Dr. NP Singh, Director, stressed on the importance of nursery management in horticultural crops with a preview of increasing demand of quality planting materials through his words.

Training Programme on Artificial Insemination in Pigs to farmers and professionals

A two day training program for pig growing farmers was conducted during 17-18 August, 2016 at the institute. A total of 12 progressive pig farmers from Goa and Karnataka, attended the training. Dr. EB Chakurkar, PI and Coordinator conducted the training which covered scientific pig farming, its importance, advance technologies in piggery and AI in Pigs.

A three day training program for veterinary professionals was conducted during 4-6 March, 2017 at the institute. A total of 18 participants from Bidar Veterinary College, Karnataka, Shirwal Veterinary College, Pune, Pookode Veterinary College, Kerala and Thrissur Veterinary College, Kerala attended.



Training programme on secondary livelihood opportunities in fisheries sector of Goa

A 3 days training programme on Secondary livelihood opportunities in fisheries sector of Goa sponsored by NFDB was organised at the institute during 23-25 August, 2016. Lectures and hands on

training in preparation of value added products from fish and shellfish, coastal aquaculture, aquarium construction and management and ornamental fish breeding and culture were given. The training ended with valuable inputs for the growth of coastal aquaculture, marketing of value added fish products and ornamental fish breeding.

Training Programme on Hydroponic fodder production

A two days training on hydroponic fodder production was conducted at the institute during 25 - 26 August, 2016. Participants from Goa, Maharashtra and Kerala took active participation. Basics of hydroponic structure commercially installed as well as low cost structure attempted at Institute were explained.



Training programme on Intensive Fruit Cultivation

A training programme on 'Intensive Fruit Cultivation' was conducted by Dr. (Mrs.) S.Priya Devi, Senior Scientist (Horticulture- Fruit Science) from 20 to 22 March 2017 at the ICAR campus under RKVY funded project, "Demonstration of PFT in banana, pineapple and papaya in farmers' fields of Goa".

The programme was attended by Agricultural officers including ZAOs, AOs, AAOs and Field officers from Zonal Agricultural offices and farmers of different talukas to a tune of 37, out of which, ten were farmers. This training programme covered aspects on soil health, planting material, high density planting, farming system models, fertigation, physiological disorders, important pests and diseases and their management and value addition all pertinent to important fruit crops of Goa.



Canacona Tribal Farmers' Meet

The program on "Tribal Farmers Meet" of Cancona zone was organized at the institute on 25th August, 2016 under Tribal Sub Plan (TSP) Programme with a view to apprise them of the benefits of adopting improved production technologies on plantation, spice and fruit crops. Dr. (Smt) Mridula Sinha, Hon. Governor of Goa, was the Chief Guest. During the meet, planting material of improved varieties of cashew, mango, coconut, arecanut, nutmeg and black pepper was distributed.



Orientation training on soil sampling for fertility assessment

An orientation training on Soil sampling for fertility assessment was organized at the institute in collaboration with ICAR-NBSS&LUP and Department of Agriculture, Government of Goa, on 1st December 2016. Dr. Ramaurthy, Pr. Scientist (Agronomy), ICAR-NBSS&LUP, Bengaluru explained for how to read the maps for reaching the sample points or grid points. The ICAR-NBSS&LUP and ICAR-CCARI, intends to collect about 4850 soil sample using scientific methodology through participatory approach. Based on data of analysis of these samples, soil fertility maps and land use plan for state of Goa will be prepared.



Mera Gaon Mera Gaurav

Mera Gaon Mera Gaurav

The Institute has identified and adopted four villages of Goa state as directed by the Council under MGMG initiative. The objective of this programme was to facilitate flow of technologies of ICAR-CCARI and advisories to the farmers of the identified villages.

The four groups of scientists constituted are as follows:



Village 1: **Ibrampur**

Leader - E B Chakurkar

Members- Susitha Rajkumar, Maneesha SR,
Manjulekshmi N, Sanjay Uddarwar

Village 2: **Surla**

Leader - Arunachalam V

Members- S Priya Devi, Safeena SA, Gopal Mahajan,
Vishwanath Reddy, Chethan Kumar H B

Village 3: **Rachol**

Leader - M Thangam

Members- Manohara KK, R S Rajkumar, Sreekant GB

Village 4: **Khola**

Leader - A R Desai

Members- R Ramesh, Mathala J Gupta, R Maruthadurai,
Shivasharanappa N, Sunetra Talaulikar

The scientists groups visited the identified villages and collected the baseline information about the villages after interactions with the farmers and village panchayat. The major problems of the villages were identified and the technologies suitable for addressing those problems were disseminated by various OFT, FLD , trainings and interactive meetings with farmers and other stakeholders.



Village	Problems identified	Technologies disseminated
Ibrampur	<ul style="list-style-type: none"> • Feed availability, low milk yield, mastitis and other diseases • Non-availability of improved varieties of poultry breeds • Wild animal menace • Pests and disease in banana and coconut 	<ul style="list-style-type: none"> • Training and awareness programmes on importance of feeding bypass fat in dairy animals to increase milk fat percentage and health of dairy cows • Training on rural backyard poultry farming • Training on clean milk production • Demonstration on pest management in banana and coconut
Surla	<ul style="list-style-type: none"> • Neglected state of banana, coconut and pineapple in kulaghars • No commercial cultivation of flower crops • Wastage of jackfruit 	<ul style="list-style-type: none"> • Supply of quality planting material of coconut, pineapple and red amaranthus. • Micronutrient application in coconut, Field hygiene in banana, flower induction in pineapple, demonstration of commercial rose cultivation • Training on value addition in jackfruit
Rachol	<ul style="list-style-type: none"> • Low productivity in paddy and fish • Lack of awareness about backyard poultry farming 	<ul style="list-style-type: none"> • Capture based aquaculture • High yielding salt tolerant rice varieties • Training on backyard poultry farming
Khola	<ul style="list-style-type: none"> • Shortage of quality planting materials/ seeds of cashew, coconut, vegetables and paddy • Shortage of post harvest and farm machineries • Pest and disease in chilli 	<ul style="list-style-type: none"> • Good agricultural practices on nursery management and pest and disease control in vegetables • Provided technical assistance for identifying and recognising cola chilli as farmers variety • The cola chilli farmers association was awarded with Plant Genome Saviour community award 2016 by Agricultural Ministry, Govt • Distribution of farm and processing machinery through TSP



