

NATIONAL SEMINAR ON HARMONIZING BIODIVERSITY AND CLIMATE CHANGE: CHALLENGES AND OPPORTUNITY (NSBC-2015)

*National Seminar on*  
**HARMONIZING BIODIVERSITY  
AND CLIMATE CHANGE:  
CHALLENGES AND OPPORTUNITY  
(NSBC-2015)**



**Abstract Book**

17-19 April, 2015



*Organized by*  
**ANDAMAN SCIENCE ASSOCIATION**  
Port Blair, Andaman & Nicobar Islands  
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Society for Plant Research, Meerut  
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**Andaman Science Association**

National Seminar on Harmonizing Biodiversity and Climate Change: Challenges & Opportunity (NSBC-2015),  
April 17-19, 2015, ICAR – Central Inland Agricultural Research Institute, Port Blair 744 101

## Abstract Book



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*Venue*

**ICAR – Central Inland Agricultural Research Institute  
Port Blair – 744 105, Andaman & Nicobar Islands**

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Andaman and Nicobar Islands



## Message



The topic of the National Seminar “**Harmonizing Biodiversity and Climate Change: Challenges and Opportunity**” is a very relevant one. It is well known that Andaman and Nicobar is one of the 12 Mega hotspot of Biodiversity of India. The importance of biodiversity of these Islands can be gauged by the presence of numerous National parks and the recognition given by UNESCO to the biosphere reserve of Great Nicobar. The study of this enormous biodiversity and recording the same for posterity by itself is a challenge for the scientific Community.

It is often said that the climate change is going to impact the island more than the mainland. Sea level rise, sea surface temperature rise and associated phenomena are going to have serious impact on biodiversity as a whole, species succession, species abundance and biodiversity index in particular. It is in this respect, the National Seminar NSBC-2015 is very contextual and I am certain delegates from island and mainland will deliberate on this relevant topic and come out with fruitful recommendations.

NSBC-2015 being organized at Andaman is expected to provide a platform to exchange knowledge across the country and subject matter specialists and to facilitate discussion on issues confronting biodiversity.

The pre-conference proceedings are being published in two volumes. The souvenir covers the plenary lectures, lead papers and invited lectures in different session. The second volume covers the contributory papers for oral and poster presentation. A total of 153 abstract papers were received for presentation are accommodated under two sub themes i.e., Biodiversity and climate change. The abstracts are arranged in alphabetical order of the surname of the first authors with each of the sessions and an author index is also provided at the end of the abstracts for the convenience of the user.

The NSBC-2015 organizing committee is thankful to all the contributors who have shared their findings, knowledge and ideas through this publication for the benefit of all the researchers, planners and policymakers of the country in general and Andaman & Nicobar Islands in particular.

**Date:** 11<sup>th</sup> April, 2015

**Place:** Port Blair

**(S. Dam Roy)**





## PREFACE

India's biodiversity hotspots cover a significant proportion (16.86%) of the total global area under biodiversity hotspots. Among the hotspots under India's political boundaries, the Western Ghats account for 64.95%, Indo-Burma 5.13%, Himalaya 44.37%, Sunderban and Islands 1.28%. India's biodiversity hotspots are less studied and face stiff challenges in view of predicted climate change and increasing human disturbances. Since, more than a decade no comprehensive studies particularly on the biodiversity hotspots of India: the Himalayas, Indo-Burma, Western Ghats and Islands are done. In the face of predicted climate change and the 'four major mass extinction', these eco-regions face new challenges of conservation of natural resources of flora and fauna for nourishment. Conservation of endemic flora and fauna might also provide an umbrella for the protection of herbivorous insects, nematodes, fungi and large proportion of their parasites. However, these four biodiversity hotspots in India are facing their own challenges due to climate change and over increasing human disturbance and are the major causes for forest destruction and species extinction. This could lead to extinction of native flora in the hotspots of biodiversity because further pole-ward migration is not possible due to the topographic barriers. During 2004, an event such as the Indian Ocean tsunami have caused tremendous loss of forest cover in Andaman and Nicobar Islands, which form part of Indo-Burma, Sunderban and Islands hotspots. Threats such as invasive alien species, forest fires, and droughts put undue stress on the vegetation of these hotspots. Climate change induced species' shifts have been observed and predicted across the nation. There is a need for vegetation characterisation of biodiversity hotspots in India, with a consistent spatio-temporal scale and vegetation classification.

In this context, a National Seminar on "Harmonizing Biodiversity and Climate Change: Challenges and Opportunity" (NSBC-2015) organized by Andaman Science Association (ICAR-Central Island Agricultural Research Institute), Port Blair. The seminar was an attempt to bring out the significance of wetlands, biodiversity and mitigate the effects of climate change. The circular inviting papers on the theme of the seminar is seeing from interested participants of various organizations has received a thumping response. The three day seminar activities includes lead paper presentations, nine themes lectures on the related topics of the major areas of biodiversity and climate change through discussions, suggestions / recommendations followed by field visits.

The compiled information including the extended summary, lead papers, invited lectures and abstracts on different sessions are published in two sections i.e. biodiversity and climate change. A total of 08 extended summary, 153 research abstracts, and full length papers were received for oral as well as poster presentations and are accommodated in eleven sub sections, keeping in view of the theme of the seminar. The abstracts are arranged in order of the theme and mode of presentation within each sessions and author index is also provided at the end of the abstracts for convenience of the reader.

The Organizing Committee of the National Seminar is grateful to the Bioersivity International, Regional Office, New Delhi, PPV & FRA, New Delhi and Society for Plant Research, SVPUAT, Meerut for providing financial assistance to conduct this seminar. The NSBC-2015 organizing committee is thankful to our co-organizers, Society for Plant Research (SVPUAT, Meerut), Association for Coastal Agricultural Research (CCARI, Goa) and Indian Society of Pulses Research and Development (IIPR, Kanpur) for their organizational support.

The Organizing Committee NSBC-2015 is thankful to all the contributors who have shared their findings, knowledge and ideas through their publication for the national perspectives in general and islands in particular to save the existing biodiversity of flora and fauna.

**Editorial Committee,  
NSBC-2015**





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**CONTENTS**

<b>S. No.</b>	<b>Track &amp; Section</b>	<b>Page No.</b>
	<b>Extended Summary</b>	1
<b>1.</b>	<b>Track-01: Biodiversity</b>	13
1.1.	Adaptive management and competing claims on natural resources	13
1.2.	Contemporary approaches to genetic resources conservation and use	27
1.3	Fisheries governance for food security	47
1.4	Livestock diversity approaches for sustainable agriculture	55
1.5	Plant variety protection and farmer's right	63
1.6	Wild Life management and innovation for sustainability	69
<b>2.</b>	<b>Track-02: Climate Change</b>	75
2.1	Climate change adaptation in agriculture and natural resource management	75
2.2	Coastal zone management in the era of climate change	87
2.3	Rights based approach to food and nutrition security	97
2.4	Integrated pest management	107
2.5	Managing risk in the face of climate change	115





**EXTENDED SUMMARY**





## **Harnessing inter and intra varietal variation in traditional and popular rice cultivars for achieving higher productivity in Andaman & Nicobar Islands**

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In Andaman & Nicobar Islands, rice is annually cultivated on an area of about 8400 ha with a total production of about 24000 tonnes and productivity of 2.84 tonnes/ha. Rice cultivation in the islands started with the settlement of various communities hailing from different mainland states and provinces. The settlers introduced the various rice land races and old varieties from their respective home lands having characteristics suiting to their ethnic food habits and customs.

More than 20 land races introduced by different settlers over time have been studied, documented and characterized by ICAR-CIARI, Port Blair during last 3 decades. Among these, C14-8 (Aath Number Dhan), Khusbayya, Gol Dhan, Red Burma, Ameta, Khochi, Mushley, White Jeera, Ranchi Dhan, White Burma, Black Burma, Anamel, Appeem, Bhavani, Bhurkhuch, Black Jeera Dhan, Jaganath, Jungle Dhan, Kapilee, Kho-Chu, Pagla Jaya, Lal Swarna, Murkhul, Nama Dhan, Nona Dhan, White Burma and Jeera Chamba etc. are notable. Despite various efforts for introduction and cultivation of modern high yielding and semi-dwarf rice varieties, about 50 % of the rice area is still under important traditional land races in the islands. Low yield, prevalence of pests and diseases and varietal admixtures are the major constraints of these land races for their cultivation in these Islands. Besides, the less availability of chemical fertilizers and shift towards organic agriculture are also the major constraints for the adoption of high yielding and fertilizer responsive varieties in the islands. The rainfall often continues up to mid December month. Therefore, mostly the long duration varieties including these land races are planted to escape the onslaught of rainfall during harvesting and threshing.

Of the various traditional cultivars, C14-8 or *Aath number dhan* rice variety is the most popular among the islands' farming community due to least management requirement for its cultivation, weed competitiveness and late maturity suiting to prolonged rainfall period. However, C14-8 produces only 2.2 tonnes/ha which is quite low. The traditional C 14 -8 rice cultivar is an extremely long duration rice crop that comes to maturity in 175-180 days *i.e* after the rainy season in the Andaman and Nicobar Islands. Hence C14-8 has been very well adapted to such climatic and cultural conditions and thus carved out its niche in the islands. Similarly rice land races like Khushbaya and Black Burma are also quite popular with Karen community farmers in Middle Andaman. Nevertheless, these varieties have developed lot of admixture in them due to their long term cultivation by farmers. We have started breeding efforts on genetic purification of these well adopted and adapted rice land races followed by pure seed production to augment or restore their productivity potential.

The single panicles of C14-8 cultivar were selected from different places and evaluated as panicle to row progenies during 2011 followed by large size plot evaluation across locations during 2012. A total of 13 best performing lines of C 14-8 rice with different grain colour were evaluated across three locations (Bloomsdale Farm, Port Blair in South Andaman, Diglipur in North Andaman and Sundergarh, Middle Andaman) during *Kharif* 2013. Data were recorded for 15 qualitative and quantitative characters. The perusal of yield data across 3 locations revealed the overall top performance of C14-8-11-113 followed by C14-8-11-108 (both yellow paddy husk color) and C14-8-11-91 (brown paddy husk color) thus revealing their superiority as compared to control mix population. These selected varieties were also further evaluated at 3 locations during *kharif* 2014. Based upon their overall performance at research farms and farmers' fields supplemented by farmers' participatory variety selection, two varieties CIARI Dhan 8 (C14-8-11-113) having yellow paddy husk color and CIARI Dhan 9 (C14-8-11-91) having brown paddy husk color have been released by IVRC at ICAR-CIARI, Port Blair during 2014 for general cultivation in the islands.

Similarly, evaluation of intra-varietal diversity in Khusbuyya and Black Burma land races has also led to identification of promising high yielding variants progenies which are being further confirmed across locations. The varietal purification efforts, pure seed production and growing of resultant varieties derived from these land races are expected to contribute towards rice productivity enhancement keeping the farmers' preference and interests intact in the islands.

NSBC- 2015- ES-02

## Mitigation of nitrous oxide emissions in paddy through use of nitrification inhibitors

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Rice is the most important food crop of India and is grown on 43 million ha with a production of 105 million tons out of which two thirds is contributed by irrigated lowland ecosystems. Agricultural soils fertilized with nitrogen account for about 80% of the anthropogenic emissions of  $N_2O$  to the atmosphere. Rice paddy fields have been recognized as one of the sources of atmospheric  $N_2O$  which is produced primarily from the microbial mediated processes viz., nitrification and denitrification in soil. Nitrous oxide is a long-lived greenhouse gas which currently accounts for 2-4% of total global warming potential (GWP) and could contribute to as much as 10% of GWP in future (Cicerone, 1989). The GWP of each molecule of  $N_2O$  is about 310 times greater than that of  $CO_2$ . As per an estimate, fertilized soils emit 10–17 Tg  $N_2O$ –N per year on the global scale and  $N_2O$ –N emissions from paddy fields in India is estimated to be 0.002–0.21 Tg per year. Several attempts have been made to reduce  $N_2O$  emissions through use of nitrification inhibitors like dicyandiamide (DCD) and neem coated urea (NCU). The present study was undertaken to assess the  $N_2O$  emission and inhibition potential of DCD and NCU in semi-arid tropical (SAT) conditions.

Field experiments were conducted during *khari* 2012 at the research farm of Directorate of Rice Research, Rajendranagar, Hyderabad. The clayey experimental soil (Veritsol; Typic Pellustert) with 7.8 pH was medium in available N, P and K. The treatments combinations studied consisted of three sources of nitrogen (urea alone and in combination with DCD and NCU), each applied at three levels of recommended dose of nitrogen (RDN), along with an absolute control under FRBD with a common control. 30 day old seedlings of PA6444 were transplanted at a spacing of 20 cm x 15 cm on 13 July 2012. The crop received 26.4 and 75 kg/ha of phosphorus (P) and potassium (K) as single super phosphate and muriate of potash, and was broadcast applied uniformly before final puddling of field. Nitrogen (N) as per the treatments was applied in 3 equal splits at transplanting at transplanting, 30 and 60 DAT. DCD was added to urea at 15% of N added through urea.

Gas samples were collected using closed chambers (50 cm X 30 cm X 100 cm) made with 6 mm acrylic sheets which were placed on aluminium channels (50 cm X 30 cm) inserted in the soil. The aluminium channel is filled with water to make the arrangement airtight. Boxes were kept on the plants for 1 hour continuously during the daytime (10:00– 11:00 hours) on the days of sampling. Samples were collected through sampling ports fitted at the top of the chamber using gas tight syringes at 0, ½ and 1 hour. The samples were transferred to the laboratory and analysed for  $N_2O$  by a gas chromatograph (Varian GC 450) equipped with back flush system and an electron capture detector (ECD), manual on-column injector and an O.D packed column. Total  $N_2O$ –N emissions during the study period were estimated by multiplying the average emissions of two consecutive samplings by the number of days in between. The per cent inhibition of total  $N_2O$  emission was calculated using the following equation:  $N_2O$  inhibition (%) =  $[(A-B) - (C-B)] / (A-B) \times 100$ , where *A* is the total  $N_2O$  emission in urea, *B* the total  $N_2O$  emission in control and *C* is the total  $N_2O$  emission with inhibitor.

Emissions of  $N_2O$  were monitored starting from two days after transplanting (DAT) to 75 DAT in all the treatments. The  $N_2O$  fluxes (*i.e.* rate of emission per unit area per day) were significant up to 75 DAT and were not detectable thereafter. The  $N_2O$  flux during the study period was higher with urea as compared to urea with inhibitors, indicating the inhibitory role of the nitrification inhibitors on  $N_2O$  emission.



Total N<sub>2</sub>O–N emission during 75 days was highest with urea (66.8 g N<sub>2</sub>O-N/ha) followed by NCU (59.3 g N<sub>2</sub>O-N/ha), urea plus DCD (54.8 g N<sub>2</sub>O-N/ha) and were least in control (37.5 g N<sub>2</sub>O-N/ha) with no nitrogen. Total emissions with urea, urea + DCD and NCU were 78, 46 and 58%, respectively, higher than control. Total N<sub>2</sub>O–N emissions were in the range of 0.046% (with urea + DCD) to 0.056% (with urea alone) of the total nitrogen applied through different treatments (120 kg N/ha). The N<sub>2</sub>O–N emissions were reported to vary between 0.010 and 0.55% of the total nitrogen applied in rice.

The nitrification inhibitors played an important role in reducing N<sub>2</sub>O emissions from the rice field. The highest inhibition of total N<sub>2</sub>O emission (41%) was recorded from plots treated with urea + DCD followed by NCU (26%). The study indicated that application of fertilizer N through urea in irrigated rice could lead to a significant increase in N<sub>2</sub>O emissions as compared to no fertilizer application. Application of nitrification inhibitors like DCD and NCU reduced N<sub>2</sub>O emission significantly from the rice field.

NSBC- 2015- ES-03

## Empowerment of Tribes in Bio Diversity of Chhattisgarh

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The government through various programmes focuses on empowerment of tribal – one of the vulnerable groups. Rural development has been marked by a gradual shift from the intervention-based method to participatory approach in their development. Current trends suggest an increased awareness of the human dimensions, women role, environment protection, sustainability and food security. STs, among various social groups in Chhattisgarh, have the highest percentage of the poor. As per the BPL survey, 6.96 lakhs out of the 14.2 lakhs ST families are below the poverty line. The entire primitive tribe (*Kamar, Abujhmaria, Pahadi Korwa, Baiga Birhor*) population of 1.31 lakhs, out of the total ST population of 78.22 lakhs in the state is under BPL category (Census of India, 2011). Variability in the socio-economic- participatory conditions of tribes inhabiting in the state is unique. They are a friendly and jovial lot who are industrious and diligent. Although shrouded in poverty they live life to the hilt and love to music, dance, mirth and merriment, add colour to their simple lives. The tribal women are most active in economic activities. The tribal areas of Chhattisgarh have witnessed several rebellions against the intrusion by outsiders, in the domain of traditional rights and the tribal way of life. Recently in past few years, intrusion of *Naxalites* has severely affected their life. However, implementation of various government scheme and increased interaction with developed society have brought quality life and changed their mindset. *Kamars* a primitive tribe are found in 249 villages of Gariyaband and Dhamtari districts and nowhere else. This tribe is struggling for survival mainly due to malnutrition and poor health practices (Palta *et al.*, 1998). The percentage of ST in total population is 51.6, 67.1 and 18.7 in northern, southern and central parts of state respectively. These parts constitute 33.6, 27.2 and 39.2 per cent share in ST population of state respectively.

The study was conducted during the year 2012-13 and 2013-14 with the objective to examine the variability in tribal culture and sketch out the socio-economic- participatory profile of tribes as affected by various government programmes, migration, malnutrition, communication gap, un-employment and naxalite activities. The study was confined to rural tribal households. Three parts of state based on agro-climatic zones (Northern, central and southern) were taken up for the study. Ten villages from each zone/part (in all 30) were selected based on simple random sample plan. Prior to start the systematic study, a pilot survey of tribal villages was undertaken, to get first hand information of socio-cultural-economic status of tribal families. The number of respondents in each part was selected based on their share in state ST population viz. 100, 120 and 80 from northern, central and southern part respectively. Thus in all 300 respondents were chosen for the study. For this study 30 villages, 10 from each part and 300 respondents were selected. Selection of the respondents in the study villages was made so as to cover the socio-economic pattern of tribal with different levels of benefits accrued from government schemes and suffered from constraints of varying intensity. The functional heads of the households were selected as respondents for study, as most of the decisions were taken by them. The sources of information were primary as well as secondary.

In order to elicit information from the respondents, pretested interview schedule was used. Besides family details, respondents were asked about, education level, public distribution system, basic amenities, engagement schedule, MNREGA programme, their opinion with regard to this programme, MNREGA officials and various constraints. The interview schedule was filled in the presence of *Village Sarpanch* and respondents. The required observations were made; filled data was analyzed to get needed socio-economic-cultural parameters. The difficulty of language was a big hurdle in the way of investigation. Each tribe has its own dialects. Therefore for each tribe interpreter's help was taken to avoid communication gap with the respondents. The findings of study revealed a very dismal scenario of empowerment of tribal community in the state. Their socio-economic-participatory pattern in the state is as interesting and varied as the tribes. Each tribe has its own dialect. Therefore, communication gap and low interaction exists with development schemes and developed society and also among different tribes. The land holding pattern among tribal is not much different to that of general population, the 6.96 lakhs tribal families out of 14.2 lakhs are BPL. It is true that their needs are limited but most of them are lacking the participation in various schemes/missions/programmes run by various departments of government such as tribal development board, agriculture and forest department and number of NGOs. STs were found to be sufferings from constraints of various intensities viz. naxalism (63.3%), alcoholism (74.3%), migration (27%), malnutrition (30%), unemployment (30.3%), communication gap (38%) and atrocities (23.7%).

Each tribe of the state speaks his own dialect. These tribes in general understand their own dialects and a big communication gap were found to exist in between government officials and tribal. Due to their ignorance and indifference towards the government schemes, the tribal have not come forward for taking its benefit. All these factors have resulted in very slow progress of these schemes and women empowerment. Language is a big barrier in the implementation and acceptance of these schemes. More than one third (38%) respondents reported this problem during investigation. Therefore, there is an immense need to involve sociologists and dialect interpreters in Govt. Schemes for successful implementation.

NSBC- 2015- ES-04

### **Mungbean (*Vigna radiata* L. Wilczek) genetic resources *vis-à-vis* farmers' variety of Bay Islands for traits of agronomic interest and its implication in breeding programme**

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Mungbean (*Vigna radiata* L. Wilczek) is most important pulse crops of the genus *Vigna* which are grown as a main component crop in various cropping systems in several regions of India as a kharif, rabi and summer crops. This crop is generally grown under rainfed, highly unstable, complex production environments on marginal lands and in relayed cropping with cereals using residual moisture in the soil. It is considered as the most economically important *Vigna* crop in Asia. Seeds of these crops are a major inexpensive source of dietary proteins for vegetarian's diet. Their unusual capacity for symbiotic nitrogen fixation underlies their importance as a source of protein in the human diet and of nitrogen in both natural and agricultural ecosystems and are also increasingly recognized as a source of valuable secondary metabolites. Developing mungbean genotypes with improved determinate growth habit and synchronous maturity is essential. The role of plant genetic resources and farm saved seeds in the improvement of cultivated plant species in general and in mungbean particular has been well recognized. The farmers variety *vis-a-vis* landraces are the source of important gene(s) for agriculture and genetic diversity measured at the molecular level is generally greater in landraces/ wild relatives than their related cultigens. However, the use of mungbean farmers variety *vis-a-vis* landraces collection, particularly in the islands conditions, is still limited despite this wide recognition. Until a collection has been properly evaluated and its attributes become known to breeders, it has little practical use. Evaluation of farmers' variety *vis-a-vis* landraces,

in the broad sense and in the perspective of genetic resources, is the description of the material in a collection. In view of the wide range of genetic variability in the indigenous landraces of mungbean ranging from weedy types to high yielding, all necessary care taken before their evaluation and characterization. It covers the whole range of activities starting from the receipt of the new samples by the curator and growing these for seed increase, characterization and preliminary evaluation, and also for further or detailed evaluation and documentation. In view of the wide range of genetic variability in germplasm collections of cultivated plants ranging from wild and weedy types to high yielding varieties, all necessary care should be taken before making any strategy for their evaluation and characterization. Also, the breeding aims change rapidly. By and large, for effective evaluation of germplasm, a close organizational and personal contact between curator and breeder is necessary in the context of breeding objectives *vis-a-vis* evaluation programme.

The recent developments in gene transfer technology have made it possible to transfer genes from even cross incompatible wild species. Therefore, evaluation of landraces of mungbean is an appropriate approach seeking genes which are rare or absent in cultigens. The overall effect of plant breeding on genetic diversity has been a long standing concern in the evolutionary biology of crop improvement. Genetic diversity of species and gene pools can increase the productivity of farming systems in a range of growing conditions, and more diverse farming systems are also generally more resilient in the face of perturbations, thus enhancing food security. It is an essential requirement for increasing crop productivity through breeding. The indigenous landraces collected from the different parts of the Bay Islands along with breeding lines and established cultivars of mungbean (*Vigna radiata* L.) were analysed using morphological markers to understand the genetic diversity.

To evaluate the genetic variability among mungbean landraces of Bay Islands, an experiment was laid out at the experimental field of Central Inland Agricultural Research Institute, Port Blair, Andaman & Nicobar Islands (India). The objective of this study was to characterize indigenous mungbean landraces on the basis of morphological markers to determine their usefulness for analysing diversity in their gene pool. The goal of this study was to provide data useful to mungbean breeders and also to provide an insight into the evolution and dissemination of mungbean. The specific objectives were to determine the genetic diversity and relationships within and among landraces and cultivated mungbean accessions, and to determine which accessions should be included in a mungbean breeding programme as an aid to efficient evaluation of mungbean genetic resources. This study was conducted to determine the genetic variability on the basis of 14 DUS parameters and 11 quantitative yield and yield attributing traits.

The various genetic parameters (GCV, PCV, broad sense heritability and genetic advance) for estimation of genetic variability of landraces were analysed. In the germplasm lines, the mean morphological and yield performance showed that there were significant differences ( $p < 0.01$ ) for the quantitative traits. The data revealed that, highest genetic variation was present for plant height, followed by seed yield per plant, number of pods per plant, days to flowering and days to maturity. However, moderate genetic variation was observed for other characters, including length of pods, seeds per pod while small genetic variance was observed for 100-seed weight among these 56 accessions. Phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were highest in seed yield per plant followed by number of branches per plant and number of pods per plant. The analysis of variance showed significant differences among the genotypes for all the traits at 0.01 % level. Highest seed yield was observed in genotype ANM-12-02 (IC-0611650) followed by ANM-11-12 (IC-0611666), ANM-11-07-2 (IC-0611663), ANM-11-05 (IC-0611661), ANM-12-01 (IC-0611649), ANM-11-08 (IC-0611664), ANM-11-15 (IC-0611667), ANM-11-46, ANM-11-47, ANM-11-11 (IC-0611665), and ANM-11-44 (IC-0611669) were significantly different in terms of yield attributing traits *vis-a-vis* plant ideotype. The magnitude of differences between PCV and GCV were minimal for number of branches per plant, days to flowering, days to maturity and 100-seed weight suggesting minimum role of environment on the expression of genes controlling these traits. The minimum and maximum values of the coefficient of variation for each quantitative trait indicated that there is considerable morphological variation among the accessions. Therefore, the possibility to obtain superior genotypes for various morphological traits needs to be explored through field evaluation and characterization of diversity, present among genotypes. It involves description of variation for morphological markers of direct interest to users. Broad sense of heritability estimates were high for number of branches per plant (92.79%), 100-seed weight (92.52%), seed yield per plant

(75.63%), days to maturity (64.39%) and days to flowering (61.46%). Among these diverse accessions, several plants with high yield potential were identified, some of which exceeded the limit of mean values obtained for five high yielding genotypes than the recommended varieties used as checks and should be useful for the future breeding programme. The mean and variance along with heritability estimates (broad sense) were in good coordination which revealed the repeatability of the experiment and suggested that these characters were less influenced by the environment, and could be improved through individual plant selection with greater success.

This finding revealed that genetic variability of indigenous landraces to be exploited, and suggested that selection of proper genotypes plays a vital role for broadening the genetic base of cultivated mungbean landraces involving diverse parents for a successful breeding program. Parents with broader genetic base can create higher genetic variation which can increase the genetic gain in selection. So depending upon breeding objectives, the result of cluster analysis can be applied for crossing program for mungbean improvement.

NSBC- 2015- ES-05

## Biodiversity and productivity of herbage species in silvipasture system

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In manmade silvipastoral system tree species as well as improved grass and legume species are grown parallel but over a period the production and quality of forage get deteriorated due to invasion of alien plant species for such silvipasture system. Multipurpose tree species viz; *Dalbergia sissoo*, *Gmelina arborea*, *Pongamia pinnata* and *Terminalia arjuna* were grown at 5x5 m spacing with *Chrysopogon fulvus* and *Stylosanthes hamata*. Over a period the tree canopy spread, the sun light was intercepted under the tree which resulted the changes in structure and production share of quality herbage vegetation of such well established silvipasture system. In paper the structure of herbage flora was studied at Dr. Richhariya Research & Instructional Farm, IGAU Baronda, Raipur Chhattisgarh.

The population structure of under storey vegetation was recorded during peak growth period i.e. October. Twenty quadrates of 50 x 50cm size were laid out randomly in each treatment. The numerical strength of every species was counted in each quadrate and thus the population structure of herbage species was estimated for frequency, density and basal area (Curtis, and McIntosh, 1950). The Importance Value Index (IVI) was determined as the sum of relative frequency, relative density and relative basal area.

Dry matter production of crop was also recorded in peak growth period in October. Fresh weight recorded of each harvested sample was dried at 75°C in hot air oven for 72 hours to estimate the dry weight. The growth performance of four MPTs, viz; *Dalbergia sissoo*, *Gmelina arborea*, *Pongamia pinnata* and *Terminalia arjuna* after 10 years of plantation are presented in Table-2. The maximum tree height was recorded in order of *G.arborea* (7.2 m) > *D.sissoo* (6.1 m) > *P. pinnata* (5.5 m) > *T.arjuna* (5.4 m) respectively with considerable variations in collar diameter in similar order *G.arborea* (15.03 cm), *D.sissoo* (13.25cm), *T.arjuna* (12.45cm) and *P.pinnata* (12.01 cm) respectively, where the diameter at breast height (DBH) was recorded in order of *D.sissoo* (13.1 cm) > *G.arborea* (11.5 cm) > *T.arjuna* (9.43 cm) > *P.pinnata* (9.06 cm) respectively. Over all the growth performances was found better in *G.arborea*, followed by *D. sissoo*, *P.pinnata* and *T.arjuna*. It may be presumed that *G.arborea* and *D.sissoo* were fast growing as well as more hardy and tolerant to stress conditions. The distribution and performance of plants in an ecosystem depend on the microclimatic conditions as well as genetic potential of the species to develop adaptability for the environments. In present study, herbage flora was quantified for their numerical strength and biomass production where the total number of herbage species available under *D.sissoo*, *G.arborea*, *P.pinnata*, *T.arjuna* and in control plots was 14, 14, 17, 12 and 15 respectively with Similarity index of 61.64 per cent. The association index between introduced species *S.hamata* and *Chrysopogon fulvus* was highest under *D.sissoo* (100 %), while lowest in control plots (57.14 %).

The total number of species encountered during the course of study was grouped into three major categories i.e. grass, legumes and forbs and on the basis of Impotent Value of Index (IVI) the presence of these four species were in order of *Pennisetum pedicellatum* > *Heteropogon contortus* > *Chrysopogon fulvus* > *Eremopogon faveolatus* in



control, and in silvipasture system these were in order of *Pennisetum pedicellatum* > *Chrysopogon fulvus* > *Eremopogon faveolatus* > *Heteropogon contortus* under *D.sissoo* and *T.arjuna*, while under *G.arborea* and *P.pinnata* these were in order of *Pennisetum pedicellatum* > *Heteropogon contortus* > *Eremopogon faveolatus* > *Chrysopogon fulvus*.

Seven leguminous species viz; *Alysicarpus monilifer*, *A. bupleurifolius*, *A. tetragonolabus*, *Aschinomon indica*, *Cassia pumila*, *Hylandia latibrosa* and *Stylosanthes hamata* lodged their presence, where *Aschinomon indica* was dominated at all the micro-sites reported very common in agricultural field of Chhattisgarh. Six forbs viz; *Celosia argentia*, *Chorchorus aletorius*, *Cyprus rotendus*, *Fembristylis tenera*, *F.Schoenoides* and *Sida carpinifolia* were reported, of which only *C.argentia*, occurred in all the micro-sties. These forbs ultimately found responsible for biomass production and nutritive values, were heavily infested gradually dominating over introduced grass + legumes pasture crop during 10 years growth of silvipasture system. In such man made silvipastoral systems where the physical environment of under storey crops governed by top storey woody species, the structural and functional relationship of herbage species was expressed in species diversity.

NSBC- 2015- ES-06

### **Agricultural diversification for climate change adaptation in Island ecosystem**

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Global climate change and food insecurity are the two major challenges for humanity, with the former appearing to escalate faster than the later. The impacts of changes in climate and climate variability on agricultural production will have substantial effects on small holder farmers in many parts of the tropics and subtropics, and the resulting reduced food security potentially will increase the risk of hunger and undernutrition. Averting this challenge requires that farmers adapt by making changes in farming and land management decisions that reduce the negative consequences associated with changing climate. The adaptation options may include increasing the resilience of existing farming systems, diversification and risk management.

Diversification may be of on farm and off farm diversification. The onfarm diversification occurs when more species, plant varieties or animal breeds are added to a given farm or farming community. It also includes landscape diversification i.e different crops and cropping systems interspersed in space and time. Non farm diversification may occur when taking up non farm activities or processing of farm products. Both on-farm and off-farm diversification helps in adapting to climate change by smoothing the short-term household income fluctuations and providing households with a broader range of options to address future change. It is important to recognize that diversity can be created temporally as well as spatially, adding even greater functional diversity and resilience to systems with sensitivity to temporal fluctuations in climate. Product/crop diversification can also lead to diet diversification because of on farm production which can have an an important role to play in adapting to climate change. This can be achieved by on farm diversification of crop production and integration of other on farm activities like livestock, back yard poultry, fisheries etc. depending on the site specific conditions which is highly dependent on the geographical and socio-economic context of the specific farming system. While diversification is an important element of climate change adaptation, there is surprisingly limited information available that can be used to guide farmers and farming communities in a particular situation. This is more pertinent to the island ecosystem of Andaman and Nicobar which is vulnerable to climate change events.

#### **Andaman and Nicobar Islands**

The Andaman and Nicobar group of Islands lie in the Bay of Bengal (6-14° N latitude; 92-94° E longitude) 1200 km east of main land India. The islands enjoy tropical humid climate because of their location in equatorial zone surrounded by Andaman Sea. The islands receive rainfall from both the south west and north east monsoons and maximum precipitation is between May & December. The mean annual temperature ranges from 23 to 30° C. Rainfall is heavy due to annual monsoons and measures around 3000 to 3800 mm each year. Maximum rainfall is received during May to December and dry period extends only for 3 to 4 months from January to April. Agriculture

in the Islands depends on rains which mostly occur during monsoon months (June-September). Due to heavy concentrated rainfall in a short span, flat topography, low infiltration rate and lack of proper drainage most of the cultivated fields are deeply waterlogged limiting the cultivation of HYVs of rice and mono cropping of tall *indica* rice varieties in *wet season*. During dry season, acute shortage of irrigation water along with increase in soil and water salinity due to presence of brackish water table at a shallow depth compelled the farmers to keep their land fallow leading to high poverty and unemployment among the rural people.

## **Crop Diversification**

### **(a) Genetic/Varietal diversification**

The crop diversification can be achieved at two genetic level or species level. In Andaman Islands, long duration, photosensitive rice variety (C14-8) is traditionally grown during monsoon season. It is transplanted during August and harvested in December or January after withdrawal of monsoon rains. Because of which land is kept fallow during the dry period and mostly monocropping of rice is the general norm in this region. Recently number of medium duration, photo insensitive and high yielding varieties were developed or evaluated for the islands and are found to increase not only the yield but also the allow dry season crops.

### **(b) Cropping system diversification**

Rotation systems have been used for millennia to maintain soil fertility and productivity and to suppress pests and diseases. Diversification through crop rotation can be an especially useful strategy in farming systems that integrate crop and livestock production. The addition of forage crops to cereal-based system enhanced nitrogen supply through fixation by legumes, and increased nutrient cycling due to greater livestock density and manure production. These changes allowed the intensification of both crop and livestock production and increased yields substantially.

Rice is the only cereal crop grown in the Islands during wet season due to water logging in valley and coastal plains. The land is kept fallow during dry season. Crop rotation with vegetables, pulses, oilseeds and maize not only increase the production and improve food and nutritional security due to increase in farm income and on farm availability. Suitable rice based cropping systems viz., rice-green gram, rice-maize, rice-vegetables (okra), rice-ground nut, and rice-fallow were evaluated for the valley areas. The results indicated that highest yield was obtained in rice-maize system (16773 kg ha<sup>-1</sup>) followed by rice-okra (15630 kg ha<sup>-1</sup>). Accordingly these systems also recorded highest net return and B: C ratio of more than 3.0.

### **(c) Diversification through intercropping or mixed cropping**

The practice of growing two or more crops together is widespread throughout the tropics. The benefits of nutrient exchange, reduced weed competition and pathogen control can generate substantial increase in income and stability to the system. In Andaman Islands coconut is grown in an area of 7135 ha, which can be utilised to grow inter crops like green fodder, pulses besides spices like clove, cinnamon, black pepper etc. The cultivation of pulses in new niche areas like intercropping in coconut is promising for increasing the pulse production in these Islands because at present only 1154 tonnes of pulses are grown in the Islands from an area of 2610 ha which is not sufficient to meet the local demand of 6200t. The sole crop area after rice cultivation is limited in the Islands because of competition from vegetable cultivation. As in coconut plantation, 76 % of land is lying vacant which may be utilized for pulse cultivation.

The intercropping of red gram in coconut recorded grain yield of 459 to 544 kg/ha. The black gram varieties/lines, AN-11-19 recorded higher yield (354 kg/ha) which was at par with VBN 6 (330 kg/ha). Though the yield level of pulses under coconut plantation is low (40-60 % of sole crop yield), there is a scope to increase the pulse production in Andaman Islands through area expansion under coconut plantations.