TRAINING-CUM-AWARENESS PROGRAMMES ORGANIZED

S. No.	Name of the Training	Venue	Period
1.	Value addition to fruits and flowers	Issorcim, Vasco, Goa	April 22, 2016
2.	Seafood value addition and ornamental fish breeding and rearing	State Fisheries Training Center Dhauji,	May 05, 2016
3.	Grass cutter machines	ICAR-CCARI, Old Goa	May13, 2016
4.	Management of backyard poultry chicks, growers and layers	ICAR-CCARI, Old Goa	May 25, 2016
5.	Value addition in jackfruit	Tarwada, Surla	June 08, 2016
6.	Value addition in jackfruit	Gaonkarwada, Surla	June 14, 2016
7.	Value addition in jackfruit	Ghodkatad, Surla	June 16, 2016
8.	Scientific management of goats	ICAR-CCARI, Old Goa	June16-17, 2016
9.	Value addition in jackfruit	Joshibhat, Surla	June 18, 2016
10.	Value addition in jackfruit	Kadchal, Surla	June 21, 2016
11.	Value addition in jackfruit	Lower Bayem, Surla	June 30, 2016
12.	Value addition in jackfruit	Panjem, Shiroda	July 21, 2016
13.	Nursery management in Horticultural Crops	ICAR-CCARI, Old Goa	July 22 – August 16, 2016
14.	Value addition in jackfruit	Daboli, Shiroda	August 04, 2016
15.	Value addition in jackfruit	Taliywada, Borim	August 06, 2016
16.	Value addition in jackfruit	Padalwada, Bethoda	August 10, 2016
17.	Artificial insemination in pigs	ICAR-CCARI, Old Goa	August 17-18, 2016
18.	Secondary livelihood opportunities in fisheries sector of Goa	ICAR-CCARI, Old Goa	August 23-25, 2016
19.	Value addition and entrepreneurship development in women	ICAR-CCARI, Old Goa	August 23-25, 2016
20.	Hydroponic fodder production	ICAR-CCARI, Old Goa	August 25-26, 2016
21.	Scientific management of Goats	ICAR-CCARI, Old Goa	September 28-29, 2016
22.	Management of bacterial wilt in brinjal and chilli diseases	Salgini Goa	November 21, 2016
23.	Management of bacterial wilt in brinjal and chilli diseases	ICAR- CCARI, Old Goa	November 22, 2016
24.	An orientation training on Soil sampling for fertility assessment	ICAR-CCARI, Old Goa	December 1, 2016
25.	Awareness training programme on management of insect pest and diseases of vegetable crops	ICAR- CCARI, Old Goa	December 12, 2016
26.	Hands on training on Aquarium fabrication was conducted in the Institute in collaboration with State fisheries department, Panjim during	ICAR- CCARI, Old Goa	January18- 20, 2017
27.	Ornamental fish culture	ICAR- CCARI, Old Goa	February17, 2017
28.	Artificial Insemination in pigs	ICAR- CCARI, Old Goa	March 4-6, 2016
29.	Intensive fruit cultivation	ICAR- CCARI, Old Goa	March 21-22, 2017
30.	Diseases of chilli and their management	Shristal, Canacona	March 11, 2016
31.	Diseases of chilli and their management	Salgini, Netravali, Sanguem	March 21, 2016
32.	Vegetable seeds, fertilizers- micro nutrients and areca nut seedlings	Surla, Bicholim	August 20, 2016
33.	Livestock feed-bypass fat and poultry birds	Ibrahimpur, Pernem	September 23, 2016

Glimpses of Institute

Conferences, Workshops & Seminars
Swachha Bharat Abhiyan
Other Events
हिन्दी पखवाड़ा
Participitaion in Sports Events
Distinguished Visitors
Committees and Meetings
Personnel





Conferences, Workshops and Seminars organized

NRM Directors Meet

Director's meet of NRM Institutes under ICAR, was organised at the institute during 11-12 April, 2016. The conference was graced with the presence of Dr. AK Sikka, Deputy Director General (NRM), Dr. SK Choudari, ADG, (SW&M), Dr. PS Minhas, Director, NIASM, Baramati, Dr. DK Sharma, Director, CSSRI Karnal, Dr. AR Sharma, Director, ICAR-DWR, Jabalpur, Dr. A Raizada, Head, ICAR-IISWC, Bellary, Dr. AK Patra, Director, IISS, Bhopal, Dr. SK Singh, Director, ICAR-NBSS&LUP, Nagpur, Dr. SK Ambast, Director, ICAR-IIWM Bhubaneshwar, Dr. OP Chaturvedi, Director, CAFRI, Jhansi, Dr. AS Panwar, Director, IIFSR, Modipuram, Dr. OP Yadav, Director, ICAR-CAZRI, Jodhpur, Dr. BK Kandpal and Dr SK Dhyani, Principal Scientist, ICAR New Delhi.



The objective of the conference was to address the problems in a network mode, particularly related to natural resource management for coastal region of the India. The programme concluded with special emphasis on collaborative research among all NRM institutes in a network mode on biodiversity conservation, coastal delineation and mapping of soil, water, ecosystem, farming system etc.

Annual Review Meeting of ICAR-AICRP on Pig and Mega Seed Project

The Annual Review Meeting of ICAR - All India Coordinated Research Project on Pig and Mega Seed Project was held during 6-7 June, 2016 at the institute. Shri Francis D'souza, Deputy Chief Minister of Goa was the Chief Guest and other dignitaries present were Dr. RS Gandhi (ADG AP&B, ICAR), Dr DK Sarma (Director, NRC on Pig), Dr Vineet Bhasin (PS, ICAR) and Dr Santosh Desai, (Director, Dept. of AH&VS). Deputy Chief Minister Shri Francis D'souza urged the scientist to characterize and multiply the local breeds of pigs which are more disease resistant than the exotic pigs.



AASTHA – 2017

National Symposium on Advances in Agriculture through sustainable technologies and holistic approaches (AASTHA)–2017 was held during 15-16 February, 2016 at the International Centre, Goa. The Symposium was organised by Society for Advancement of Human and Nature (SADHNA), Solan, HP. Shri. Ulhas P Kakode, Director, Directorate of Agriculture, Government of Goa was the chief guest for the inaugural session of the symposium.



National Symposium on Climate Smart Agriculture for Nematode Management

National Symposium on Climate Smart Agriculture for Nematode Management was held at the institute during 11-13 January, 2017. Dr. NP Singh, Director NIASM, Baramati, inaugurated the symposium in presence of Dr. Akhtar Haseeb, Vice Chancellor, NDUAT, Faizabad, Dr. Pankaj, Principal Scientist and Secretary, NSI and Dr. EB Chakurkar, Director, ICAR-CCARI, Old Goa. Chief Guest Dr. Singh, released the Book of Abstracts and Souvenir of the symposium as well as Mobile app "Nematode Info" developed by Dr. Pankaj, Harender Kumar and Anjani



Kumar. Dr. Akhtar Haseeb, President of NSI released the Constitution and By-law of NSI and he narrated the genesis of NSI and Nematology as a discipline in the Indian Context. More than 100 participants from all over the country participated in the symposium.

III AAHP Convention and National Symposium on Poultry Health and Welfare

Association of Avian Health Professionals (AAHP) in collaboration with the institute organised a 2 days national symposium on Poultry Health and Welfare during 20-21 October, 2016 at Hotel Fidalgo, Goa. This symposium was an occasion in which researchers and industry personnel from India and abroad assembled to find out solutions for the poultry health and welfare. Shri. Francis D'Souza, Hon. Deputy. CM, Govt. of Goa inaugurated the event. He highlighted the importance of agriculture and animal husbandry in the state of Goa. Further, during his address, he specifically focused on the importance and scope of rural backyard poultry sector in Goa. He also stressed that the exchange of information and ideas about poultry health and welfare among industry people and researchers will definitely help in the management of diseases in poultry sector. Dr. NP Singh (Director, ICAR-NIASM), Dr. JM Kataria (Director, ICAR-CARI), Dr. Santhosh Desai (Director, Animal Husbandry and Veterinary Services, Govt of Goa) and Dr. MR Reddy (Principal Scientist, ICAR-DPR) were present during the inaugural session.



Swachha Bharat Abhiyan



A Lecture on "How to keep our environment clean and the different ways cleanliness impacts on productivity in the office" was organised at the Institute on 22nd October, 2016. Shri K.D. Sadhale, Environmentalist, Nirmal Vishwa delivered the lecture.

Owing to the importance of Swachh Bharat Abhiyan or Clean India Mission, Govt. of India, the institute organised a cleanliness awareness programme on 16th May, 2016. The scientists, administrative, technical, supporting, SRFs, RAs and contractual staff of the institute and Krishi Vigyan Kendra (KVK) have participated in the cleanliness drive. A silent procession was also organised to create awareness and motivate the people of Old Goa for maintaining individual hygiene and cleanliness of the surroundings.

The institute organised Swachhta Campaign on 2nd October, 2016 under the dynamic leadership of Dr. EB Chakurkar, Director (Acting) of the institute to commemorate the day the Swachh Bharat Mission of Govt. of India was launched. The cleanliness drive has covered cleaning the areas ICAR-CCARI and KVK campus.

A Swachha Bharat Awareness Camp was organised by the institute in Collaboration with Old Goa Panchayat on 23rd October, 2016. Dr. EB Chakurkar, Director, ICAR-CCARI, Old Goa, Shri Vinayak Fadte, Sarpanch, Se Old Goa and Dr. PB Usgaonkar, Medical Officer graced the occasion.



हिन्दी पखवाड़ा कार्यक्रम

भा०कृ० अनु०प०-केन्द्रीय तटीय कृषि अनुसंधान संस्थान, इला, ओल्ड गोवा में सितम्बर 14-28, 2016 के दौरान हिन्दी पखवाड़ा का आयोजन बड़े उत्साह एवं सुनिश्चित रूप से किया गया। सितम्बर 14, 2016 को पखवाड़े का उदघाटन करते हुए निदेशकजी, डॉ० (श्री) ई०बी० चाकुरकर ने सभी कार्मिकों को पखवाड़ा कार्यक्रम में

उत्सुकता से भाग लेने के लिए प्रेरित किया। डॉ० मतला जूलियट गुप्ता, प्रभारी, राजभाशा ने पखवाड़ा कार्यक्रम की रूपरेखा प्रस्तुत किया एवं सभी कर्मचारियों को उत्साह से पखवाड़ा कार्यक्रम में भाग लेने का अनुरोध किया। पखवाड़े में आयोजित विभिन्न कार्यक्रम निम्न प्रकार से हैं।

दिनांक	समय	प्रतियोगिता / कार्यक्रम
14/9/2016	3:30 – 4:30 बजे अपराह्न	हिन्दी पखवाड़ा प्रारम्भ
15/9/2016	3:30 – 4:30 बजे अपराह्न	प्रशासनिक भाषा अनुवाद एवं सुलेख
16/9/2016	3:30 – 4:30 बजे अपराह्न	टिप्पणी लेखन – प्रशिक्षण एवं प्रतियोगिता
17/9/2016	3:30 – 4:30 बजे अपराह्न	कार्यालय पत्राचार एवं मसौदा लेखन – प्रशिक्षण एवं प्रतियोगिता
19-23/9/2016	3:30 – 4:30 बजे अपराह्न	कार्यालय में कंप्यूटर पर राजभाषा प्रयोग का प्रशिक्षण (तकनीकी, प्रशासनिक एवं वैज्ञानिकों के लिए)
24/9/2016	3:30 – 4:30 बजे अपराह्न	कार्मिकों के बच्चों के लिए प्रतियोगिताएं
25/9/2016	3:30 – 4:30 बजे अपराह्न	कार्यालय द्विभाषी फॉर्म भरने का प्रशिक्षण एवं प्रतियोगिता
26-27/9/2016	3:30 – 4:30 बजे अपराह्न	कंप्यूटर पर राजभाषा प्रयोग पर प्रतियोगिता
28/9/2016	3:30 – 4:30 बजे अपराह्न	पुरस्कार वितरण एवं हिन्दी पखवाड़ा समापन समारोह

पखवाड़े में करीब 49 कर्मचारियों एवं 15 बच्चों ने भाग लिया। इस पखवाड़े के दौरान मुख्यालय से प्राप्त परिपत्र के अनुसार अधिक से अधिक कार्यक्रम, ज्यादा से ज्यादा लोगों को प्रेरणा और प्रोत्साहन के माध्यम से सरकारी काम काज में हिन्दी का अधिक प्रयोग करने के लिए प्रेरित करने वाले थे। प्रतियोगिताओं के निर्णायक श्री पाण्डेय, पूर्व, हिन्दी अध्यापक, श्रीमति मनीशा एम०, श्री सौरभ मुनि, वित्त एवं लेखा अधिकारी, श्रीमति लिजेट नोरोन्हा, निजी सहायक एवं डॉ० (श्रीमति) मतला जूलियट गुप्ता, प्रभारी, राजभाशा थे। सितम्बर 28, 2016 को पखवाड़े का पुरस्कार वितरण एवं समापन कार्यक्रम संस्थान के निदेशक डॉ० (श्री) ई०बी० चाकुरकरजी के अध्यक्षता में सम्पन्न हुई। समापन कार्यक्रम

में निदेशक, डॉ० (श्री) ई०बी० चाकुरकरजी ने सुनियोजित रूप से हिन्दी पखवाड़ा को सम्पन्न करने के लिए डॉ० श्रीमति मतला जूलियट गुप्ता, प्रभारी, राजभाशा को सराहा एवं इस कार्यक्रम के आयोजकों, प्रतिभागियों एवं निर्णायकों को पखवाड़े की सफलता पर बधाई दिया। श्री सौरभ मुनि, वित्त एवं लेखा अधिकारी एवं श्रीमति श्रेया चौतन्य बर्वे ने पखवाड़ा कार्यक्रम के बारे में प्रतिवेदन प्रस्तुत किया। अंत में डॉ० श्रीमति मतला जूलियट गुप्ता, प्रभारी, राजभाशा ने धन्यवाद प्रस्तावना प्रस्तुत किया।