Two varieties viz., ICGS 76 and TG 37A of table purpose ground nut were intercropped in more than 10 year old coconut plantation having the spacing of 7.5 m between rows. The result indicated that TG37A recorded significantly higher pod and kernel seed yield (1652 and 858 kg ha<sup>-1</sup> respectively) compared to ICGS 76 (1245 and

740 kg ha<sup>-1</sup>). On an average, the light intensity of 42500 lux was recorded during flowering stage (45-55 DAS) in the plantations of more than 10years age which is sufficient for ground nut.

#### **(d) Diversification through integrated farming system**

In conventional diversified systems crops and livestock coexist independently from each other and serve primarily to minimize risk and not to recycle resources. In an integrated system, crops and livestock interact to create a synergy, with recycling allowing the maximum use of available resources. Crop residues can be used for animal feed, while livestock and livestock by-product production and processing can enhance agricultural productivity by intensifying nutrients that improve soil fertility, reducing the use of chemical fertilizers. So the integrated farming system not only allows the diversification but also allows synergy between the components to increase production and productivity. Based on the principle of enhancing natural biological processes above and below the ground, the integrated system represents a winning combination that (a) reduces erosion; (b) increases crop yields, soil biological activity and nutrient recycling; (c) intensifies land use, improving profits; and (d) can therefore help reduce the negative consequences of climate change and have the potential for providing mitigation co-benefits besides help reduce poverty and improve food security. Different IFS model have been evaluated for hilly uplands, mid slopes and low lying areas of Andaman Islands and the result showed increase in net return and employment generation. This land specific IFS is more resilient to climate change and sustainable under island condition.

#### **Conclusion**

The challenges posed by climate change will have greater impact on small holder farms by way of erratic rainfall, persistent droughts, desertification, high temperature besides changing policy environment within which they operate. Considering the increasing population growth and degradation of land resources, the key options to tame climate change related problems rest on: agricultural diversification through the use of water and nutrient efficient cultivars, modifications in existing cropping systems and adoption of site specific integrated farming systems to diversify the farming systems and also harness the mitigation cobenefits. The land management options to reduce the impacts of waterlogging and facilitating insitu water harvesting will also play a major role in ensuring food security of the small holder farmers.

NSBC- 2015- ES-07

### **Impact of climate change on coastal agricultural bio-diversity: Issues and strategies**

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Gone are the days that evinced assured food production with little or no major risk factors playing key role in sustainable farming. Climate change, being ascribed as the primary reason, is a complex phenomenon attributed to several factors including the nature's own dynamism and human life style on the planet earth. While agricultural bio-diversity has been the bed rock for food security on earth, its jeopardy due to impact of climate change is a global concern. By and large, Coastal zones are among the most productive areas in the world, offering a wide variety of valuable habitats and ecosystems services that have always attracted population and human activities. The enchanting beauty and richness of coastal zones have made them popular settlement areas and tourist destinations, important business zones and transit points. Notwithstanding this, the coastal zones have very fragile ecosystem and thus, are also among the most vulnerable areas to climate change and natural hazards. The impact of climate change has been leading to flooding, erosion of natural resources, sea level rise as well as extreme weather events. These impacts are far reaching since; vital natural resources including the agro-biodiversity are at great risk and peril, thereby posing the greatest challenge for food security in near future at alarming rate. Coastal zones while supporting the about 1/3rd of global population, have a treasure house of immense agro-biodiversity resources besides other economic resources. Agriculture and allied food and protective food genetic resources ( Rice, legumes, fruit and vegetable crops, fish genetic resources, etc.), an array of plantation and spice genetic





resources, medicinal and forestry genetic resources form the vital bio-diversity domain of the coastal regions which are being constantly threatened by the climate change of late. The clinching experiences perceived within a short period of time like – Erosion of 75 specialty rice varieties to 15-20 varieties in Wynad district of Kerala, Similar threat to local rice, cashew, mango, kokum and vegetable genetic resources in Goa, devastation of jackfruit and cashew germplasm by Thane Cyclone in Panruti, Cuddalore district, Tamil Nadu, devastation of cashew plantations in Coastal Andhra Pradesh by Hudhud cyclone are briefly reviewed in this article.

These issues warrant for urgent strategies through priority research programmes to address the above issues. Integrated coastal zone management, in its broader sense, would greatly facilitate the strategic approach in addressing the key issues. The Convention on Biological Diversity (CBD) advocates for native seed conservation as one of the approaches for strategic plan for mitigating the impact of climate change on crop diversity. Integrated “climate change and conservation research” include: using climate change models to identify populations most at risk of extinction, predicting suitable areas for adaptation and restoration, screening of genetic resources to range of climate change variable parameters for physiological and breeding responses, conservation of blue carbon deposits, etc.



## **NSBC 2015 - Track – I : BIODIVERSITY**

### **1.1. Adaptive management and competing claims on natural resources**





## **Analysing lycopene content in tomato (*Lycopersicon esculentum* Mill.) in response to pesticide toxicity**

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Vegetables and fruits are vital constituents of our day to day diet. Tomato is one of the major food sources in India. It consists of an important plant pigment Lycopene which is an excellent antioxidant and plays an important role in prevention of prostate cancer. Tomato crop is frequently damaged by pests resulting in enormous fruit yield and its quality losses. Excessive use of pesticides by farmers was a great concern since even the commercially banned pesticides are being used due to ready availability at low cost and wide range of activity. The present study was to investigate the effect of two major synthetic pesticides (endosulfan and malathion) on two varieties (Pusa Ruby and Pusa Early Dwarf) of tomato. Endosulfan and malathion both were taken at a concentration of 0.05, 0.15 and 0.25%. A biopesticide (Neemarin- a neem formulation) was also taken at 0.5% to test for its efficacy. Lycopene content (estimated by peaks observed during HPTLC) was found to decrease with increase in the doses of pesticides. A relatively lower content was estimated at 0.25% of both the pesticides where as an increase resulted on exposure to Neemarin. Hence use of lower doses of synthetic pesticides and optimal dose of biopesticide for crop protection against pest would be advisable.

## **Diversified genetic resources for improving drought and heat tolerance in Chickpea**

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Chickpea is the most important pulse crops of Madhya Pradesh accounting for 77% of state pulse production from 58% area with pronounced horizontal and vertical growth rates. The state also contributes about 42.23 and 28.3% to national and global chickpea basket from an area of about 36.63 and 24.6%, respectively. In Madhya Pradesh, chickpea improvement started prior to reorganization of the old Madhya Pradesh in 1956. The collection, evaluation and characterization of germplasm including land races have been made and donors for yield traits, resistance against soil borne disease, biological nitrogen fixation, maturity duration, seed size and consumer's quality traits have been identified. By using these donors, early maturing, medium to bold seeded and high yielding varieties like JG 11, JG 130, JG 16, JAKI 9218, JG 6, RVG 201, RVG 202 and RVG 203 having durable resistance against *Fusarium* wilt have been developed and released for general cultivation in the country. These varieties are making chickpea revolution in South and Central parts of the country. Being a dominant rainfed crop, drought and high temperature during reproductive stage of the chickpea are presently major yield reducers. AMMI analysis showed significant genotype – environment interaction for seed and biomass yield, conversion efficiency from source to sink, flowering and seed filling durations, drought and heat tolerance index, growing degree days, helio-thermal units and photo-thermal index. AMMI stability value showed that RSG 888, JSC 49, ICCV 10, JG 11, IPC 2005-66 and Annigeri for seed yield, JSC 48, JG 130, JG 11 and JSC 49 for drought tolerance index and JSC 49, GCP 101, PG 105 and BGD 72 for heat tolerance index were stable genotypes. These genotypes can be used in breeding for improving seed yield with drought and heat tolerance ability in chickpea.

### Effect of bagging on mango peel colour and composition of pigments

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Colour is considered as the important quality traits of mango that attracts the consumers and facilitates marketing. An experiment was conducted to study the effect of pre-harvest bagging on colour development, carotenoids and anthocyanin contents in mango peel. Fruits of red fruited mango 'Lily' were bagged at 75% maturity and bags were retained for 30 days. Effects of bagging treatment were evaluated in comparison with control. Results revealed that bagging significantly affected the colour intensity, anthocyanins and carotenoid contents. As per the Royal Horticultural Society's colour chart, colour shades changed from red purple to greyed purple. Colorimetric evaluation showed increased lightness and reduced brightness in bagged fruits. The total carotenoids and anthocyanins were also found to be reduced by 50% and 62%, respectively in bagged fruit peels when compared with unbagged control. In control fruits also, yellow green patches were observed at shaded and unexposed areas. Hence, it could be concluded that light has a prominent role in colour development in mango fruits.

### Study of the Native *Rhizobium* of SVBPUAT and its nearby areas and its response on different attributes of black gram

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The present trial was conducted at Sardar Vallabh Bhai Patel University of Agriculture and Technology (SVPUAT), Meerut (U.P.) to evaluate the effect of *Rhizobium* as a biofertilizers on different plant parameters related to yield performance of blackgram (*Vigna mungo*) cv.urd shekhar-2 during March to June 2013. Use of biofertilizers is one of the important components of integrated nutrient management as they are cost effective and renewable source of plant nutrients that supplement chemical fertilizers for sustainable agriculture. The association of plant and Rhizobial inoculants provides a symbiotic effect which enhances the plant growth and essential nutrients present in the soil. The rhizosphere developing in the surrounding of roots also gives a strong nitrogen assimilation mechanism for the leguminous plants. The pot studies of four treatments (T<sub>1</sub>: control, T<sub>2</sub>: DAP, T<sub>3</sub>: IARI (Urd 10B), T<sub>4</sub>: Native strain) revealed that *Rhizobium* as biofertilizer gave significant improvement in plant productivity and quality. The study also showed a progressive increase with a positive effect in nodule frequency, plant root length, seed number and seed weight in treatments containing *Rhizobium*.

## Genetic divergence analysis for certain yield and quality traits in rice (*Oryza sativa* L) under saline condition

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Rice is staple food for Asian people and there is urgent need to produce more rice per unit area, which can be attained by possibly utilizing the unexplored germplasm for adverse climatic and soil conditions. Among the stress, salinity is profound and gaining importance in upcoming years; obviously developing new varieties using genetically diversified parents with saline tolerance will be better option in increasing yield. This study was undertaken to identify promising genotypes based on its diversity evaluated using Mahalanobis  $D^2$  statistic. Genetic divergence was studied for different yield and its component traits for 60 rice genotypes collected from different eco-geographical regions of India. Based on 11 morphological and quality characters namely, days to first flower (days), plant height (cm), number of tillers / plant, number of panicles / plant, panicle length (cm), number of grains / panicle, 1000 grain weight (g), grain length (mm), grain breadth (mm), grain L/B ratio and grain yield / plant (g) these genotypes were grouped into 6 clusters. The analysis of variance revealed significant differences among the genotypes for all the characters studied. The characters like grain length (22.14%), number of grains / panicle (17.34%) and plant height (16.44%) contributed maximum towards genetic diversity. The maximum inter cluster distance ( $D^2 = 7925.46$ ) was recorded between clusters III and VI. Hybridization among genotypes from clusters III and VI which may serve as potential donors to develop potential recombinants with high yield coupled with desirable traits.

## Screening the natural populations of Madhunashini (*Gymnema sylvestre*) for morphological and biochemical parameters using reverse phase- high performance liquid chromatography

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In order to supply uniform, genuine, good quality raw material to the pharmaceutical industries and to reduce the burden on natural stocks, cultivation of medicinal plants is the need of the hour. However, improved varieties with optimum levels of active ingredients have so far not been developed in a number of important medicinal plants. Considering this, an investigation was done to assess the extent of variability amongst the natural populations of Gudmar (*Gymnema sylvestre*), an important anti-diabetic plant of the Indian System of Medicines. Evaluation of the lines for morphological parameters revealed highly significant differences for leaf related parameters (leaf length, width, area, fresh as well as dry weight and petiole length) which directly contribute to the biological yield of the plant. Further, a high performance liquid chromatography- photodiode array detection (HPLC-PDA) method was developed for identification and quantification of bioactive principle *i.e.* gymnemagenin using solvent system consisting of acetonitrile, potassium dihydrogen orthophosphate and orthophosphoric acid in a gradient elution mode. Results revealed significant differences for gymnemagenin content amongst the lines evaluated. This could help in identification of lines having improved gymnemagenin content, which in turn promote the cultivation of this high value medicinal plant. Further, these lines could be used in breeding programmes for development of cultivars with optimum levels of gymnemagenin.

## Assessing the suitability of ultrasound assisted solvent extraction method for extraction of gymnemagenin from *Gymnema sylvestre* leaves and quantification using reverse phase high performance liquid chromatography (RP-HPLC)

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Ultrasound assisted extraction is one of the promising green techniques for extraction of bioactive molecules from medicinal plants, however limited reports are available regarding Indian medicinal plants. Present experiment was carried out to explore the possibility of using ultrasound-assisted extraction as a tool to extract gymnemagenin from an important anti-diabetic medicinal plant, *Gymnema sylvestre*. Mature leaves were shade dried, powdered and extracted using ultrasound processor at 30% amplitude. Extraction was carried out using three levels of hydro-alcoholic solvent (25, 50 and 75%) for five durations (20, 30, 40, 50 and 60 minutes). Treatments were compared with 24 hour cold percolation as control. The extracts were hydrolyzed prior to RP-HPLC analysis in order to convert the gymnemic acids into gymnemagenin. The HPLC analysis of the samples revealed significant variations with respect to gymnemagenin recovery amongst the treatments and ultrasound assisted extraction was found to be faster and more efficient technique for extraction.

## Effect of pinching on yield of African marigold (*Tagetes erecta* L.) in tropical Island conditions

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Marigold (*Tagetes erecta* L.) is one of the most popular traditional flower crops grown in India. It has gained popularity due to its easy culture, wide adaptability, profuse flowering, short juvenility, long blooming period, attractive colors, shape, size and good keeping quality which attracts the attention of flower growers. Marigold flowers are widely used for making garlands, religious offerings, bedding and potting etc. The demand for marigold flowers is in increasing trend and the farmers will be benefitted if they are able to produce more number of flowers per plant. Flower yield is mainly dependent on number of flower bearing branches which can be manipulated by arresting the vertical growth of plants and encouraging side shoots by means of apical bud pinching. Such side shoots would provide more scope to bear flower and in turn contributes to higher flower yield in marigold. Hence the experiment was carried out to study the effect of pinching on flower yield of African marigold Cv. Pusa Narangi Gaiinda. Three treatments were imposed which consisted of T<sub>1</sub> (control- no pinching), T<sub>2</sub> (single pinching- 20 days after transplanting) and T<sub>3</sub> (double pinching- 15 days after single pinching). The results showed that maximum plant spread (47.2 cm), numbers of branches (13.7), flower duration (36.7 days), number of flowers per plant (56.6), size of flower (6.18 cm), weight of single flower (7.08 g), flower yield per plant (347.8 g) and seed yield per plant (20.23 g) was observed in double pinching than single pinching and non-pinching. The flower yield per plant was maximum in double pinching with three times more yield than the control i.e. no - pinching.



## Yield performance of legume vegetable crops in Andaman and Nicobar Islands

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The legume such as French bean, dolichos bean, cowpea and cluster bean are high value vegetables in islands. Except cowpea, rest of the crops is mainly grown during dry season (December – April). French bean, dolichos bean and cluster bean are transported from mainland during heavy rainy months to meet the local demand. Therefore, the present study was made to evaluate four legume vegetables i.e. dolichos bean (bush and pole types), cowpea (bush and pole types), French bean (bush and pole types) and clusterbean in island conditions. In cowpea, Arka Garima (11.0 t/ha) and Kashi Kanchan (9.0 t/ha); dolichos, Arka Jay (9.0 t/ha); French bean, Arka Anoop (7.2 t/ha); Arka Komal (7.0 t/ha) and Cluster bean, Krishna 41 (6.0 t/ha) were found promising for dry season in island conditions. In continuation of the dry season trials, four legume vegetables were tested in mid rainy season (July-October months) in island conditions for yield observations. The performance of the all the legume vegetables was poor as compared to dry months. Bush type varieties of cowpea (Arka Garima and Arka Kanchan) did not perform well in rainy season (3.4-3.5 t/ha) however, performance of pole type varieties Arka Mangala (6.2 t/ha) and Local genotype (4.5 t/ha) was better. In dolichos bean, Arka Bold (3.0 t/ha) and Arka Jay (3.6 t/ha) recorded very low yield. Similarly, the yield cluster bean was also less in rainy season (3.8 t/ha) than dry season (6.0 t/ha). The French bean is sensitive crop to heavy rains and out of four bush type varieties (Arka Anup, Arka Komal, Arka Suvidha and Arka Shrestha) and five pole type genotypes (IIHR-PB-1, IIHR-PB-2, IIHR-PB-5, IIHR-PB-7 and Don) evaluated in mid rainy season in uplands, pole type genotypes (5.2-6.6 t/ha) performed well over the bush type genotypes (3.6-5.4 t/ha). The poor performance of the legume vegetables during rainy season was attributed to lack of suitable varieties, low light availability, excess moisture in root zone, flower and fruit damage by heavy rains, loss in crop stand by fungal diseases (particularly in French bean) and damage by insect pests. Thus, the study suggests for evaluation of more genotypes and also to develop other production and protection technologies to ensure local production of legume vegetables in islands.

## Determination of the conservation value of mangroves of Andaman

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Despite documentation of the mangroves all along the Andaman and Nicobar Islands, there are no clear demarcating maps for mangrove habitats with location-specific data on their species composition and associated flora and fauna. The present study intended to identify and evaluate the conservation value of each mangrove areas of Andaman for considering their potentiality as highly sensitive area. A total of 79 contiguous patches of mangroves in Andaman Islands were identified and biological data with respect to patch contiguity, species diversity and circumference at breast height (CBH) were collected. A 10 m × 10 m plot was used to determine the density of the true mangroves. Altogether, 72 species of true mangroves and mangrove associates distributed among 37 families and 68 genera were reported from the identified contiguous patches. The relative basal

cover ranged from 72.18 m<sup>2</sup> ha<sup>-1</sup> (Austin Strait of Mayabunder) to 11.49 m<sup>2</sup> ha<sup>-1</sup> (Katan of Baratang). A total of 19 species of true mangroves trees distributed in 10 genera and 8 families were reported with  $\geq 30$  cm CBH. The number of species varied from 1 to 10 per quadrat and from 1 to 16 per site and a majority of the quadrats had 2-3 species, indicating a patchy distribution. Further, the study revealed that the mangrove forests of the Islands are characterized by a mixed species composition, and the sites are represented by different combinations of the dominants and co-dominant species. Many regional endemic mangrove species have been found to have wider distribution, thus representing a homogenous biodiversity in the Islands. Habitat loss through anthropogenic interference was found to be a primary reason for the decline of species diversity in most of the degraded survey sites. The present study recommends protection of mixed species forests to the success of mangrove biodiversity conservation.