“ राष्ट्रभाशा के बिना राष्ट्र गूंगा है। – महात्मा गांधी ”
शुभकामनाएँ।



Other Events

Foundation day

Institute celebrated foundation day on 1st April, 2016. This occasion was blessed with the presence of Chief Guest, Dr. Gurbachan Singh, Chairman, ASRB, New Delhi. Dr. NP Singh, Director of institute highlighted the journey of the institute from a research station to a full-fledged organisation. The institute honoured the staff members who performed well there was release of a series of publications. Dr. Gurbachan Singh stressed upon the need of research programmes including sustainable integrated farming systems models, biovillages, organic farming systems, climate change and farming systems, climate resilient coastal agriculture, germplasm conservation and water harvesting systems, energy efficient technologies in farming systems and economic evaluation of the farming practices etc.

International Day of Yoga

International Day of Yoga was celebrated on 21st June, 2016 and Shri Shailendra Gupta (Certified Yoga Instructor) was the chief guest. He addressed the gathering and explained the importance of yoga, benefits of different asanas, how the different asanas have to be performed and science behind each asanas.

National Productivity Week

National Productivity Week was observed at the institute during 12-18 February, 2017. The purpose was to draw the attention of all concerned, towards the concept and encourage implementation of productivity tools and techniques with contemporary relevant themes. Dr. S. Mutnuri, Associate Professor, Applied and Environmental Biotechnology Laboratory - Dept. of Biological Sciences, BITS Pilani (Goa Campus) delivered a Guest lecture on "Waste Management - Reduce, Reuse and Recycle."

International Women's Day

International Women's Day was celebrated at the institute on 10th March, 2017. A recipe competition exclusively on pulses was organised on the occasion. Ms. Caroline Colaco, Advocate, Panjim, Ms. Sandra Fernandes, Green growth Institute, Sangolda and Ms. Neeru Goel, Freelance physiotherapist delivered the lectures.

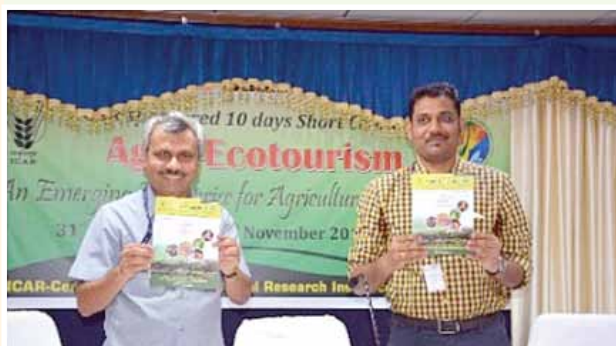


Stakeholder's meet on Prospective human resource development strategies

A one day stakeholder's meet on "Prospective human resource development strategies in Agriculture, Veterinary and Fisheries sectors in Goa and Puducherry" was held at the institute on 11th February, 2017. Dr. B. Ramesh Kumar, Dean of Rajiv Gandhi Institute of Veterinary Education and Research, Puducherry inaugurated the function. The meeting was attended by dignitaries from Agriculture, Fisheries and Veterinary departments from both Goa and Puducherry. The training covered lectures on current status and future prospects of Agricultural Education in both the states. Further discussions were carried out for the future prospects of trained human resource in the allied sectors.

Short Course on Agro-Ecotourism

Institute organized a short Course on "Agro-Ecotourism: An emerging enterprise for agricultural diversification during 31 October- 9 November, 2016. A total of 17 participants from 10 states and one Union Territory (A&N Islands) attended the course. The course was inaugurated by Shri. Nilesh Cabral, Hon'ble MLA and Chairman of Goa Tourism Development Cooperation. Dr. NP Singh, Director, ICAR-NIASM, Baramati chaired the inaugural session. During the course, the participants were exposed to various topics of agro- ecotourism viz., Basic components of Agro-Ecotourism (AET); Spices, Plantation and Medicinal & Aromatic Crops as a component of AET; Exotic crops; Minor fruits as nutraceuticals; Traditional flower crops; IPM for insect pests in AET cropping systems; Conservation of animal genetic diversity through agro eco tourism; Organic animal husbandry practices; Post Harvest Management and Value addition; Ornamental Fish Culture techniques; Recreational Fisheries: Deep sea biodiversity and Diving. Field visits were arranged for the trainees to Sahakari Spice farm, Ahire Agro tourism center, Sattari., Dive Goa, Candolim, Shriram Goshala, Valpoi.



Participation in Krishi Unnatti Mela 2017

The institute participated in the Krishi Unnatti Mela 2017, held at ICAR-IARI Campus, New Delhi during 15-17 March, 2017. The Mela was inaugurated by Hon. Union Minister for Agriculture Shri. Radha Mohan Singh. In all, 139 various ICAR Institutes along with KVK's and Agricultural universities and around 50 private companies participated in the Mela. Stall had displayed the various exhibits of the Institute along with the posters. The visitors sought the information on newly released varieties of rice and cashew. The value added products such as Cashew apple crunch, Nutmeg taffy, Nutmeg mouth freshner, Cashew apple syrup and Nutmeg pericarp syrup, By-pass fat, Karad grass block attracted the visitors.





Meeting for initiation of weather based agromet advisory services

A meeting for initiation of weather based agromet advisory for Goa with Meteorological Centre, Goa was held on 29 July, 2016 at the Institute. Dr. Narendra Pratap Singh, Director, ICAR-CCARI, Old Goa gave a brief introduction about the weather based agromet advisory services. Presentation on different aspects of weather based agromet advisory services was made. It was then followed by the discussion on the aspects of wide circulation of advisories and future course of action. The programme was attended by expert Scientists and PC, KVK of the Institute, officials from Meteorological Centre, Goa.



Meeting of Goa State Coordination Committee (SCC) for Doubling of Farmers Income

A meeting of Goa State Coordination Committee (SCC) for Doubling of Farmers' Income by March, 2022 was convened at the Institute on 27th March, 2017 under the chairmanship of the Dr. Eaknath B. Chakurkar Director, ICAR-CCARI, Old Goa. About 30 participants including Directors of Directorate of Agriculture, Animal Husbandry & Veterinary Services and Directorate of Fisheries, Govt. of Goa, representatives from NABARD, Horticulture Corporation, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli (MH), ICAR-CMFRI- Karwar centre, progressive farmers from Goa and scientists of ICAR-CCARI attended the meeting and contributed to prepare detailed strategic plan.