NSBC- 2015- T01- AMCC – 11

## Heterotic expression and combining ability analysis for yield and yield components maize (*Zea mays* L.)

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Combining ability over environments was studied for twelve yield and yield related traits in maize involving 33 F<sub>1</sub> crosses produced in line  $\times$  tester design. Pooled analysis of variance over environments revealed significant differences among lines, testers and line  $\times$  tester crosses. The performance of lines, tester and crosses were significant for all the traits except testers for number of leaves per plant and ear girth. Inbred lines L2, L3, L4, L19, L22 and L21 were good general combiners for most of the traits. Inbred lines L15, L4 and L13 for earliness; L19, L1 and L2 for higher number of ears per plant; L2, L3 L1 and L5 for higher plant height and ear height were identified. On the basis of SCA and *per se* performance hybrid L2  $\times$  T1, L17  $\times$  T1, L10  $\times$  T2, L6  $\times$  T2 and L1  $\times$  T3 identified as early in maturity. Twenty one crosses revealed significant and positive SCA effects for grain yield per plant. Among these, L14  $\times$  T3, L7  $\times$  T1, L1  $\times$  T2, L6  $\times$  T2, L22  $\times$  T2, L8  $\times$  T3, L4  $\times$  T1, L17  $\times$  T2, L9  $\times$  T1 and L19  $\times$  T1 and L19  $\times$  T1 were found to be promising for grain yield. Three types of cross combinations were resulted due to high  $\times$  high, high  $\times$  low and low  $\times$  low GCA effects when one or both the parents were poor general combiners, they resulted into a hybrid having highly significant SCA were effects upon crossing. This is exemplified by hybrid L21  $\times$  T3 and L9  $\times$  T1 for grain yield per plant, biological yield per plant and 100 kernel weight; L5  $\times$  T3 for kernels per row. Cross combination L1  $\times$  T2, L7  $\times$  T1, L22  $\times$  T2, L14  $\times$  T3, L8  $\times$  T3, L9  $\times$  T1, L19  $\times$  T1 and L21  $\times$  T3 resulted good heterotic expression.

NSBC- 2015- T01- AMCC – 12

## Breeding fruit trees for fruit quality improvement

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Fruits play a crucial role in human diets and as a commercial commodity in trade. Fruit quality is considered as the most important criteria to be accepted by consumers. In breeding programs, although varieties have important traits in them, lack of producing good quality fruits makes the breeding program unsuccessful. Therefore major challenge for fruit breeders is to develop good quality fruits. However, the breeding for quality improvement is hampered by its polygenic control, tight linkage with undesirable traits, lack of its genetical knowledge *etc.* Also fruit trees are bound by limitations like large size of the tree, long juvenile phase, environmental problems (*e.g.* fruit drops due to natural calamities). Beside this, breeding program is time consuming and less interest is observed among the breeders. Till date, several attempts have been carried out to improve the quality characters in staple crops mainly tomato, maize, potato *etc.*, and little efforts have been diverted to tree fruits. Conventional and non conventional breeding approaches help in the evolution of the quality fruits in order to meet both domestic

and global fruit requirement. The biotechnological approaches provide precise, reliable, easy way for the breeding fruit trees for fruit quality improvement. Also it reduces the time, efforts and patience of the breeder when dealing with cumbersome fruit trees. Efficacy of approaches like marker assisted selection, candidate gene, genomics, transgenics, cisgenics have shown advantage when dealing with cumbersome crops. This review would focus on present status of different breeding approaches for fruit quality improvement in fruit trees.

NSBC- 2015- T01- AMCC – 13

## **Foliicolous lichen diversity in the Andaman and Nicobar Islands**

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Foliicolous lichens inhabit the surface of living leaves of vascular plants. These leaf-inhabiting lichens are widely distributed in wet or moist, highly humid or foggy tropical and sub tropical forests throughout the world. They occur only on surface of leaves with limited lifespan. These lichens have an accelerated lifecycle and respond rapidly to changes in environmental conditions. Therefore, they have a great potential to be used as bioindicators of altitudinal zonation, microclimate and disturbance in the tropics. These lichens can also indicate biological richness and species diversity. The species richness of foliicolous lichens in undisturbed localities was twice that of disturbed localities in the montane rainforests. Foliicolous lichens are comparatively well-studied world-wide and more than 800 species are presently known world-wide and 136 species from India. The dicotyledonous and monocotyledonous leaves in the high humid moist evergreen forests of the Andaman and Nicobar Islands harbour a good number of foliicolous lichens. The recent investigations on these lichens resulted into the documentation of 87 species under 27 genera and 13 families. Pilocarpaceae shows highest diversity with 7 genera and 19 species and Porinaceae with 2 genera and 23 species. *Porina* is the largest genus with 21 species, followed by *Strigula* with 12 species, *Mazosia* with 5 species, *Aulaxina*, *Byssoloma* and *Sporopodium* with 4 species each. Interestingly, 8 genera are represented by 1 species each. *Coccocarpia* is the only foliose genus with 2 species.

NSBC- 2015- T01- AMCC – 14

## **Micro-propagation of *Costus sp* - important medicinal plants of the Andaman and Nicobar Islands**

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Andaman and Nicobar islands which is a hot spot of biodiversity hosts a large number of medicinal plants and herbal cure is traditionally bestowed with the aboriginal tribes of this Island. Among the different medicinal plants *Cheilocostus speciosus* and *Costus pictus* are the two important medicinal plants distributed through-out the Islands and widely used by the inhabitants for treating various ailments. *Cheilocostus speciosus* or crape ginger is possibly the best known cultivated species of the genus *Costus*. Various medicinal properties are attributed to it, particularly in the treatment of asthma, fungal diseases, rheumatism, diabetes and hepatoprotective disorders. It is valued very much for its diosgenin content which is a suitable material for synthesis of steroidal drugs and contraceptives. *Costus pictus* is another important medicinal plant that is distributed throughout the Islands. It is commonly known as spiral ginger or Insulin plant. *Costus pictus* possess therapeutic effect, mainly in reducing blood glucose level in addition to its antihyperglycaemic and insulin secretion. Since these species are not commercially

cultivated and is being exploited from wild, the tissue culture technique was standardized in these two species for mass multiplication and germplasm conservation. The nodal segments of *Cheilocostus speciosus* and *Costus pictus* were used as explants for the tissue culture experiment. The explants were inoculated in MS media supplemented with different concentrations of growth regulators NAA and Kinetin. In *Cheilocostus speciosus*, the maximum bud break percentage (85.3) and maximum shoot (40.9 mm) and root length (12.1 mm) was observed in the MS media supplemented with 3 mg/l kinetin and 3 mg/l NAA. In *Costus pictus*, growth regulator combinations of BAP and Kinetin were used in the shooting media and it was observed that Kinetin @ 1.0 mg/l gave maximum bud break percentage (78.3%), maximum number of shoots (3.3 per explant) and shoot length (19.5 mm). In the rooting media IBA @ 1.0 mg/l recorded maximum rooting percentage (91.6) with maximum number of roots per plant (5.6) and root length (6.8 mm).

NSBC- 2015- T01- AMCC – 15

### **Rodent menace in storage and their management in South Andamans**

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Rodents are persistent pests of stored grains and commodities in the Andaman and Nicobar islands. These notorious entrants ventured into the islands along with the food grains cargo brought from the main land. Rats and mice damage more than they consume. In rice fields they cut away panicles with mature grains and carry them to their burrows. Extensive spillage of grains occurs in this process and also many number of grain bearing plants are killed. In storage, not only do they eat away the grains and animal feed but also spoil the entire lot by excreting over the produce and shedding their hairs. Excretory pellets, animal hairs and urine stained grains of rice can cause serious health hazards besides critically hampering consumer preference. The larger rats like *Bandicota benghalensis*, *Rattus* sp. also charge upon young ones of protected mammals and ground dwelling birds and hence are a serious threat to the conservation of protected vertebrates of the islands. Rodents are also infamous for vectoring the dreaded disease Leptospirosis (Andaman yellow fever). Survey on different species of rodent pests infesting stored grain/poultry feed was carried out all around S. Andamans. *Mus booduga*, *Rattus rattus* and *Bandicota benghalensis* were observed as major pests of stored grains and animal feed. Laboratory experiments were simultaneously carried out to know the grain consumption per animal. *Rattus* sp. of uniform age were selected from the trapped rats and confined in cages for assessing grain loss by this species. It was found that on an average each animal consumed about 11.21 to 15.54 g of rice grains per day. Rodents can be effectively managed by the use of rodenticides viz., Bromodialone 0.005% cake. Zinc phosphide (2%) baiting can be recommended in cases where population peaks are attained during the breeding season. As non-chemical methods worth trying, cats can be kept as pets in agricultural farm houses, owl perches can be erected in localities of crop fields and storage godowns and most importantly rodentivores snakes must be conserved and never be killed. Hence by gradually and progressively encouraging the natural enemies, rodents can be effectively controlled with only minimal use of rodenticides.

## Evaluation of Jamun (*Syzygium cumini* L.) germplasm for major biochemical constituents

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Jamun fruits are relished by masses either in raw form or as value added products such as nectar, squash, syrup, mixed fruit juice and jelly. Being hypoglycaemic in nature, pulp and seeds of jamun are highly regarded in traditional system of medicines against diabetes. Fruit is well known for its antioxidant property owing to compounds such as anthocyanins, flavonoids, phenols *etc.* The present study is concerned with evaluation of sixteen accessions of jamun for various biochemical constituents. Results revealed significant differences for total soluble solids, moisture content, total sugars, vitamin C, protein, total anthocyanins, total phenols, flavonoids and antioxidant activity (DPPH and FRAP assay). The study could form the basis for classifying the studied accessions into different groups according to their processing potential.

## Assessing the variability amongst seedling population of Jamun (*Syzygium cumini* L.) for morphometric parameters

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Jamun (*Syzygium cumini* L.), belonging to the family Myrtaceae, is native fruit crop of South East Asian region, particularly India. In India, trees of jamun could be found growing in wet as well as dry tropics and subtropics. Owing to propagation by seeds and cross pollination, considerable variations are noticed among the progenies. In the present study, twenty four accessions of jamun were evaluated for their morphological attributes using the minimal descriptors developed by National Bureau of Plant Genetic Resources, New Delhi. Results revealed that the accessions exhibited wide variations with respect to parameters *viz.* tree height, tree spread, tree girth, leaf related parameters (length, width, petiole length), fruit related parameters (shape, length, width, weight, pulp %, pulp colour) and stone related parameters (length, width, weight, extent of polyembryony). A number of accessions were observed to have desirable characters. These accessions could be useful in crop improvement through selection or hybridization.



## Genetic diversity assessment in certain heirloom varieties of Mango (*Mangifera indica* L.)

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Mango (*Mangifera indica* L.), the national fruit of India, has been in cultivation for over 4000 years. There is large diversity for mango in the country due to its propagation by seeds. There are several instances wherein vast orchards of mango were established and maintained by the royal families. Akbar maintained Lakhibaag with a lakh of mango varieties. In the Peninsular region of India, there were several kings who maintained mango varieties. One such heritage orchard exists in Mandya district of Karnataka. The trees in the orchard date back to the era of Tipu Sultan, the emperor of the then Mysore province. This orchard has fruits of unique shapes, tastes and flavours. An attempt to characterize the germplasm was made so that the desirable traits of these unique types could be made use of in the breeding programme. Assessment of the genetic diversity in 38 genotypes along with the commercial varieties Alphonso and Raspuri was carried out using eight labelled primers (MiIHR17, MiIHR18, MiIHR23, MiIHR26, MiIHR30, MiIHR31, MiIHR34, MiIHR36). The results revealed that the genotypes could be grouped into three distinct clusters. Cluster II comprised of 17 genotypes along with Alphonso and Raspuri, whereas cluster I and III consisted of 14 and 7 genotypes, respectively. Genetic distance between cluster II and III was more than that between clusters II and I. The genetic diversity in these unique indigenous varieties is discussed.

## Physico-chemical and phytochemical changes in Malay apple (*Syzygium malaccense* (L.) during storage

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*Syzygium malaccense* (L.) Merr. & Perry commonly known as Malay apple or mountain apple is a native of Indo Malayan region and is an important tropical fruit crop belonging to the family Myrtaceae. The combination of trees, flowers and fruit in Malay apple has been praised as the most beautiful species of the Myrtaceae family. This fruit crop is well adapted in the tropical climatic condition of the Andaman and Nicobar Islands and these fruits are found in home gardens of the inhabitants. The fruits are a rich source of phytochemicals like flavonoids, phenolics and antioxidants. Besides this the fruit is used medicinally to treat diabetes, inflammation and act as antimicrobial agent. The fruits are harvested during August to December with minimum shelf life period. A study was conducted to analyze the physico-chemical and phytochemical changes of the fruits in the storage period at the ambient temperature and refrigerated temperature (4°C). The shelf life of the fruits extended up to 14 days at refrigerated storage condition whereas it was only 3 days in the room temperature. The biochemical changes like phenols, TSS, browning index, colour value, anthocyanin, ascorbic acid, antioxidant activity, titrable acidity, sugar acid ratio were assessed everyday during the above two storage treatments. The TSS and sugar acid ratio of the fruits increased during the storage period and it was found to be 7.5°B and 2.23, respectively on 10<sup>th</sup> day of storage. The antioxidant activity increased during the storage period and it was found to be highest in ABTS

method on 11<sup>th</sup> day (78.16%). The phenolic content and ascorbic acid content was highest on the 9<sup>th</sup> (42.7 mg/100 g sample) and 12<sup>th</sup> (5.88 mg/100 g of fresh fruit) day of storage at refrigerated temperature. The storage of the fruits in the room temperature showed that the phenolic content and the antioxidant content decreased during the storage period and a decrease in TSS and sugar acid ratio was also observed from the second day. Thus the shelf life of the matured harvested fruits is very less in Malay apple at room temperature and for maximum utilization of the phytochemicals of the fruit the fruits has to be consumed at a fresh stage immediately after harvest whereas in refrigerated storage condition the fruits are to be consumed within 10 days of storage period for maximum availability of phytochemicals.

NSBC- 2015- T01- AMCC – 20

### **Changes in the biochemical quality of processed products of aonla during storage**

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The experiment was undertaken at Jain Irrigation Systems Limited, Jalgaon, Maharashtra, to generate detailed information on changes in physico-chemical composition of different processed products of aonla during storage. Fully matured fruits of cultivar 'NA-7' were used to prepare the products viz., Individual Quick Frozen fruit (IQF), puree, juice, flakes and powder. The experiment was laid out in Completely Randomized Design (CRD) with five treatments and three replications. One kg of each product were taken from each replication and stored for three months. During storage, quality parameters were recorded at ten days interval. TSS content of processed products did not show any significant change during storage. The acidity per cent of all the products increased constantly throughout the storage period while considerable reduction in ascorbic acid content was observed during storage. The total and reducing sugar content of undehydrated products increased upto 40 days of storage and decreased thereafter till the end of storage period. But, the same have decreased continuously in dehydrated products right from the beginning. The non-reducing sugar content decreased continuously throughout the storage period in all the products. The phenol and tannin contents also showed a decreasing trend in all the products during storage.

NSBC- 2015-T01- AMCC – 21

### **Comparative analysis of nutrient composition and physicochemical properties of selected local and newly introduced rice varieties grown in Andaman Islands**

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Rice, a major commodity in world trade, provides 20 % of the world's dietary energy supply. The rice grain consists of 75-80 % starch, 12-14 % water and only 6-8 % protein with a full complement of amino acids. The nutritional value of rice varies with variety, soil fertility, fertilizer application and other environmental conditions. Andaman farmers are rice producers growing many varieties and prone to accepting any new varieties with seemingly better grain yield without considering their nutritional value. Therefore, there is need to assess the quality of new varieties being introduced into the state and compare them with the local varieties in order not to lose the already existing varieties which may be better than the new ones in overall merit. The rice cultivars were field-grown, processed, and analyzed for proximate and mineral composition. High percentage carbohydrate was found in all the genotypes (59.7-71.2 %). There is no significant difference in protein content of selected genotypes. Jaya had the least energy value of 286.69 J/kg, while CSR23 had the highest value (356.67 J/kg). Gayatri had the highest fat content (1.39 %), while Ranjit contained the least fat (0.73 %). Pagla Jaya had the highest percentage of



crude fibre (2.54 %), while CARI-5 had the least (1.14%) for crude fibre. In relation to mineral content, Jaya was highest in sodium (0.098 mg/100 g), Ranjit had the highest amount of calcium (0.09 mg/100 g), Pagla Jaya and white Swarna had the highest percentage of phosphorus (0.42 mg/100 g and 0.39 mg/100 g). One of the newly introduced paddy variety CSR23 had relatively mineral and energy content but had less fat content. Based on correlation analysis, Potassium, magnesium, manganese, copper and zinc may be independently selected for improvement of mineral content in rice grown in the Islands. Consumers and farmers should therefore be better informed on the choice of rice varieties based on their nutritional attributes.



## **NSBC 2015 - Track – I : BIODIVERSITY**

### **1.2. Contemporary approaches to genetic resources conservation and use**





## Database design and documentation of agricultural crop diversity conservation in Andhra Pradesh and Telangana

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Agriculture has to face two main challenges in relation with biodiversity to sustain agricultural biodiversity and ecosystem services provided by, and necessary for, agriculture, and mitigate the negative impacts of agricultural systems and practices on biodiversity which is not used directly whether in the same or other ecosystems. AP is one of the agro-climatically important states in the country with nearly 128 local communities engaging in the traditional cultivation practices. Based on monsoons and availability of water from man-made sources, farmers of Andhra Pradesh grow and maintain more number of crops including the plantations crops and maintain in three cropping seasons (*kharif*, *rabi* and summer). In AP the cultivated crop plant species caused in growth of 140 species belonging to 132 genera and 46 families. Species belonging to crop groups namely vegetables, fruits and commercial crops dominated the collection. Species richness was predominant in cultivated crops like Cereals 4 species, Millets 9 species, Pulses 10 species, Oil seeds 7 species, Narcotics 2 species, Spices 12 species, vegetable crops 31 species, Fruit crops 25 species, commercial crops 23 species and Leafy vegetables 12 species. Angiosperms. Of the 2601 angiosperms, 531 are tree taxa representing, 245 shrubs and 290 climbers. Of these dicotyledons comprise 1972 species and monocots 674 species. Andhra Pradesh is the traditional farmers or indigenous people have played an important role on preserving genetic variability. Traditional ecosystems, such as home gardens, are essentially in situ reservoirs of genetic diversity. A considerable proportion of the remaining natural habitats and biodiversity reserves are in indigenous lands. The traditional crops such as minor millets, coarse cereal grains are occupy less area of cultivation; productivity is also less compare to other crops. However, all the published information is in scattered form and accessing this information is difficult due to its present form in hard copy. A database been It contains description and basic set of information related to Agricultural crop diversity resources related information like such as phylum, class, tribe, order, common name, scientific name, habitat, distributions, telugu name, seed traits, and economic importance cultivable crops in AP and Telangana and collection of data on crops grown, source of irrigation, yield particulars, input use, cropping pattern, incidence of pests and diseases, employment pattern, constraints faced, etc. Database is designed by relational database method, front end in JSP and back end MS-SQL server created the tables using MS-SQL and the passport data sheet has been designed and database developed and also the crop species distribution in particular location and genetic diversity of crop map has been constructed using the help of GIS. It is concluded that which will be resource base for the end user viz. researcher, academician and policymakers.

## Carotenoids and anthocyanin composition in mango (*Mangifera indica* L.) fruit peel

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Wide colour variations are known to occur in peel of different mango varieties. These variations are mainly contributed by two major groups of compounds viz. carotenoids and anthocyanins. A study was conducted to assess the composition of fruit peel of mango cv. Ostin using liquid chromatography mass spectroscopy (LCMS). At ripe stage, the peel colour as evaluated by Royal Horticultural Society's colour chart was observed to be red. However, in earlier developmental stages, the presence of red purple blushes at shoulders and yellow green colour at beak and unexposed areas was observed. The peel was smooth, waxy and red coloured with purple blush. The peels from four random fruit areas were collected and used for analysis. Total carotenoids and anthocyanin contents

by spectrophotometer were 1.62 mg/100 g and 9.45 mg/100 g, respectively. These two groups of pigments were further analyzed for LCMS profiling. Seven carotenoids were characterized and  $\beta$ -carotene followed by esters of violaxanthin and cis  $\beta$ -carotene were the most abundant carotenoids. Twenty four anthocyanin compounds falling under six groups *viz.*, cyanidin, delphinidin, peonidin, petunidin, pelargonidin and malvidin were identified. Sugar bound compounds like peonidin-3-O-glucoside, cyanidin-3-O-monoglucoside, petunidin-3-O-acetylglucosides, delphinidin-3-O-(6-O-acetyl)-glucoside, petunidin-3-O-acetylglucoside, trans-peonidin-3-O-(6-O-p-coumaryl)-glucoside were observed to be the major anthocyanins in mango red peel. The reports on the profiling of these two pigments in peel are very limited as compared to pulp. Here we report the status of these two important pigments in red peel coloured cultivar.

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## Diversity of mushrooms in Indo-Bangladesh region of North-East India

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The North-Eastern region of India, comprising the states of Arunachal Pradesh, Assam, Meghalaya, Manipur, Tripura, Mizoram, Nagaland and Sikkim is geographically nested in one among the top 25 global biodiversity hotspots in the world. Indo-Bangladesh is an 'oriental region' providing a profusion of habitats, which features diverse biota with a high level of endemism. The region is an important sub-centre for the origin of mushrooms, the most important among the macro fungi. Many of these fungi are becoming extinct and facing threat of extinction because of climate change effects and habitat alteration. Therefore, studies on their taxonomy and diversity are gaining importance in the recent days which will help in mapping their baseline information and distribution patterns, needed for the assessment of changes in biological diversity. Mushrooms are not only important in the ecosystem dynamics but also in human diet and health. In this study, 25 major important wild mushrooms have been identified from this region which were Shiitake (*Lentinula edode*), Maitake (*Grifola frondosa*), Reishi (*Ganoderma lucidum*), Oyster mushroom (*Pleurotus ostreatus*), White button mushroom (*Agaricus bisporus*), Bearded tooth mushroom (*Hericium erinaceus*), Cordyceps (*Cordyceps sinensis*), King Stropharia (*Stropharia aeruginosa*), Turkey tail mushroom (*Trametes versicolor*), Almond mushroom (*Agaricus subrufescens*), Chaga mushroom (*Inonotus obliquus*), Winter mushroom (*Flammulina velutipes*), Birch polypore mushroom (*Piptoporus betulinus*), Blue chanterelle (*Polyozellus multiplex*), Cauliflower mushroom (*Sparassis crispa*), King oyster mushroom (*Pleurotus eryngii*), Pioppino mushroom (*Agrocybe aegerita*), Golden jelly fungus (*Tremella mesenterica*), Zhu-ling (*Polyporus umbellatus*), Cendawan budak sawan (*Amauroderma sp*), Cendawan tilinga kera (*Auricularia spp*), *Lentis spp*, Cendawan pengereng (*Microporus xanthopus*), Cendawan bering (*Pycnoporus sanguineus*) and *Xylaria polymorpha*. Species richness was higher in the rainy seasons (22 species) than in the early dry seasons (15 species) and tended to decrease with altitude, with 20 and 17 species for low and high altitudes, respectively. Shiitake was the most abundant species during the rainy seasons. Cauliflower mushroom was rare during the rainy seasons but most abundant during the dry seasons. Almond mushroom was recorded only in Meghalaya during the rainy seasons. The study established the fact that mushroom diversity in the Indo-Bangladesh Region is under serious threats of extinction and it needs conservation which may be achieved through cultivation, creation of national parks and forest reserve etc.

## Endemic insects of Bay Islands

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India, a mega-diverse country with 2.4 % in the world land area and accounts for 7-8% of all recorded animal and plant species in the world. It harbours almost all types of habitats including forest, grassland, desert, coastal, island and marine ecosystems. The understanding of endemic species in any of the geographical area is important not only in terms of conservation and management but also to characterise the particular bio-geographical region. The geographical areas with high richness of endemic species are very fragile and susceptible to any climatic changes and also the regions of active speciation, warranting the special protection for the conservation of its diversity. The long isolation of Andaman and Nicobar Islands from the Indian sub-continent has resulted in high endemism particularly in terrestrial faunal elements. Due to the sea barrier, the distribution of fauna in these islands varies from island to island. Some species are restricted to certain areas in Andaman's, some to Nicobar, while others are common to both the group of islands. Sometimes, a species is even confined to a particular island. These islands with 0.25% of the geographical area of India harbour about 3.9 % of all known species (63,760) of insects in the country. Presently, 2,506 species of 1,552 genera under 20 orders of insects have been recorded from these islands. Altogether 2,138 and 674 species of insects are known from Andaman and Nicobar group of islands, respectively. Out of 2,506 species, 599 species/subspecies (24%) are known to be endemic to these islands. At species level endemism is being recorded highest, in Trichoptera (70.8 %) and least in Blattaria (6.6%), while in sub-species level, more than 70% endemism is recorded among the butterflies. The study indicates that the number of endemic species / subspecies may increase if the molecular taxonomy is also supplemented in case of doubtful and sibling species.

## Growth, yield attributing parameters and seed quality of summer mungbean (*Vigna radiata* L) as influenced by dates of sowing, spacing and fertilizer with seed treatment under North Indian conditions

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Mungbean (*Vigna radiata* L) is a popular pulse crop of India because it is a rich source of carbohydrates (60 %), protein (24 %), fat (1.5 %), vitamins, minerals and amino acids etc. Mungbean is a legume crop and hence, improve the soil fertility by atmospheric nitrogen fixation. Date of sowing, spacing, fertilizer and seed treatment appear to be the most considerable parameters for realizing the growth, yield and seed quality parameters. In summer cultivation when temperature is high, relative humidity is low and evapo-transpiration is greater, the 3 to 4 irrigations may be needed to obtain higher yields of summer mungbean. Therefore, present investigation was undertaken to determine the date of sowing, spacing, fertilizer and seed treatment with *Rhizobium* & PSB for obtaining higher seed yield and quality of summer mungbean. The experiment was carried out at the ICAR-DSR, Mau during the period from March to June, 2014. The treatments were laid out in split plot design (SPD) with three date of sowing as main treatments; two spacing as sub treatments and six combinations of fertilizer and seed treatment as sub-sub treatments with the variety SML 668 with 3 replications. Growth parameters *viz.*, plant height 30, 60 DAS, first & final picking (25.77, 44.09, 47.67, 54.67 cm respectively), days to first (64.17) & final (74.31) picking, number of pods / plant at first (18.88) & final (27.21) were influenced significantly by date of sowing. Sowing of mungbean on 30 March gave significantly higher values for all the growth parameters as compared to 15 April and 30 April sowing. Wider spacing (30 x10 cm) was significantly superior over 20 x10 cm spacing for plant height 30 & 60 DAS (24.1 & 41.5), days to first (66.15) & final (74.3) picking, number of pods /

plant (18.41 & 26.75). The recommended dose of fertilizer as a basal (RDF) + seed treated with *Rhizobium* and PSB + Borax spray (100 ppm) at flower initiation recorded significantly higher plant height 30, 60 DAS, first & final picking (25.3, 42.6, 46.8, 52.1 cm), days to first (67.0) & final (75.67) picking, number of pods / plant at first (19.85) & final (28.18). Similarly, dates of sowing significantly affected yield & yield attributing traits viz., pod length (8.41cm), number of seeds /pod (8.78), test weight (43.69 g), seed (12.14 q/ha) stover (20.79 q/ha) and biological yield (32.95 q/ha). However, harvest index was not found to be significantly affected by date of sowing. Above parameters were significantly higher in March 30 sowing, than sowing on 15 April and 30 April. The 30 x 10 cm spacing was significantly superior over 20 x 10 cm spacing for all the observed traits viz., pod length (8.14 cm), number of seeds /pod (8.48), test weight (42.55 g), seed (11.44 q/ha) stover (20.05 q/ha) and biological yield (31.51 q/ha). The recommended dose of fertilizer as a basal + seed treated with *Rhizobium* and PSB + Borax spray (100 ppm) at flower initiation was found to be significant superior for all the observed traits viz., pod length (8.92 cm), number of seeds /pod (9.06), test weight (43.41g), seed yield g/plant (23.72g), seed yield (12.99 q/ha) stover yield (22.38 q/ha) biological yield (35.39 q/ha). Highest germination (93.69%), root length (22.23 cm), shoot length (23.86 cm) seedling length (42.09 cm), seedling dry weight (0.278 g), vigour index I (3949.7) and vigour index II (26.24) were obtained under sowing on March 30. The 30 x 10 cm spacing recorded significantly higher values for traits viz., germination (92.41 %), root (21.46 cm), shoot (23.08 cm) seedling length (40.83 cm), seedling dry weight (0.264 g), vigour index-I (3782.7) and vigour index-II (24.62). The RDF + *Rhizobium* and PSB seed treatment + borax spray (100 ppm) registered significantly superior seed quality parameters viz., germination (93.94 %), root (22.28 cm), shoot (23.74 cm) seedling length (42.13 cm), seedling dry weight (0.268 g), vigour index I (3946.2) and vigour index II (25.25). Hence, early sowing at 30<sup>th</sup> March with spacing 30 x 10 cm and RDF + *Rhizobium* and PSB seed treatment + borax spray (100 ppm) may be recommended to farmers of Eastern U.P. for realizing higher seed yield and seed quality parameters.

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## **An overview of fruit biodiversity in Himachal Pradesh with particular reference to temperate fruits**

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Himachal Pradesh nested in the lap of North Western Himalayas is endowed with varied agro-climatic conditions ranging from sub-tropical to humid temperate and cold desert. The elevation ranges from 350 to 6000 m above mean sea level. Because of this variation a wide range of fruit crops (32) are cultivated in the state which ranges from sub tropical climate (mango, citrus) to humid temperate (apple, pear) and cold desert (pistachio, Hazelnut). Besides, more than 20 types of wild fruits also exist in the state. As a consequence, Himachal Pradesh has emerged as an important fruit growing state on the horticulture map of the country. There has been a rapid increase in the area and production of temperate fruits with a major share under apple accounting for 48 per cent (1.06 lakh ha) of the total area under fruits and 75 per cent (4.1 lakh tonnes) of the total fruit production. Today, the state has acquired the prestigious status of apple state of the country and is all set to be the fruit bowl of India. How the cultivated area has been transformed from cereal based farming to fruit based orcharding system with a particular mention of apple and its varieties has been reported in this paper. No doubt, there has been a tremendous increase in the area and production of fruits in the state after the independence era but the productivity still remains very low compared to developed countries. The situation has further been aggravated by the threat of climate change. The effects of climate change are already beginning to appear in Himachal Pradesh as is evident from the fact that farmers in Kullu district have shifted from apple to vegetables and pomegranate cultivation.



Likewise the mid hills of Shimla district have become marginal for apple cultivation and there has been a shift in the area of production to higher elevations which is corroborated by a declining trend in snowfall over the years. At the same time, threat of climate change could be converted into opportunity e.g. it is now possible to grow Avocados successfully under the mid hills of Himachal Pradesh. To address the adverse effect of climate change on productivity and quality of temperate fruits, efforts should be intensified to identify fruit varieties suitable to different ecological regions under the changing climate. Some of the underutilized and lesser known fruits that exist in the wild are also discussed.

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### **Genetic variation among Karnal bunt (*Tilletia indica*) isolates collected from Jammu and Kashmir using molecular tools**

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Karnal bunt disease of wheat, caused by fungus *Tilletia indica* (syn. *Neovossia indica*) is an important disease in NorthWestern Plain Zone of India. Besides India, the disease was also known to occur in several tropical and sub tropical areas of the world including Nepal, Pakistan, Mexico, North-Western Europe and USA. All the disease management strategies based on host resistance require the knowledge of variability in pathogens. DNA was isolated from fresh mycelia of twelve *T. indica* isolates by using CTAB method. The RAPD was performed with 10-mer oligonucleotide primers of Operon Technologies; Alameda, California, for studying the polymorphism among different isolates. The assays was repeated thrice with each primer. Screening of six 10-mer oligonucleotide primers (OPAD 3, OPAC 12, OPAC 17, OPAA 11, OPAD 19 and OPV 14) revealed 2 RAPD primers (OPAD 19 and OPV 14) to yield informative (polymorph), strong and reproducible DNA amplicons (bands) of *T. indica* isolates by PCR. The level of polymorphism was different with different primers among different isolates. Primer OPAD 19 resulted into same fingerprint among five isolates while isolates from other places showed different banding pattern. Present study revealed genetic variation among *T. indica* isolates of Jammu & Kashmir collected from different places which could lead to improved strategies for controlling the disease.

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### **Genetic diversity, germplasm collection and conservation of Rubber**

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Para rubber tree is the most important source of natural rubber (NR) and meets around 98% of global requirement. The economic product from rubber tree is latex, a specialized cytoplasm is contained in a laticiferous system in bark differentiated by activity of vascular cambium. Spectrum of *Hevea* germplasm can be broadly classified into (a) Wild types from primary center of diversity in Brazil (b) Cultivars developed in centers of secondary diversity (South East Asian countries). The famous 'Wickham collection' of rubber formed the base for the development of entire rubber plantations in the East. In 1876, Wickham collected 70,000 seeds of *H. brasiliensis* of which 2,700 of these seedlings survived in a journey from S. America to London were raised at the Royal Botanic

Gardens, Kew, England. A few of them were dispatched to Sri Lanka to Malaysia, Singapore and Indonesia. The Royal Botanic Gardens in Colombo became a major source of rubber seeds for domestic use and export. India received a major share of Malaysian and Ivory Coast germplasm centres which had varying proportions of wild germplasm. In 1981, International Rubber Research and Development Board (IRRDB) germplasm conserved in source bush nurseries/gene pool gardens in Rubber Research Institutes of the different IRRDB member countries. In India, currently a total of 4,548 accessions including 90 ortet clones received from Malaysian center were established in traditional and non-traditional areas. In conservation nurseries, each accession is represented by 5-10 plants in 1×1 m. spacing, along with selected popular Wickham clones as controls. Major characterization effort is done at juvenile phase of growth for a set of easily identifiable and highly heritable characters like tree growth habit, leaf whorl characters like leaf whorl shape, size, separation etc. and leaf characters like leaf colour, size, shape, texture, leaf lamina surface and leaf margin.

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### **Harnessing existing diversity in newly collected pigeonpea germplasm of Chhattisgarh origin**

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Pigeonpea [*Cajanus cajan* (L.) Millsp] is the major pulse crop of India after chickpea which contributes significantly to nourishment of a sizeable population. It belongs to the family of 'Fabaceae' and is also known as 'Arhar' or 'Tur', generally used in preparing *dal* which is rich in protein and minerals and eaten by majority of Indian population. It is an important legume of the tropics and subtropics because of multifarious uses viz., source of food, fodder and fuel wood; material for fencing, for soil improvement through N fixation and wind barriers. It is the fourth most important pulse crop in the world where in, India alone accounts for 85 per cent of the world supply. It is grown as a field crop as well as backyard crop in more than 80 countries. Pigeonpea is cultivated throughout tropical, sub-tropical and in the warm temperate regions. On the basis of wide range of diversity present in India, pigeonpeas considered to be of Indian origin. Later on, De (1974) and Van der Maesen (1990) on the basis of abundance of *Cajanus cajan* and its wild relatives in the evergreen forest area of Western Ghat and Malabar Coast of India concluded its origin in India and reported that with the migration of Indian population, it spread over to other parts of the world. In the state of Chhattisgarh, pigeonpea is being cultivated in all the three agro climatic zones viz. Northern Hills, Chhattisgarh Plains and Baster Plateau. A wide range of diversity in the crop is found throughout the state. Tribal farmers of the state are cultivating local landraces which are heterogeneous in composition because of its often cross-pollinated nature. An effort to collect its diversity from four districts of Northern Hills of Chhattisgarh was made during 2014 with involvement of the KVK personnel of the target districts viz. Balrampur, Surguja, Koriya and Jashpur. A total of 163 landraces were collected from 39 tribal dominating villages of the region. These collected landraces along with previously collected 23 accessions of Chhattisgarh Plains and 37 accessions of Bastar plateau origin were evaluated in augmented design with two checks viz. ICPL 87119 and Rajeevlochan for different yield attributes during *khari* 2014-15 at IGKV, Raipur. Because of the climate change, many new collections suffered in the process of acclimatization. Results of the evaluation revealed that a wide range of variability has been observed for all the traits. The earliest maturity of 146 days was observed in accession RP-102 of Surguja district of Northern Hills. In the process of harnessing the existing variability, 24 SPS were made considering each landrace as genetically heterogeneous bulk. Within 24 SPS, the highest yield (100 g/plant) was obtained from SPS made from accession RP-168 of Chhattisgarh Plains origin whereas, maximum number of pods (245) was recorded in the SPS made from accession RP-124 of Koriya district of Northern Hills. Hence, these selected single plants may be used in breeding programme for the development of high yielding pigeonpea varieties.