Interface Meeting with Developmental Departments

The Interface Meeting for Kharif season 2016 with Developmental Departments, Govt. of Goa and other stakeholders was organized by ICAR-Central Coastal Agricultural Research Institute, Old Goa on 31st May 2016. Mr. Ashish Madhaorao More, Secretary (Agriculture) was the chief guest and Mr. Ulhas Pai Kakode, Director, Directorate of Agriculture graced the occasion. Officials of Directorate of AH&VS and Directorate of Fisheries were also present for the inaugural session of the meeting.

An interface meeting with Department of AH&VS, Goa Dairy and Goa Forest was held on 30 June, 2016 at the Institute. The meeting was attended by Dr. Narendra Pratap Singh, Director, ICAR-CCARI, Old Goa, Dr. Santosh V Desai, Director, Department of AH&VS, Govt. of Goa and Mr. Vishal Surve, Assistant Conservator of Forest, Govt. of Goa.

Participitaion in Sports Events

Fifteen Staff members sports contingent of the institute including Chief-de-mission and Manager, participated in the ICAR West Zone sportsmeet held at Dr. Karni Singh Stadium, ICAR-NRCC, Bikaner, during 24th to 27th September 2016.

The sports meet was officially inaugurated by the chief guest, Shri. Vedprakash, IAS, Dist. Collector. Dr. E.B. Chakurkar, Director, ICAR-CCARI, also attended the

opening ceremony.

The staff participated in various sports activities such as 100m, 200m, 400m, 800m and 1500m, carrom, badminton as individual events and volleyball and football as team events.

The following players excelled and won the laurels for the institute.

Sr. No.	Name of Participant	Event	Position
1	ICAR-CCARI, Goa team	Football	II nd Place
2	Anil Khandeparkar	800 mts.	II nd Place
3	Anil Khandeparkar	1500 mts.	II nd Place
4	Tushar Mangaraj	400 mts.	III rd Place
5	Tushar Mangaraj	800 mts.	III rd Place



Distinguished Visitors

Visit of Secretary (DARE) and DG (ICAR), New Delhi and other dignotories

Dr. Trilochan Mohapatra, Secretary (DARE) & DG (ICAR), New Delhi along with Shri. Chhabilendra Roul IAS, Additional Secretary, (DARE) & Secretary, (ICAR), Dr. K Alagusundaram, DDG (Agril. Engineering and NRM), Dr. H Rahman, DDG (Animal Sciences), Dr. JK Jena, DDG (Fisheries Science), Dr. NS Rathore, DDG (Education) and Dr. AK Singh, DDG (Agril. Extension) visited this Institute on 7th September, 2016. The Secretary (DARE) & DG (ICAR) laid the foundation stone for the construction of Farmers Training and Community hall. During his address, DG, ICAR appreciated the efforts made by the director, scientific, technical, administrative and supporting staff towards the significant achievements in research and extension programmes. Further he urged that the institute should carry out focused research programmes for the coastal regions in a collaborative mode including other crop specific institutions to avoid duplication of the activities.



Visit of Honourable Union Minister of State for Agriculture and Farmers Welfare

Shri. Parshottam Rupala, Honourable Union Minister of State for Agriculture and Farmers Welfare, Govt. of India, the institute on 4th October 2016. The purpose of the

visit was to review the research activities and different schemes for farmers from Department of Agriculture, Govt. of Goa. Shri. Vineet Verma, Director, Dept. of Agriculture and Cooperation, Ministry of Agriculture, Shri. BR Singh, Secretary (Agriculture), Govt. of Goa, Dr. EB Chakurkar, Director, ICAR-CCARI, Shri. Ulhas Pai Kakode, Director, Dept. of Agriculture, Govt. of Goa were present during the occasion. Dr. EB Chakurkar presented the research activities undertaken. Shri. Parshottam Rupala stressed upon studying the impact of adoption of soil health cards to improve the crop yields and reduction in use of the fertilizers by replacing with organic manures. He also suggested to link all the soil health cards with the Krishi Cards of the farmers.



the fertilizers by replacing with organic manures. He also suggested to link all the soil health cards with the Krishi Cards of the farmers.

Date	Name of Visitor	Designation/ Institute/ Place
01-04-2016	Dr.Gurbachan Singh,	Chairman, ASRB, New Delhi.
11-04-2016	Dr.Alok Kumar Sikka	Deputy Director General, Natural Resource Management (NRM), ICAR, New Delhi
11-04-2016	Dr.PS Minhas,	Director, NIASM, Baramati
11-04-2016	Dr. SK Choudhari	Assistant Director General (SW&M), ICAR, New Delhi
31-05-2016	Mr. Ashish Madhaorao More	Secretary (Agriculture), Govt. of Goa
03-06-2016	Prof. (Dr.) Ram Krishna Pal	Director, ICAR-NRC on Pomegranate, Solapur
06-06-2016	Shri Francis D'souza	Deputy Chief Minister, Goa
06-06-2016	Dr Vineet Bhasin	Principal Scientist, ICAR, New Delhi
06-06-2016	Dr. RS Gandhi	Assistant Director General (AP&B), ICAR, New Delhi
06-06-2016	Dr Santosh Desai	Director, Directorate of AH&VS, Govt. of Goa
06-06-2016	Dr DK Sarma	Director, ICAR-NRC on Pig
25-08-2016	Smt. Mridula Sinha	Hon. Governor, Goa
07-09-2016	Dr.Trilochan Mohapatra	Secretary (DARE) and DG (ICAR), New Delhi
07-09-2016	Shri. Chhabilendra Roul IAS,	Additional Secretary, (DARE) and Secretary, (ICAR), New Delhi
07-09-2016	Dr. K Alagusundaram	DDG (Agril. Engineering and NRM), ICAR, New Delhi
07-09-2016	Dr. H Rahman	DDG (Animal Sciences), ICAR, New Delhi
07-09-2016	Dr. JK Jena	DDG (Fisheries Science), ICAR, New Delhi
07-09-2016	Dr.Narendra Singh Rathore	DDG (Education), ICAR, New Delhi
07-09-2016	Dr. Ashok Kumar Singh	DDG (Agril. Extension),ICAR, New Delhi
04-10-2016	Shri. Parshottam Rupala	Hon. Union Minister of State for Agriculture and Farmers Welfare, Govt. of India
04-10-2016	Shri. Vineet Verma	Director, Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India
04-10-2016	Shri. BR Singh	Secretary (Agriculture), Govt. of Goa
04-10-2016	Shri. Ulhas Pai Kakode	Director, Directorate of Agriculture, Govt. of Goa
05-10-2016	Dr. CD Mayee	Ex-Chairman, Agricultural Scientists Recruitment Board, New Delhi
31-10-2016	Shri. Nilesh Cabral	Hon'ble MLA and Chairman of Goa Tourism Development Cooperation, Goa
31-10-2016, 11-01-2017	Dr. NP Singh	Director NIASM, Baramati
11-01-2017	Dr. Akhtar Haseeb	Vice Chancellor, NDUAT, Faizabad
11-02-2017	Dr. B Ramesh Kumar	Dean, Rajiv Gandhi Institute of Veterinary Education and Research, Puducherry
02-02-2017	Shri RP Singh	Hon'ble Member, Governing Body, ICAR, New Delhi
14-03-2017	Dr.PR Bhatnagar	Head, ICAR-IISWC, RC, Vasad,

Committees and Meetings

Research Advisory Committee

The VII Research Advisory Committee (RAC) for ICAR- Central Coastal Agricultural Research Institute was constituted for a period of three years from 30/01/2014 to 29/01/2017. The composition of RAC is given below.