## A Review on *Trikatu* an Ayurvedic formulation with special reference to Andaman & Nicobar Islands

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The *Trikatu* is a unique combination of three plant origin materials *Piper longum* L., *Piper nigrum* L. and *Zingiber officinale* Rosc., having *Katu* (pungent) rasa predominance. It is also known as Triushan or katutrik. It is not only used in cooking but also used as one of the most key component in many Ayurvedic preparation used in major ailments. Chemical constituents and medicinal properties of these three drugs along with some Ayurvedic formulations are also discussed here with to have comprehensive information on it. The present paper deals with the review of major scientific information viz. morphology, action / uses, chemical constituents and Ayurvedic formulation etc. on *Trikatu* with special reference to Andaman and Nicobar Islands.

## Exploitation of grasspea (*Lathyrus sativus* L.) PGR in crop improvement at IGKV : A case view

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The genus *Lathyrus* has great diversity having 187 species and sub-species. It is widely distributed in southern and south central Europe, eastern Ethiopia, South America and Central Asia. Grasspea yet remains neglected on account of its neurotoxin compound  $\beta$ -N-oxalyl L- $\alpha$ - $\beta$  Diaminopropionic acid (ODAP). Continuous research efforts are being made to develop varieties with high and low ODAP content. As a result two-varieties viz. Mahateora (Bio L 212 x JRL 2) and Prateek (LS 8246-x a-60) having high yield and low ODAP content have been evolved at IGKV. Continuous efforts are being made for developing low/zero ODAP content, high yield, high protein and resistance against biotic and abiotic stresses varieties utilizing available genetic diversity in this university. Despite of this, other crops are regularly replacing *Lathyrus sativus* causing severe genetic erosion. Keeping in view, a large number (2000 approx) of land races were collected from different regions of Madhya Pradesh now in Chhattisgarh during 1975 to date are being maintained, Characterized for 63 descriptors and published a catalogue on grasspea by IGKV during 1995 and 2008 (Pandey *et al.* 1995 and Pandey *et al.* 2008). Only 7 accessions have ODAP content less than 0.1 per cent. Similarly, superior accessions for earliness (<100 days) were found only 10; for higher number of pods per plant (>70 pods) 25; for bold seed (>10 g per 100 seeds) only 10 and for higher seed yield per plant (>10 g) were 32 accessions. The information generated are being utilized by many research partners under national gene bank system. Some of the notable achievements made by this university is summarized bellow:

**Elite Genetic Resources(36 acc.)** : Characterization and evaluation data revealed that, most of the local cultivars had medium to high ODAP content.

Low ODAP	:	a-60, a-26a, a-84, Sel. LS 8246-1, LS 8456, Ratan.
Thrips tolerance	:	JRL-41, RLK 174-1, RLS-1, RLS-2, RLK-1433, RLK 199-2, RLK 97-3.
Flower colour	:	Dark purple - RLK 174-2

	Pink	- JRL-13, RLK 1433, RLK 1310
	White wings, keel blue	- Sel. LS 8246-2
Late maturity	:	Sel. LS 8246-1
Green seed	:	RLK 195-1, RLK 199-2.

*Developing high yielding and low ODAP lines:* To transfer low ODAP genes into white and pink flower colour back grounds, crosses are being attempted regularly and single plants progenies analyzed for ODAP content. In a cross among RW 14 x BioL212 (white x blue) 10 F<sub>3</sub> progenies 9 white and 1 blue flowered were selected for advancement ODAP ranging 0.071 to 0.099 per cent. Similarly In a cross of BioL-212 X JRL-2 (Blue x Pink) total 31F<sub>3</sub> progenies selected of which 19 were pink and 12 blue flowered selected on the basis of low ODAP ranging 0.072 to 0.094 percent.

*Developing high yield, High protein and low ODAP lines :* Two progenies namely LS 185-11-5 and LS 155-6-4 have low ODAP and high protein as comparable to BioL 212.

*Combining Ability and heterosis for yield and ODAP :* Investigation was also conducted to estimate combining ability among varieties and low ODAP accessions. The study was also aimed to know the extent of heterosis among 10 parents and 45 F<sub>1</sub>'s evaluated during *rabi*, 2012-2013. The study showed high range of variability for all the characters along with highest GCV for number of seeds plant<sup>-1</sup> followed by harvest index and biological yield plant<sup>-1</sup> and high PCV recorded for the traits number of seeds plant<sup>-1</sup> followed by harvest index and biological yield plant<sup>-1</sup> indicated the role of both the genotypic and environmental influence for expression of these characters. Similarly, the highest amount of heritability coupled with genetic advance over percentage of mean was observed for number of seeds plant<sup>-1</sup> followed by biological yield plant<sup>-1</sup>, harvest index and seed protein content indicated additive gene effects for their expression.

Heterosis was significant and positive for most of the characters, which revealed that, its utilization in the crossing programme to isolate better segregates however, hybrid breeding in grasspea is presently not in practice due to lack of sterility system. The crosses AKL-16 x Bio-L-203 and AKL-19 x Bio-L-203 observed with positive heterosis for seed yield and negative heterosis for seed ODAP content and Mahateora x Pusa-24 for days to maturity indicating scope for its utilization for evolving low ODAP containing and early maturing plant types. The parent Mahateora noted to be good general combiners for the traits seed yield, ODAP content and protein content. The cross Shiraha Local x WBK-12-2, WBK-12-2 x AKL-16 and Mahateora x Bio-L-203 proves the best specific combination for early maturity, AKL-16 x Bio-L-203, Nirmal x Pusa-24, Mahateora x Ratan, Mahateora x Nirmal and Nirmal x WBK-12-2 proves the best specific combination for seed yield plant<sup>-1</sup>, Pusa-24 x WBK-12-2 proves the best specific combination for low ODAP content.

*Use of ISSR markers for divergence studies and shorting duplicates:*

Genetic divergence of 48 genotypes was estimated and classified into six distinct clusters advising Shiraha Local, AKL-16, AKL-19, Ratan, Pusa-24, Bio-L-203, Prateek, Nirmal, WBK-12-2 could be utilized as parent in future breeding programme to get better recombinants. The genetic diversity at molecular level in 48 genotypes of grasspea using 24 ISSR markers showed RLK 466 and RLK 637 are most similar with similarity coefficient of 0.92 and genotypes Bio-L-203 and RLK-120 are least similar with similarity coefficient of 0.63. So, these genotypes should be further used in breeding programme for developing better varieties.



## Clonal diversity in Banana varieties for bract anthocyanin content

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Growing concern about synthetic colourants in the processed products has necessitated the search for natural alternatives. Anthocyanins are one of the important groups of compounds, which are responsible for imparting attractive colours in the plant parts. Being water soluble and known to possess antioxidant properties, anthocyanins are one of the choicest natural colourants. Further, they offer wide range of colour spectra which could be used for colouring various products. The bracts of banana are rich in anthocyanins, which could be used for extraction of pigments for use in food industry. Present study aimed at screening the clones of two banana varieties for identification of anthocyanins rich types. Twenty-four clones of Elakki Bale and nine clones of Nanjanagud Rasabale were used for the analysis. The male inflorescences after denavelling were used for determining their anthocyanin content. All the bracts were separated out, and the innermost, middle and outermost bracts were used for analysis. Isolated tissues were extracted using acidified methanol and centrifuged to obtain the supernatant. The absorbance was determined using UV visible spectrophotometer and the quantification was done for the samples. Results revealed significant variations amongst the clones and varieties tested. Lines rich in anthocyanins were identified, which could be used for commercial scale cultivation for extraction of anthocyanins in food industry.

## Biodiversity of Coastal areas of Nicobar Islands: *Canavalia rosea* (Sw.) DC

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*Canavalia rosea* (Sw.) DC is a species of flowering plant of the genus *Canavalia* in the pea family, *Fabaceae*, which has commonly known as Beach Bean, Bay Bean, Seaside Jackbean, Coastal Jackbean and MacKenzie Bean. *Canavalia* is a creeping legume plant, which grows on the beaches and fore dunes of coastal areas of Nicobar group of Islands. It has high tolerance to salt spray, burial, low-nutrient substrates, and high temperature. *Canavalia* is a perennial trailing, herbaceous vine, leaves are compound and the leaflets are roughly circular in shape, with an entire margin and a short petiole. The leaflets close under the hot sun at midday, which reduces evapotranspiration. New leaves are produced at the beginning of the rainy season. The flowers are small, pink-purple in racemes. Blooming occurs with high intensity between September to May, although sporadic racemes can be found throughout the year. The pods are produced at the end of the rainy period. Fruits are large & flat, 7-12 cm long and 2.3-2.6 cm wide, with marbled brown dormant seeds. They are prominently ridged and woody when mature and usually contain 4-6 seeds per pod. Mean seed weight varies from 0.5 to 0.65 g and mean seed length is 1.4 cm. The root is monopodic and presents a mycorrhizal association. The species is an important sand colonizer and plays a significant role in the geomorphology of beaches and frontal dunes. The species often covers large areas and forms a relatively continuous mat that stabilizes the sandy substrate in which it grows. The long stolons creep over the sand and cover large areas, forming a continuous mat of vegetation. These plants are commonly used to prevent soil erosion because the dense cover decreases the impact of storm surges; the roots bind the substrate together and prevent sand from shifting. Different parts of *Canavalia* plant have diverse medicinal properties, and their use may provide health benefits for coastal inhabitants. The Nicobarese use *Canavalia* plant leaf and shoot decoction to relieve pain, promote healing of burns, stop bleeding while the roots have been used for the treatment of aches and pains. This information could be provides a useful basis for people fascinated in conducting research on *Canavalia rosea* (Sw.) DC as well as suggesting new avenues of research.

## ***Coscinium fenestratum*, a critically endangered medicinal species: Ethno-botany, uses, conservation and multiplication**

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*Coscinium fenestratum* (Gaertn.) Colebr. is an important medicinal plant belonging to the family Menispermaceae. It is a dioecious, large woody climber with cylindrical with yellowish stem, commonly called as 'Daru-haridra' in Sanskrit. It is commonly found in high rainfall wet evergreen forests of Western Ghats of India and Sri Lanka. IUCN, Switzerland, categorized the status of *C. fenestratum* as endangered in India, vulnerable in Vietnam, rare in Singapore and indeterminate in Sri Lanka. The Foundation for Revitalization of Local Health Traditions (FRLHT), Bangalore, India while assessing the threat status of medicinal plants, classified this under rare, endangered and threatened (RET) species especially, critically endangered species. Woody stem contains an alkaloid Berberine, which is used for treating bleeding piles, cough, wounds, ulcers, skin diseases, abdominal disorders, jaundice, liver disorders, intrinsic haemorrhage, diabetes, snake bite, intermittent fever and traditionally for treating eye infections to get soothing effect. The yellow dye obtained from the heart wood has been used in traditional fabric dyeing. The plant regenerates from stumps of old plants and also through seeds, but the rate of regeneration is found to be extremely low. Seeds have a dormancy period of six months and about 200 days were taken for 90% germination. It is a slow growing plant and due to massive demand in crude drug market, the woody stem of this plant is being over-exploited from the wild sources. Hence an attempt has been made to review the literature on its botany, utility, multiplication and conservation of the species. This may create awareness for the multiplication and conservation of this critically endangered medicinal species by reducing its dependency on forest reserve.

## **Diversity of tree borne oil seeds in Andaman and Nicobar Islands**

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Andaman and Nicobar Islands predominantly depend on fossil fuel for power generation and every day about 250 kiloliters of diesel is used. In recent years, efforts are being made to explore eco friendly plant based fuel sources as a supplement or substitute of fossil fuel. Biofuels are renewable and environmentally safe that can substitute at least 10% of the current requirement of the fossil fuels in this island. Nearly 2,100 species of indigenous and exotic angiosperms have reported from these islands, of which 11% are endemic. A study was undertaken on the diversity of Tree Borne Oil seeds (TBOs) of Andaman and Nicobar Islands to utilize the potential. It was observed that Andaman and Nicobar Islands have wide diversity of TBOs with high oil content. The results revealed that *Jatropha* is one of the most important species which are widely distributed with varying amount of oil viz., *J. curcas* (37%), *J. gossypifolia* (40%), *J. podagrica* (35%), *J. multifida* (33%) and *J. glandulifera* (26%). Maximum diversity was observed in *J. curcas* which is the predominant species followed by *J. gossypifolia*, *J. podagrica* and *J. multifida*. All of them are mostly prevalent in forest areas except *J. multifida* which is available in homegardens as an ornamental plant. Apart from this, *Aphanomixis polystachya* (38%), *Buchananania splendens* (54%), *Calophyllum inophyllum* (51%), *Manilkara zapota* (39%), *Pongamia pinnata* (36%), *Sapium baccatum* (49%) and *Simaruba glauca* (53%) were other potential oil yielding TBOs. In Nicobar group of Islands *Calophyllum soulattri* (49%) was identified as a potential TBO which are traditionally used by the tribals. This tree species can also be grown along the farm boundaries and waste lands. From this study it was concluded that Andaman and Nicobar group of Islands having wide diversity of TBOs which has utilized for future bio-diesel based electricity production besides the conservation of the TBOs in this fragile ecosystem.

## **New high yielding and disease resistant medium duration rice varieties for Andaman and Nicobar Islands**

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Rice is the principal crop of Andaman and Nicobar Islands, which is grown annually on about 8390 hectares of land and producing over 23916 tonnes of paddy with a productivity of 2.85 t/ha. However, the rice demand of A & N Islands is around 60,000 tons per annum. Medium duration rice varieties are required to facilitate timely vacation of rice fields for sowing of post rice crops like vegetables and pulses in the Bay Islands. Selection in medium duration material originally from IRRI, Philippines led to introduction of medium duration, high yielding, good grain quality and disease resistant lines like IR 78581-12-32-2 (CARI Dhan 6) and IR 75417-R-R-R-R-267-3 (CARI Dhan 7). The highest average grain yielded (t/ha) over the years and locations was recorded by CARI Dhan 6 (4.04) which was 12 % higher over the best check variety CARI Dhan 3. It was followed by CARI Dhan 7 (4.74 t/ha) thus showing yield advantage of 16 % over the best check. CARI Dhan 6 has long slender grains and CARI Dhan 7 has medium slender grains. These varieties have also high milling percentage and head rice recovery. These varieties possess resistance against bacterial leaf blight disease and are also preferred by the farmers of Andaman and Nicobar Islands.

## **High yielding antioxidant rich varieties of Noni (*Morinda citrifolia* L.) for livelihood and health improvement in tropical islands**

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Noni (*Morinda citrifolia* L.) is a recent domesticated medicinal cum contingency food crop in tropical islands. More than 200 bioactive compounds have been reported and lot of industries are using this fruit in preparing various herbal and cosmetic products. But, efforts were needed for genetic improvement for higher yield, regular bearing, higher recovery of juice or pulp fraction, antioxidant richness, adaptation to challenged conditions and suitable genotypes to grow in different crop situations. The present paper highlights the significant outcomes of systematic breeding efforts on Noni at ICAR-Central Island Agricultural Research Institute, Port Blair from 2008-2014. This breeding programme led to develop first time four varieties of Noni which were released as CIARI Samridhi, CIARI Sanjivini, CIARI Sampada and CIARI Rakshak by Institute Variety Release Committee (IVRC) of ICAR-CIARI, Port Blair in 2014. The CIARI Samridhi is a dwarf statured selection having small fruits (63.1 g) and heavy and above bearer. Fruits maturity takes around 100-105 days from bud formation to fruit maturity. Juice recovery is high and fruits are rich in micronutrients and phytochemicals. Its seeds contain high amount of fatty acids. It is resistance to disease and pests, suitable for intercropping in coconut and arecanut and for high density planting. The fruit yield ranges from 16.0 to 20.0 t/ha/year. The CIARI Sampada is a selection from local germplasm for medium and uniform size fruits with above bearing character. It has high recovery of fruit pulp and fruits are rich in phytochemical compounds. It also fit well in intercropping system. Fruit weight ranges from 160 to 200 g, fruit yield from 15.0 to 17.0 t/ha/year. The fruit maturity takes place around 110 to 120 days after fruit



bud formation. The CIARI Sanjivini is a semi dwarf selection from local germplasm of *Noni*. It has medium small fruits (69.5 g) with round the year above bearer capacity. Fruit maturity takes around 100-105 days after fruit bud formation and fruit yield ranges from 14 to 17 t/ha/year. The variety is rich in phytochemicals, micronutrients and fatty acids. It is resistant to disease and pests. It is suitable for intercropping and open cultivation in tropical conditions. The programme also resulted in development of CIARI Rakshak germplasm collected from sea-shore areas in the islands. It grows well in sea water or salinity affected lands in tropical region. It has dwarf stature (1.7-2.0 cm) and small size fruits (67.9 g). Fruits are relatively rich in phytochemicals and do not carry high content of sea salts. Though, the fruit yield is relatively low (7.0-9.0 t/ha) but it has potential in economic restoration of sea water affected lands.

NSBC- 2015- T01- CAGR – 18

### **Differential response of ney poovan banana (*Musa ab*) cultures to carbon sources and their concentrations during proliferation, and concurrent *ex vitro* rooting and hardening**

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The mixed diploid bananas are known for their exceptionally superior quality attributes, besides their hardy nature. Though tissue culture has revolutionized the commercial propagation of bananas, these types have been the least studied ones. The area expansion largely depends on the conventional planting material (suckers), which could spread the devastating *Fusarium* wilt disease in new areas. Present is an attempt to optimize the kind and concentration of carbon source for culture multiplication and to study its effect on subsequent concurrent *ex vitro* rooting and hardening (CEVRH). Among the four carbon sources tested, mannitol was least suitable as the cultures grown on it exhibited no growth. Sucrose at 3% concentration promoted shoot multiplication, whereas better *ex vitro* root induction and hardening performance was exhibited by the shoots obtained from glucose (2%) supplemented medium. Hence, it could be advocated that change of carbon source in the multiplication medium from sucrose to glucose just prior to rooting could improve the *ex vitro* performance of the plantlets. This is apparently the first report describing the practical approach of CEVRH for reduction in production cost of the plantlets in banana. Further, it could be a boon for the varieties showing poor multiplication rate resulting in high cost of production.

## Development of nectar from Pummelo (*Citrus grandis*), an underutilized fruit crop, by blending with kokum (*Garcinia indica*) and mango ginger (*Curcuma amada*)

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The present study concerned standardization of the recipe for preparation of blended nectar from a Geographical Indication tagged ecotype 'Devanahalli Pink Fleshed' of an underutilized fruit, pummelo. Pummelo fruit juice was blended with mango ginger and kokum juices in the ratio of 65:30:5 (v:v:v) and diluted in different proportions by adjusting Total Soluble Solids (TSS) to 15 °B, 17 °B and 19 °B. Sodium benzoate was used as preservative. The product could be successfully stored for four months at room temperature. During storage, total soluble sugar, total sugars and pH increased, while titratable acidity and ascorbic acid decreased. Overall acceptability scores of the product showed that 20 % blended juice, 19 °B TSS and 0.3% acidity was the best recipe which was rated 6.5 on a 7-point hedonic scale. Product had a fair amount of ascorbic acid (5.29 mg/100 ml) and low total sugar content (11.61 %).

## Micronutrients and antioxidants in leaf and stem parts of Indian spinach variants

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Indian spinach (*Basella alba* L. and *B. rubra* L.) is a common leafy vegetable in tropical regions and have three natural variants i.e., green, red and intermediate. The present study revealed significant ( $p < 0.05$ ) differences between these three types for micronutrients, phytochemicals and antioxidant activity contents in leaf and stem portions. The leaf of red type had highest ascorbic acid ( $138.0 \pm 1.7$  mg/100 g) and anthocyanin ( $280.0 \pm 2.0$  mg/100 g), green type was rich in chlorophyll ( $41.6 \pm 0.9$  mg/100 g) while intermediate type in flavonoids ( $459.0 \pm 3.2$  mg/100g). The RP-HPLC of their leaf samples identified variation in kind of compounds in carotenoids (lutein, zeaxanthin,  $\beta$ -cryptoxanthin,  $\alpha$ -carotene and  $\beta$ -carotene), phenolics (caffeic acid, chlorogenic acid, ellagic acid, sinapic acid and naringin) and anthocyanin (petunidin, cyandin, petunidin, pelargonidin, peonidin and malvidin). The correlation studies showed a strong positive correlation between DPPH and ABTS activities and carotenoids ( $r = 0.70$ ;  $r = 0.64$ ,  $p < 0.05$ ), chlorophyll ( $r = 0.78$ ,  $r = 0.84$ ,  $p < 0.05$ ) and ascorbic acid ( $r = 0.31$ ,  $r = 0.36$ ,  $p < 0.05$ ). The information highlights nutritive potential of Indian spinach of three types and indicates their health benefits.

## Evaluation of pulse cultivation and resource optimization under coconut plantation

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India is the largest producer, consumer and importer of pulses in the world. India accounts for about 33 per cent of world area and about 22 per cent of world production. The production of pulses in A & N islands is 1155 t/year as against the requirement of 6200 t/year due to lesser area (2610 ha) and low productivity (571 kg/ha). Out of 50,000 ha of cultivated land, 21768 ha is under coconut plantation. In coconut plantation, 76 % of land is lying vacant which may be utilized for pulse cultivation. Under this context, a field trial was conducted at Sippighat research farm of CIARI during 2013 - 2014 to evaluate the feasibility of pulse cultivation under coconut plantation. The trial was laid out in split plot design by assigning varieties/lines of pulse crops (red gram, green and black gram) in main plots and plant spacing in subplots with 2 replications. The soil was sandy loam with pH 5.1, E.C 0.3 dSm<sup>-1</sup>, very low in soil available N, P and K. The red gram was sown in August 2013 and harvested in March 2013. Green and black gram were sown in January 2014 and harvested in March 2014. The results of the experiment revealed that all the varieties/lines of red gram, green and black gram grown under hilly coconut plantation registered low yield. Among the redgram varieties, Co-6 recorded higher number of pods per plant (89 nos), seed weight/plant (22.31 g/plant) and seed yield (544 kg/ha) and was at par with ANP-12-02. Among the spacing adopted, 75×45 cm recorded higher number of pods/ plant (71 nos), seed weight/ plant (18 g/plant) and seed yield (520 kg/ha). Among the mung bean varieties/lines, ANM-11-12 recorded number of pods/plant (6.29 nos), seed weight/ plant (1.86 g/plant) and higher seed yield (400 kg/ha) and was at par with VBN 3. The spacing 25×10 cm recorded higher seed yield (419 kg/ha) due to higher plant population. Among black gram varieties/cultivars, AN-11-19 recorded higher yield (354 kg/ha) which was on par with VBN 6 (330 kg/ha). The spacing 25×10 cm recorded higher seed yield (379 kg/ha). The yield of red gram, green gram and black gram recorded under coconut plantation is 40-60 % lesser than the yield achieved in sole crop situation. Though the yield level of pulses under coconut plantation is low, there is a huge scope to increase the pulse production in Andaman through area expansion. The red gram variety (Co-6) with 75 x45 cm spacing, green gram (ANM-11-12) and black gram (AN-11-19) with 25 x10 cm spacing recorded comparatively higher yield under coconut plantation which can be recommended to the farmers.

## Isolation, purification and characterization of peroxidase from monocot cereals

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Five cereals viz. *Zea mays* (Maize), *Finger millet* (Ragi), *Oryza sativa* (Asian rice), *Pearl millet* (Sajje) and *Triticum aestivum* (wheat) were used to get the crude extract of peroxidases (EC. 1.11.1.7), an oxidoreductase, whose primary function is to oxidize molecules at the expense of hydrogen peroxide. Their peroxidase activity was measured in crude extract by recording the spectrophotometric values. Partial purification of crude enzyme extract was done by ethanol precipitation and ion-exchange chromatography. It was observed that after partial purification, the enzyme activity was increased as compared to crude enzyme extract. DEAE cellulose eluted samples of peroxidase for maize showed a 1.17 purification fold, 1.08 U/mg specific activity with 69% recovery; for *Finger millet* showed 1.9 purification fold and 2.3 U/mg specific activity with 85% recovery, for rice showed 1.30 purification fold and 0.51

U/mg specific activity with 86% recovery, for *Pearl millet* showed 1.22 purification fold, 1.18 U/mg specific activity with 85% recovery and for wheat showed 1.25 purification fold, 2.4 U/mg specific activity with 82.6 recovery. The obtained results showed that specific activity of Ragi and wheat was higher as compared with maize, Asian rice, and *Pearl millet*. Further, influence of pH, temperature, activator and inhibitor was studied. The highest activity for pH was observed in the range of pH 7-8 and the lowest in pH 3 and pH 10. Enzymes were thermostable and showed highest activity in the range of 55-60°C and least at 4°C and 90-100°C. Enzyme activity increased continuously and maximal activity was noted at 1ml of CaCl<sub>2</sub> as activator and minimal at 0.2 ml whereas maximum decreased level of activity at 1ml of EDTA as inhibitor and highest at 0.2 ml. Finally, partially purified enzymes were confirmed for its purification using SDS-PAGE and Native-PAGE. The molecular weight was found to be 45,000±2,000 Daltons with the mid range marker. Here, cereals are used as a low cost material for isolation and purification of peroxidase extraction. Being a heat stable enzyme, peroxidase has wide range of applications in health sciences as a diagnostic tool.

NSBC- 2015- T01- CAGR – 23

### **Tuber crops based farming system for sustainable livelihood options of Nicobari tribes in Andaman & Nicobar Islands**

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The Nicobari tribal community is generally conservative as far as food resources are concerned. They mainly rely on coconut, tuber crops, pigs and marine fisheries for their livelihood. The traditional method of cultivation and utilization of tuber crops by these people have been acquired from their ancestors. They use the virgin land for establishment of coconut plantations and they rarely practice mixed cropping involving coconut, tuber crops, spices and fruit crops due to lack of non-availability of planting materials and scientific cultivation of tuber crops based farming. Central Island Agricultural Research Institute (CIARI) has made an effort to impart scientific knowledge on tuber crops cultivation and utilization through participatory mode under All India Coordinated Research Project on Tuber Crops. The model comprises of 200 m<sup>2</sup> of fenced area in the vicinity of the tribal settlement and integrated with piggery unit at Harminder Bay, Little Andaman. After sensitization program on tuber crops based farming system under Tribal Sub Plan of AICRP on Tuber Crops, the farmers were given the planting materials of elephant foot yam, ginger, poultry chicks and piglets from the year 2013 onwards. In addition, they also used their own seed tubers of Nicobari Aloo, Colocasia and setts of Cassava for tuber production. From the tuber crop based farming system the tribal farmers have generated an amount of Rs. 5,500 to 9,650 from crop component and from pigs they generated approximately Rs. 20,500 to 43,000. The total income generated from the system ranged from Rs. 29,000 to 52,650 at Harminder Bay. While organic cultivation of Elephant foot yam at Small Lapathy and Big Lapathy villages of Car Nicobar under community planting recorded the yield of 1,350 to 1,850 kg in 3,750 m<sup>2</sup> and 5,000 m<sup>2</sup> area, respectively. The income generated from the system ranged from Rs. 54,000 to 74,000. Technical interventions by CIARI have made visible impact like increase in income, livelihood improvement and employment generation.

## Multivariate approaches of assemblages of zooplankton distribution and abundance in the offshore waters of Andaman and Nicobar Islands

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In order to study the assemblages of zooplankton in Andaman and Nicobar Islands (A & N), a survey was conducted from ten stations during the period from 30<sup>th</sup> January 2012 to 7<sup>th</sup> February 2012 on board the *Ocean Research Vessel (ORV) Sagar Manjusha*. The samples were collected by horizontal hauls using the zooplankton net (300 µm mesh size, 0.5 m mouth diameter and 1.5 meter length) fitted with digital flow meter. A total of 88 species were found, among those the order copepoda was the most abundant taxon of which the calanoid species such as *Acartiadianae*, *Centropages calaninus*, *Eucalanus attenuates*, *Eucalanaus monachus* and *Paracalanus parvus* were dominated. The other species dominated were cyclopoid *Copiliavitrea*, *Corycaeus danae*, *Corycaeus speciosus* and *Oithona brevicornis* along with *Oikopleura* sp., Gastropod veliger and Echinopluteus larvae. The highest abundance (16330 Nos./m<sup>3</sup>) was recorded from station 4 near to Barren Island, while the lowest (2460 Nos./m<sup>3</sup>) was recorded in station 3 near to Rangat. Diversity (H) was found higher in station 9 located east of Campbell Bay and lowest in station 6 near to Neil Island. The cluster analysis (CA) and principal component analysis (PCA) being the multivariate analyze provided the better understanding of variation of zooplankton community across studied offshore sites in A & N Islands.

## Front Line Demonstration on SRI method by KVK at NICRA Village Kharghana of district Bilaspur (CG)

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Front Line Demonstration was conducted on rice crop in the system of rice intensification at village khargahna village block Takhatpur district Bilaspur of C.G. during kharif 2012-13. The krishi vigyan Kendra has provided critical input like seed, M.B. plough implement, puddling implement rotavator, ambika paddy weeder and technical guidance to the farmers. The front line demonstration were conducted under irrigated condition and rainfed with an objective of enhancing the production potential of paddy crop through improved and drought variety and agro-technique management. The FLD comprised of new improved technology and existing local farmer practice. The FLD was conducted at the farmer's field. The number of farmers was 17 and area was 6.8 ha. Spread of involved in SRI was done in association with selected farmers group through discussion and interaction sessions. Selected farmers group were encouraged at different crop growth stage. Demonstration result found that there was many advantaged of SRI method like less requirement of seed at sowing, less requirement of water for irrigation, less requirement of labour at the time of nursery from planting and increased more number of tillers per plant. The costs of land preparation leveling and weeding were high in SRI method as compared to convention methods. The total cost of cultivation in high Rs. 21,000=00 in SRI method. However net profit was higher i.e. Rs. 47,500=00 as compared to the convention methods. The benefit cost ratio was found 1:3.2.



## Conservation and utilization of cytoplasmic male sterile lines for development of short and medium duration Pigeonpea hybrids

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Pigeonpea (*Cajanus cajan*) is an important food legume of acute regional importance, providing significant protein to the human diet in Asian countries, especially India, where it is mostly produced and consumed. Due to its narrow genetic base, pigeonpea improvement is increasingly reliant on introgression of valuable traits from wild forms, a practice that would benefit from knowledge of its domestication history and relationships to wild species. A stable cytoplasmic-genic male sterile system (CMS) of A4 cytoplasm derived from a cross between cultivated (*Cajanus cajan*) and wild relative (*Cajanus cajanifolius*) was developed, that opened up the possibility of production of commercial hybrids. Promising stable CMS lines have been developed in India and the stability of some of these lines have also been identified. Using restorers adapted to region specific, for exploitation of heterotic combinations with these stable CMS lines, will open the avenues for development of regional or zonal adaptive hybrids. Looking to the micro-climatic variations, it has now become necessary to have micro-climatic adaptive cultivars. The pigeonpea hybrids of early maturity (130-140 days) have better scope over medium duration cultivars (180 days) in intercropping conditions. Use of early duration CMS lines like ICP 2039 and ICP 2052 for development of early hybrids will broaden the scope in this context.

## Antagonistic activity of wild mushrooms against plant pathogenic fungi

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The present investigations on the Antagonistic activity of wild mushrooms against plant pathogenic fungi were undertaken to study characterization of fleshy fungi for anti plant pathogenic properties. Survey work was conducted in different forest areas of three districts of H.P. (Kangra, Mandi and Kullu). A total of 70 species of wild mushrooms belonging to 54 genera were collected and identified, out of which 40 species were cultured. Thirty two genera were recorded to be inedible, 14 as edible and four as poisonous. *Boletus* sp., *Polyporus* sp., *Ganoderma lucidum* and *Tricholoma* sp. were the most frequently distributed mushrooms. Antagonistic activities of 40 species of wild mushrooms against ten plant pathogenic fungi were tested by dual-culture technique. Most of the tested mushroom species markedly inhibited mycelial growth of all the phytopathogenic fungi. However, *Cordyceps* sp., *Marasmius* sp., *Stropharia* sp. and *Russula* sp. were found to have strong antagonistic activity. Culture filtrates of eleven wild mushrooms were found effective against test plant pathogenic fungi and nine were found effective against the bacterium *Ralstonia solanacearum*. Complete inhibition (100%) of *Rhizoctonia solani* and *Sclerotinia sclerotiorum* was observed by *Russula* sp., while maximum inhibition zone (30mm) was recorded by *Stropharia* sp. in *Ralstonia solanacearum*. Eleven culture filtrates and seventeen fruit body extracts of wild mushrooms were found to inhibit the conidial germination of *Alternaria brassicae*, *Fusarium oxysporum*, *Colletotrichum capsici* and *Rhynchosporium oryzae*. Minimum inhibition concentration of culture filtrates and fruit body extracts ranged between 50-80% and 25-80% concentration, however fruit body extract of *Phellinus* sp., *Russula* sp., and *Amanita*



sp. completely (100%) inhibited the spore germination of *Alternaria brassicae*. Complete inhibition was also found in *Rhynchosporium oryzae* by *Lactarius* sp., *Russula* sp., *Coprinus* sp. and *Cordyceps* sp. The culture filtrates found effective under *in vitro* were also tested for host parasite interaction under pots conditions and found to reduce the disease incidence. Minimum disease incidence (26.66, 20.33 and 33%) was found in sheath and leaf blight of maize, stalk rot of cabbage and pea wilt by *Russula* sp. and *Phellinus* sp., respectively. In biochemical tests, total phenolics (1.60-22.70 mg/100ml) were the major antioxidant components found in the culture filtrates, followed by DPPH scavenging (2.50 -7.66) and hydroxyl radicals (2.59 - 5.2). *Stropharia* sp. contained the highest phenolic content (22.70 mg/100ml) while *Cordyceps* sp. contained highest concentration (7.66 and 5.52 mg/100ml) of DPPH scavenging and scavenging effect on hydroxyl radicals among the culture filtrates tested.



## **NSBC 2015 - Track – I : BIODIVERSITY**

### **1.3. Fisheries governance for food security**





## Portable FRP Carp Hatchery: A Tool for Biodiversity Conservation in Fisheries

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ICAR-All India Coordinated Research Project (AICRP) on Application of Plastics in Agriculture (APA), centre at ICAR-Central Institute of Freshwater Aquaculture (CIFA), Bhubaneswar has designed and developed a complete set of hatchery system in fibre-reinforced plastic (FRP) material for fish breeding and hatchery rearing of seed. The portable hatchery has been found to be a suitable gadget as the users can easily install and operate it anywhere in India. In one run 1.0-1.2 million spawn can be produced from the system. The system is suitable in field conditions for breeding most of the cultured Asiatic carps viz., Rohu (*Labeo rohita*); Catla (*Catla catla*); Mrigal (*Cirrhinus mrigala*); Kalbasu (*Labeo calbasu*); Fimbriatus (*Labeo fimbriatus*); Silver carp (*Hypophthalmichthys molitrix*); Grass carp (*Ctenopharyngodon idella*); and Common carp (*Cyprinus carpio*). With some modifications this system has been used for breeding of Magur (*Clarias batrachus*); Pangasianodon hypophthalmus; Pabda (*Ompok bimaculatus*); Tengra (*Myxus vittatus* & *M. gulosus*); Silver barb (*Puntius* sp.), etc. In lean season the system can be used for ornamental fish rearing or common carp breeding or water storing. This hatchery can be a tool for fish biodiversity conservation through seed production of endangered and threatened fish. The unit can be operated by unemployed youth, Gram panchayat and Cooperative Society on self-operational / rental basis. By December, 2014, it has been installed in 26 states and A&N Island of the country.