Dr. R. B. Deshmukh	Ex-Vice Chancellor, MPKV, Rahuri	Chairman
Dr. D. P. Waskar	Director of Research (Horticulture) Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani – 431402 – Maharashtra	Member
Prof. Satya P.Bhardwaj	Ex-Head, CS&WCR&TI, 63 B, Rajpur Road, Dehradun Uttarakhand	Member
Dr. N. Sarangi	Ex-Director, CIFA, 510, Nilchakra Apartment, Cuttack Road, Bhubaneswar – 751006, Odhisha	Member
Dr. P. Indira Devi	Professor (Ag. Eco.) & Director (CEEE), College of Horticulture, Kerela Agricultural University, Thrissur – 680656, Kerala	Member
Dr. I. D. Tyagi	Ex-Prof and Head, Dept of Crop Improvement, CS.Azad UAT, T – 206, Vasundhara Valley Apartments, Sector – 6, Ghaziabad – 201012 – U.P	Member
Shri. Shrirang V. Jambhale	Savai (Ghano), P.O. Vere, Taluka - Ponda Goa - 403 401	Member
Shri. Babu N. Komarpant	Near Dhavalikar Hospital, Devabag Palolem, Canacona, South Goa 403 702	Member
Dr. B. Mohan Kumar	Assistant Director General (A,AF&CC) NRM, ICAR, KAB-II, Pusa, New Delhi	Member
Dr. Narendra Pratap Singh	Director, ICAR-CCARI, Goa	Member
Dr. M. Thangam	Principal Scientist, ICAR-CCARI, Goa	Member Secretary

The third meeting of the VII RAC was held on 28 - 29th November, 2016 at ICAR –CCARI, Old Goa. The meeting was chaired by Dr. R. B. Deshmukh, Chairman, and attended by following members Dr. S. Bhaskar, ADG (AAF&CC), ICAR, New Delhi, Dr. S. P. Bharadwaj, Dr. D. P. Waskar, Dr. N. Sarangi, Dr. I. D. Tyagi, Dr. Narendra Pratap Singh and Dr. M. Thangam, Member - Secretary along with Shri Shrirang Venkatesh Jambhale and Shri Babu Narhari Komarpant as farmer representatives.

At the outset Dr. Narendra Pratap Singh, Director of the Institute gave welcome address and highlighted the research carried out at this Institute. Then Chairman of RAC, Dr. R. B. Deshmukh addressed the gathering. A presentation of action taken report on recommendations of last RAC meeting was made by Dr. M. Thangam, Member – Secretary.

Presentations were made by all the Scientists and Programme Co-ordinator, KVK on transfer of technology, highlighting the research work done by them during the last year.

The approved RAC recommendations are as follows

1. Emphasis should be on development of climate resilient, farmer centric and market driven



farming systems for coastal agro ecological regions with focus on conservation of natural resources including land, water and biodiversity for sustainable agriculture.

2. Collection, Conservation and Evaluation of economically important crop plants, livestock and fish components and/or species which are complementary to the coastal farming systems.
3. Emphasis should be given on registration of the promising genotypes of coastal agro ecosystem with the respective national bureaus and PPV&FRA.

4. Strengthening of on-farm research to popularize the improved technologies for enhanced productivity and economic returns to the farmers.
5. Research on secondary agriculture viz., value addition and prevention of post harvest losses needs to be strengthened.

Institute Research Council

The 27th Annual Institute Research Committee meeting of the Institute was held on 8th August, 2016 at the Institute. The meeting was chaired by Dr. Narendra Pratap Singh, Director of the institute. He welcomed all the scientists and highlighted about the importance of this meeting as this institute was upgraded for coastal region. He emphasized for transfer of technology to the farmer's field and publication of research findings in peer reviewed journal.

The scientists made their deliberations on the actions taken on recommendations of last IRC meeting and research activities carried out during the last one year. Six newly joined scientists presented their new research project proposals. 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 2015-16 and finalized the technical programmes of the ongoing research projects for the year 2016-17. The Committee of the IRC is as follows.

Dr. N. P. Singh, Director, ICAR - CCARI, Goa	Chairman
All Project Leaders	Members
Dr. G. R. Mahajan, Scientist ICAR – CCARI, Goa	Member Secretary



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 14/09/2013 to 13/09/2016. Following is the composition of IMC. The meeting of the IMC was held on 28th June, 2016.

Dr. N. P. Singh	Director, ICAR-CCARI, Goa	Chairman
Shri Ulhas B. Kakode	Director, Directorate of Agriculture, Tonca, Caranzalem-Goa.	Member
Dr. B.R. Salvi	Associate Director of Research, Regional Fruit Research Station, Vengurla.	Member
Dr. U.V. Mahadkar	Director of Research, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Distt. Ratnagiri	Member
Dr. R. Venkataramanan	Joint Director, ICAR-Indian Veterinary Research Institute, Hebbal, Bangalore	Member
Dr. M. Thangam	Principal Scientist (Horticulture), ICAR-CCARI, Goa.	Member
Dr. K.K. Phillipose	PS & Scientist-in-Charge, Karwar Research Centre, ICAR-Central Marine Fisheries Research Institute, Cochin	Member
Dr. Naveen P Singh	PS (Agril. Economics), ICAR-National Institute of Abiotic Stress Management, Baramati, Maharashtra	Member
ADG (A,AF & CC)	ICAR, KAB-II, New Delhi -12	Member
The Finance & Accounts Officer	ICAR-National Institute of Abiotic Stress Management, Baramati, Maharashtra	Member
Administrative Officer	ICAR-CCARI, Goa	Member Secretary

Personnel

S. No.	Name	Designation	Additional Charge/ Co-ordinator
Research Management			
1.	Dr. NarendraPratap Singh	Director (Until 12/09/2016)	
2.	Dr. E. B. Chakurkar	Director (Acting) (From 13/09/2016)	Animal Science Section
Scientific Staff			
3.	Dr. V. Arunachalam	Principal Scientist (Horticulture)	
4.	Dr. M. Thangam	Principal Scientist (Horticulture)	Horticultural Science Section, RFD/ RAC
5.	Dr. R. Ramesh	Principal Scientist (Plant Pathology)	Crop Science Section, AKMU Cell
6.	Dr. A. R. Desai	Senior Scientist (Horticulture)	
7.	Dr. S. Priya Devi	Senior Scientist (Horticulture)	RKVY
8.	Dr. Mathala Juliet Gupta	Scientist (Agricultural Structures and Process Engineering)	<i>Raj Bhasha</i>
9.	Dr. S. A. Safeena	Scientist (Horticulture)	HRD
10.	Dr. Manohara K.K.	Scientist (Plant Breeding)	Farm
11.	Dr. R. Maruthadurai	Scientist (Agricultural Entomology)	TSP
12.	Dr. R. Solomon Rajkumar	Scientist (LPT)	Estate, ATDC & Agro Tourism Centre
13.	Dr. Susitha Rajkumar	Scientist (Veterinary Pathology)	
14.	Dr. Shivasharanappa N.	Scientist (Veterinary Pathology)	PME/ PIMS
15.	Dr. Mahajan G. R	Scientist (Soil Science)	NRM Section, IRC
16.	Dr. Gokuldas P. P.	Scientist (Animal Reproduction and Gynaecology)	ITMU
17.	Mr. Viswanatha Reddy	Scientist (Agricultural Economics)	
18.	Ms. Manju Lekshmi N.	Scientist (Fisheries Resource Management)	
19.	Mr. Sreekanth G. B.	Scientist (Fisheries Resource Management)	Fishery Section, Press and Media
20.	Ms. Maneesha S. R.	Scientist (Fruit Science)	Library
19.	Dr. Chethan Kumar H. B.	Scientist (Veterinary Public Health)	
20.	Mr. Bappa Das	Scientist (Agricultural Meteorology)	
21.	Dr. Paramesha V.	Scientist (Agronomy)	
22.	Mr. Sujeet Desai	Scientist (Land and Water Management Engineering)	
Technical Staff			
1.	Ms.Madina Sollapuri	Senior Technical Officer (Estate)	
2.	Mr. Vinod Ubharhande	Farm Superintendent	
3.	Mr. Rahul Kulkarni	Senior Technical Officer (Agronomy)	
4.	Mr. Edward Crasto	Technical Officer (Stockman)	
5.	Mr. Sidharth K. Marathe	Technical Officer (PME Cell)	Vehicle
6.	Ms. PranjaliWadekar	Technical Officer (AKMU)	
7.	Mr.Yoganand Gaude	TechnicalOfficer (Electrical)	
8.	Mr. Suresh M Gomes	Technical Assistant (Tractor Driver),	

9.	Mr. Omar Illroy Francisco De Ursula	Technical Assistant	
10.	Mr. Upendra Kumar	Technician	
11.	Mr. Prakash Parwar	Technician	
12.	Mr. Gokuldas Gawas	Technician	
13.	Mr. Data Velip	Technician	
14.	Mr. Laxman Naik	Technician	

Administrative & Accounts Staff

1.	Mr. P. Rajendran	Administrative Officer (Untill 31-08-16)	
1.	Mr. Somnath	Administrative Officer (From 19-11-16)	
2.	Mr. Saurabh Muni	Finance & Accounts Officer	
3.	Ms. Lizette Maria Carmel Noronha	Private Secretary	
4.	Ms. Montia Rita D'Silva	Assistant Administrative Officer	Estt./ Bills
5.	Mr. Agostinho Fernandes	Assistant Administrative Officer	Store/ DDO
6.	Ms. Sneha Arlekar	AssistantAdministrative Officer	Works
7.	Ms. PratibhaRevodkar	Assistant	
8.	Ms. Sohani Chopdekar	Assistant	
9.	Ms. Tarika Maoulignkar	Personal Assistant	
10.	Mr. Vinod Pagi	UDC	
11	Ms. Bushra Ansari	Stenographer Grade.III	
12.	Ms. Chitra Madkaikar	LDC	
13.	Mr. Tushar Mangaraj	LDC	
14.	Mr. Vyas Hiren Kumar	LDC	
15.	Ms. Sujatha S. Kamble	LDC	

Skilled Supporting Staff

1.	Mr. Subhash Melekar	14.	Ms. Rekha V. Naik,
2.	Mr. Francisco Fernandes	15.	Ms. Lalitha Naik
3.	Mr. Dugu Khandeparkar	16.	Ms. Partibha Folkar
4.	Mr. Ashok Gadekar	17.	Mr. Vilas P. Gaonkar
5.	Mr. Ravi S. Kadam	18.	Mr. Prabhakar Goankar
6.	Mr. Chimmnu Tivrekar	19.	Mr. Sitaram Kuncolikar
7.	Mr. Anil Khandeparkar	20.	Ms. Janika S. Shirodkar
8.	Ms. Maria S.Varella	21.	Mr. Shanu G. Velip
9.	Mr. Giri Madkaikar	22.	Mr. Nitin J.. Naik
10.	Mr. Gokuldas Kasker	23.	Mr. Mayur. N.Mandrekar
11.	Mr. Umesh Marcelkar	24.	Ms. Swati R. Khandeparkar
12.	Mr. Vittal Porwar	25.	Mr. Prallhad H.Zambaulikar
13.	Ms. Prafulla Gadekar		

ICAR-KRISHI VIGYAN KENDRA

S. No.	Name	Designation	Additional Charge
Technical Staff			
1	Mr. H. R. C. Prabhu	Subject Matter Specialist T-9 (Plant Protection)	Programme Co-ordinator
2.	Mrs. Sunetra Talaulikar	Subject Matter Specialist T-9 (Home Science)	

3.	Dr. Sanjay Kumar Udharwar	Subject Matter Specialist T-6 (Animal Science)	
4.	Mr. ShashiVishwakarma	T-5	
5.	Mr. Prajapati V.S	T-5	
6.	Mr. Irappa M Chalwadi	Driver-cum-Mechanic T-5	
7.	Mr. DilkushVelip	Driver T-1	

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		

Appointments / Joining

Name	Post	Date of Joining
Shri. Sujeet Desai	Scientist (Land and Water Management Engineering)	02-04-2016
Dr. Gokuldas P. P.	Scientist (Animal Reproduction and Gynecology)	16-05-2016
Shri. Somnath	Administrative Officer	19-11-2016

Promotions

Name & Designation	Post held	Promoted Post	Date of promotion
Dr. M. Thangam	Senior Scientist	Principal Scientist	17/12/2014
Dr. R. Ramesh	Senior Scientist	Principal Scientist	06/02/2015
Dr. Shivasharanappa N.	Scientist Grade Pay - 6000	Scientist Grade Pay - 7000	15/12/2013
Dr. R. S. Rajkumar	Scientist Grade Pay - 6000	Scientist Grade Pay - 7000	09/11/2014
Dr. Gopal Mahajan	Scientist Grade Pay - 6000	Scientist Grade Pay - 7000	02/07/2016
Shri. Irappa Chalwadi	Technical Assistant (T-4)	Technical Officer (T-5)	29-06-2016
Shri. Shashi Vishwakarma	Technical Assistant (T-4)	Technical Officer (T-5)	20-12-2015
Shri. Vishwajeet Prajapati	Technical Assistant (T-4)	Technical Officer (T-5)	27-12-2015

Superannuation

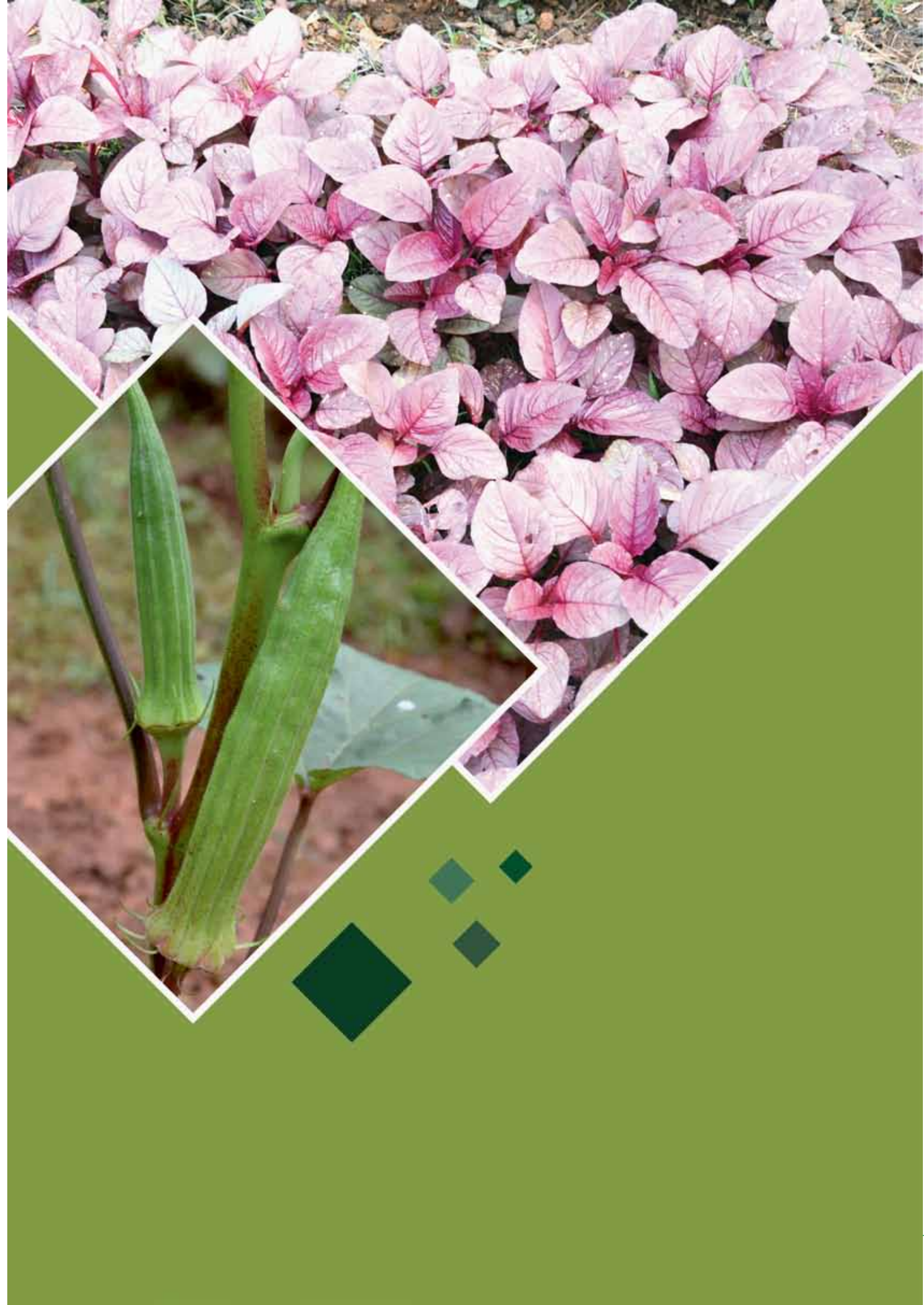
Name	Post held	Date of Retirement
Shri. P. Rajendran	Administrative Officer	31-08-2016

Transfer

Name & Designation	Post held	Transfer to	Date of transfer
Dr. Narendra Pratap Singh	Director	ICAR-NIASM, Baramati	12-09-2016
Mrs. Manjulekshmi N	Scientist (Fisheries Resource Management)	ICAR-CIFT, Kochi	04-03-2017
Shri. Vishwanatha Reddy	Scientist (Agricultural Economics)	ICAR-CTRI, Rajmundry	18-03-2017
Dr. Safeena S.A	Scientist (Floriculture and landscaping)	ICAR-DFR, Pune	31-03-2017
Shri. Raghurama Kukkude	Senior Technical Officer	ICAR-DCR, Puttur	08-07-2016
Shri. Vikrant Gupta	Lower Divisional Clerk	ICAR-NBFGR, Lucknow	09-09-2016

Heavenly Abode

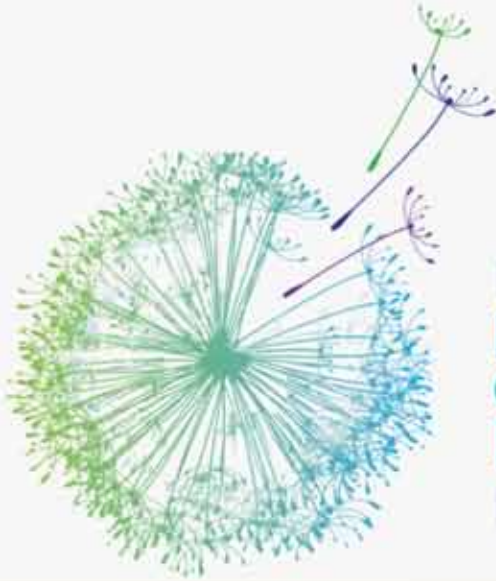
Name	Post held	Expired on
Shri. Umakanat Haldankar	Skilled Support Staff	22-02-2017





एक कदम हर कदम
सिंचनी के जलवायु
भारतीय कृषि जलवायु परिषद

एक कदम हर कदम



2017
INTERNATIONAL YEAR
OF SUSTAINABLE TOURISM
FOR DEVELOPMENT

Agro-Ecotourism for Sustainable Coastal Agriculture