## Seed production of Rohu, *Labeo rohita* and Bata, *L. bata* in FRP hatchery in Bali Island, Sundarban through brood stock and nutrient management

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Bali Island is one of the remote mangrove reclaimed buffer areas of Sundarban Biosphere Reserve (21.94°N-22.30°N and 89.00°E-89.55°E) in West Bengal. This area is mainly resided by very poor villagers including SC and ST who are continuously fighting against malnutrition, unemployment, tiger attack and lack of education. Food security is most important factor for human community and it is well known that fish can provide easily digestible protein. From the point of view of fish seed production in this remote Island, one unit of Fibreglass Reinforced Plastic (FRP) carp hatchery with one breeding pool, one hatching pool, one egg/ spawn collection tank and one plastic tank of capacity 2000 litre was installed and operated at Bali Island, Sundarban, West Bengal during months of July-August 2013 and 2014. During first year of breeding in 2013, the brood fishes were collected from ponds of Nature's Club, but it was found that due to improper feeding to the fishes and higher alkalinity (280±24 mg/l) and hardness (300±20 mg/l) of water, number of fertilized eggs and survival of spawn were low in the early monsoon season. It was found that twitching of spawn occurred, but it could not come out, presumably due to formation of a hard layer of Calcium and Magnesium in the egg membrane. But, in the later phases after proper feeding to the brood fishes with formulated feed during the next year, i.e., 2014 @1.5-2.5% of the body weight during the months of January-June and GNOC @1% of the body weight from Mid February-June, it was found that from 3 sets of rohu (female 3 nos weighing 3.3 kg and male 5 nos weighing 4.8 kg) and 12 sets of bata (female 10 nos weighing 2.5 kg and male 12 nos weighing 2.15 kg) a total number of 5 lakh eggs were produced, out of which 4 lakh spawn were recovered. The water quality was found suitable with total alkalinity 100-140 mg/l during the month of August; total hardness 90-120 mg/l; and pH 7.5-8.0. The temperature of 29.2-33.3°C during the breeding of carps was within the limit of hatchery operation. Stocking of 4 lakh spawn was done in one earthen pond of size 0.05 ha. Total 1.5 lakh fry was harvested in 15-20 days for restocking in rearing ponds for fingerling production.

## **Studies on orientation pattern of pseudofecal pellets of the sand bubbler crab, *Dotilla clepsydrodactylus*, Carbyns Cove, South Andaman**

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Sand bubbler crabs are small, intertidal inhabitants and feeds at low tide by scraping the sand surface and making pseudofaecal pellets after extracting organic detritus from the sand. *Dotilla clepsydrodactylus* is Indian sand bubbler crab. *D.clepsydrodactylus* was studied at Carbyns Cove beach area in Port Blair and to understand the feed activities and its relation with pseudofecal pellets. *Dotilla clepsydrodactylus* is an inhabitant of intertidal zone of sandy shores, and the pseudofecal pellets are always arranged towards one side of their feeding path, which also helps them to know which area is already utilized by them for feeding. *Dotilla clepsydrodactylus* are distributed evenly throughout the intertidal area, they all exhibit burrow pattern not a single igloo structure was observed in study area may be due to texture of sediment and water content. It is observed in the field that due to unavailability of space for feeding, crabs stops feeding and plug in to their burrow early, before flooding tide. Overlapping of feeding area also result in aggression behavior of sand bubbler crabs against neighbors, which has no relation with the size of crab. In the case of weight of the pseudofecal pellets produced by the crab and its morphometric measurements suggested that the smaller size crab eat more and large ones are lesser in eating. *Dotilla clepsydrodactylus* is the only species available at Carbyns Cove but they make concentric and spike patterns. They do not show any relation between directions of emergence with the pattern of pellet they form. The present study confirmed that there is much work to be carried out to understand the behaviour pattern of sand bubbler crab *Dotilla clepsydrodactylus* pseudofecal pellets formation in concentric and spike mode distribution.

## **A study on the species composition of Rays (Order: Myliobatiforms) from the landings at Junglighat fish landing Centre and from onboard commercial trawler**

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Studies on elasmobranchs from Andaman and Nicobar Islands have been meagre when compared to mainland India. This was carried out to understand the status of rays (Order: Myliobatiforms) in Andaman from the landings in the major landing center of Junglighat and by direct observation during trawling operation. A total of 11 species belonging to two families namely Dasyatidae and Myliobatidae were confirmed during the study out of the 12 species of rays reported from Andaman and Nicobar Islands. Hook and line and bottom trawl are the two main gears used for ray fishery but their catch is mainly incidental rather than targeted fishery resource. All 11 species were caught by hook and line while 5 species were caught during trawling operations. *Himanturauarnak* dominated the species composition as it comprised of 56.6% of all landed rays and the least was *Neotrygonkuhlii* with only 0.2%. Rays represented only 9.3% amongst all catch during trawl operations. The monthly average of rays that landed in Junglighat was found to be 6678.33 tons. Most of the landed resources of rays are taken for drying, salting and further processing. Once fully processed they are sent to mainland (Chennai) for export to other countries. Enquiry with fishermen revealed that rays are primarily caught from the coastal waters and the fishing grounds are mainly located in the eastern part of Andaman like Diglipur, Long Island, Baratang, Shoal Bay and Havelock.

## Biochemical composition of Indian Mackerel *Rastrelliger kanagurta* from Andaman waters

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Fish is an important food for human population rich in protein and fat. In 2012 about 158 million tonnes of fish were produced of which 136 million tonnes are used as food supply to the human beings. Marine fisheries contribute indirectly to food security. Fish are good source of PUFA which controls the blood pressure and risk of heart disease. Among the different animal foods fishes are nutritious and it contains all the essential amino acids and possess high nutrient value. Fishes consumption can reduce malnutrition among different age-groups. Mackerels are among the important commercial fishes available in Andaman & Nicobar Islands. They are available throughout the year in these islands and good source of nutrients to the populations of these islands. In this study the biochemical composition of the Indian mackerel *R.kanagurta* is carried out and compared with commonly available fishes of Andaman waters.

## Overview of Aquatic Animal Diseases in Andaman and Nicobar Islands

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Andaman and Nicobar Islands are pristine in nature and blessed with a variety of species diversity in general as well as aquatic resources in specific. The three facets of aquatic environment viz., freshwater, brackishwater and marine resources are not fully tapped to the potential and therefore have further scope for improvement. At present, only freshwater carp farming is being practiced in the Bay Islands while brackishwater aquaculture and mariculture are the identified areas for development. Diseases are the major constraints for the development in aquaculture sector. The present study reviews the work carried out till date on the disease aspects of aquatic animals. Abdominal dropsy from freshwater fishes, pop-eye disease, trematode and cestode infestations from marine fishes, WSSV and luminescent vibriosis from crustaceans and necrotic patches from corals have been reported from Andaman and Nicobar Islands. It is interesting to find that the pathogens like virus, bacteria, fungi and parasites were reported from these aquatic animals in the Island ecosystem. This is in contrast to our perception considering the virgin status of the Island. The scanty information available at present on the aquatic animal diseases itself has listed out all the possible diseases which would serve as a base for further studies in future. So it is the need of the hour to carry out a systematic study on the aquatic animal diseases of Bay Islands. Early detection of the disease and rapid response to the identified diseases are critical for the effective management of aquatic animal disease emergencies in the Island ecosystem.



## Systematics, diversity and abundance of Puffer fishes belonging to genera *Arothron* and *Canthigaster* from the South Coast of Andaman

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Puffer fishes belonging to the family tetraodontidae are usually distributed in the shallow waters. During the investigation in the stations viz. Marina Park, Chidiyatapu and Burmanullah along the South Andaman coast, five species from genus *Arothron* and two from *Canthigaster* has been recorded and were mostly found to prefer coral reefs and rock crevices, with the exception of *Arothron immaculatus*, that was found to be present in open water and confined to sandy bottom substrate with patches of sea grasses around. These fishes were found to be most diverse and abundant in Chidiyatapu with the Margelef's Richness Index of 2.49, Shannon-Wiener index of 1.05 and Pielou's evenness index of 0.96. Biometric analysis results demonstrate that they have shown an isometric growth. The individuals collected were mostly in the length between 120-160 mm. The *A. immaculatus* was found to feed mainly on Molluscs and Sea Urchin. The other food items include shrimps, crabs, sponges, micro algae, foraminiferans etc. GaSI, HSI and GSI values were calculated to throw light upon the feeding behavior and reproductive maturity of the fishes. Most of the individuals were found to be in the developing stage of maturity.

## Relative abundance of clown fishes from North Bay Island of Andaman Sea

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The hobby of maintaining an aquarium with ornamental fishes and the associated activities like collection, captive culture, fish breeding, aquarium product manufacture, distribution, whole sale and retail trade are growing very rapidly in the last few decades. Among the different marine ornamental fishes, most popular family is Pomacentridae, which includes genus *Amphiprion* commonly known as "Clown fishes or Sea anemone fishes". Clown fishes are most popular all over the world because of their small size, hardiness, attractive colour, and peaceful nature. The present study aimed to study their relative abundance at North Bay Island by using transects survey method. North Bay is about 4.5 – 5 km from Port-Blair with rich Coral reefs and survey site was at 11° 42' 09.11" N. The average relative abundance of anemone fishes at North Bay was estimated and found that the highest relative abundance of 25.94% and lowest 3.85% were recorded for *Amphiprion akallopisos* and *Amphiprion ocellaris* respectively. One-way Anova was applied which revealed significant difference ( $P < 0.05$ ) between relative abundance of anemone fishes. The Student's Newman Keul multiple range test indicated that the relative abundance of *Amphiprion akallopisos* was significantly different from *Amphiprion clarkii*, *Amphiprion ocellaris* and *Amphiprion percula*. However, the relative abundance of *Amphiprion akallopisos*, *Amphiprion ephippium* and *Premnas biaculeatus* was not significantly different.

## Symbiosis of anemone fish and sea anemones

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The present study aimed to study the symbiotic relationship of the anemonefishes with host anemones in laboratory condition and behavioural studies were carried out by observing the fishes *A. percula* and *P. biaculeatus* in 500 l FRP tank with different species of sea anemone and host anemones such as *Entamacea quadricolour*, *Macroactyla dorensis*, and *Stichodactyla gigantea*, *S. haddoni*, *S. mertensis*, *H. crispata*, *H. magnifica* and *H. malu* collected from North Bay. Observations were taken daily and result revealed that *Amphiprion percula* is having the symbiotic relationship with the three host anemone out of five i.e. *Amphiprion percula* is more symbiotic to *Heteractis magnifica* with average occurrence of 25 times in 1 hour followed by *Stichodactyla gigantea* 18 times and 13 times to *Entamacea quadricolour*. Where as in case of *Premnas biaculeatus* which is having symbiotic relationship only with *Entamacea quadricolour* with an average occurrence of 32 times in 1 hour. Symbiotic relationship was not observed with the other four host anemones during the study. A small experiment with artificial sea anemone (This is realistically molded soft polyester) also carried out and it was observed that both *Amphiprion percula* and *Premnas biaculeatus* was not entertaining artificial anemone.

## Distribution of Clupeoid fishes in Andaman waters

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Clupeoid fishes comes under order Clupeiformes Sub order Clupeoidei and 4 (four) family Chirocentridae, Clupeidae, Pristigasteridae, Engraulidae. Among these family the most abundant and majority landing comes from Clupeidae family in Andaman Islands. The estimated potential of clupeoid fishes from Andaman water is 17,600 tonnes. Clupeoid fishes in Andaman are mainly caught by ring seines and gill net. The estimated potential of Chirocentrids (Wolf herring) is 600 tonnes. In clupeidae family the major landing is contributed by *Amblygaster spp.* followed by lesser sardines and shads. The most abundant fishes are *Amblygaster spp.*, *Sardinella gibbosa*, *Sardinella fimbriata*, *Sardinella albella*, *Sardinella brachysoma*, *Sardinella albella*. *Amblygaster spp.* is locally known as Kappa Tarni and lesser sardine as Jat Tarni. Three species of Gizzard Shads available in Andaman waters are *Anadontostoma chacunda*, *A. selangkat*, *A. thailandiae*. Other clupeids includes *Dussumieria acuta*, *D. elopsoides*, *Herklotsichthys quadrimacula*. *Illisha spp.* and *Pellona spp.* are priced fish under family Pristigasteridae which are available in Andaman waters with fewer landings. Clupeoid fishes in Andaman are mainly consumed fresh, since the fish get spoils very fast. In comparison to other fishes they are use as bait fishes, mainly lesser sardine as whole frozen and *Amblygaster spp.* use as bait for tuna long lines. The availability of clupeoid fishes in Andaman waters can be seen throughout the year but heavy landings can be seen in particular seasons i.e before onset monsoon. Species like *Herklotsichthys spp.* are landed only for few months February-April. Indian Oil Sardine (*Sardinella longiceps*) which contributes maximum landings from Indian Coast has not been reported from Andaman waters. Among Engraulids *Stolephorus spp.* locally known as Maya Matshi is one of most abundant fish. In South Andaman, Port Blair Junglighat is the only landing centre where Clupeoids fishes are landed in maximum and some landings from Panighat and Wandoor. In Wandoor landing centre catch are mainly for use of bait fish for catching highly price fish which have high export values and not for local consumption.

## Distribution and abundance of *Pristipomoides* spp. from Andaman waters

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Snappers are highly priced fishes which dwell in reef and corals, rocky bottoms at depth between 20 to 360m. *Pristipomoides* spp. in Andaman is locally known as Mrigal is one of the most important snapper species in Andaman Islands. An attempt has been made to study the landings of *Pristipomoides* spp. from Andaman waters. Four species of *Pristipomoides* has been reported viz, *Pristipomoides filamentosus*, *P. multidentis*, *P. sieboldii*, *P. zonatus*. Mrigal are mainly landed at Junglighat, Wandoor, Guptapara, Dignabad and Panigat landing centres in South Andaman. The main gear used to catch *Pristipomoides* is hand lines and long lines, with fewer catches from trawlers. Baratang, Long Island, Hut bay, Mayabunder, Cinque Island, Diglipur, Rutland, North Sentinal, Daninala are important fishing grounds. The abundance and landing of *Pristipomoides* is dependent on favourable weather conditions. Since the fishes dwells in deeper water, fishermen usually fish only in calm weather conditions. Thus *Pristipomoides* spp. are landed only in particular seasons December to May or before the onset of the monsoon and sometimes landing has also been seen during monsoon months but in few numbers. The most abundant species among all is *P. multidentis*, and *P. filamentosus*. *P. multidentis* (locally known as Jat Mrigal) size ranges from 28-85 cm and weight from 0.4 to 7 kg. In *P. multidentis* it is observed that different size range fishes have been landed. *P. filamentosus* (locally known as Kala Mrigal) size ranges from 29-50cm and weight range from 0.4 to 2.5 kg. These fishes which has huge demand in local and are landed in huge quantity with heavy fishing during Dec- May. Studies on biology and population dynamics of these species are of immense importance to understand their present level of exploitation and optimally recommended levels of exploitation for sustainable fishery in the Islands.



## **NSBC 2015 - Track – I : BIODIVERSITY**

### **1.4. Livestock diversity approaches for sustainable agriculture**





## Performance of Vanaraja breeder birds under Island climatic condition for strengthening livestock diversity

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Present study was conducted to study the performance of Vanaraja breeder birds reared under Island climatic condition to diversify the livestock farming of Andaman Islands. A total of 700 female and 300 male vanaraja breeder birds were evaluated for growth rate. The body weight (g) of female birds at 0 day, 1, 2, 3 and 4 months were;  $37.72 \pm 2.28$ ,  $412.6 \pm 6.91$ ,  $1038.7 \pm 20.57$ ,  $1423.8 \pm 37.97$  and  $1843.4 \pm 58.32$ ; the respective bodyweight (g) of male birds were;  $38.44 \pm 1.51$ ,  $417.8 \pm 5.66$ ,  $1223.1 \pm 21.40$ ,  $1453.8 \pm 27.92$  and  $1853.4 \pm 55.32$ . Based on this evaluation study, it is inferred that the growth performance is on par with the standard body weight requirement for the appropriate age. The Island climatic condition is conducive for expressing the genetic potential of parent stocks and can be a source for diversifying the livestock of Andaman Islands.

## *Ex situ* conservation of mithun (*Bos frontalis*) through cryopreservation of epididymal sperm collected from dead bulls

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Conserving the mithun (*Bos frontalis*), a rare bovine of South-East Asia, could be benefited from effective *ex situ* genetic management and breeding programmes including the use of assisted reproduction. Long-term storage of epididymal sperm collected from dead mithun bulls by cryopreservation, with high survival rate, is essential for the establishment of genetic resource banks of this rare species. A study was therefore conducted to i) characterize the epididymal sperm collected from dead mithun bulls, ii) investigate the effectiveness of epididymal sperm for cryopreservation and iii) to study the expression pattern of genes related to motility (TSSK6 and ADAM5P) and fertility (PRM1, PRM2, PRM3, Tnp1 and Tnp2) in mithun epididymal sperm. For the purpose, sperm collected from caudal epididymis of eight dead mithun bulls were evaluated for concentration, progressive motility, morphological abnormalities, live sperm counts, acrosome integrity, membrane stability (hypo-osmotic swelling test; HOST) and DNA integrity. Epididymal sperm were cryopreserved using tris-egg yolk-glycerol diluent in liquid nitrogen. Post-thaw quality of the cryopreserved sperm in terms of progressive motility, morphological abnormalities, live cell counts, acrosome integrity, membrane stability and DNA integrity were assessed. The RNA extracted from fresh and post-thawed cryopreserved epididymal sperm was reverse transcribed to cDNA and expressions of the genes related to motility and fertility were determined by RT-PCR. The progressive motility, live cell counts, morphological abnormalities and acrosome integrity (normal) of fresh sperm were  $89.9 \pm 2.7$ ,  $88.7 \pm 6.7$ ,  $7.8 \pm 1.07$  and  $95.3 \pm 7.8\%$ , respectively. Fresh sperm that responded to HOST were  $88.3 \pm 7.2\%$ , and  $89.5 \pm 6.4\%$  fresh sperm had intact DNA. Following cryopreservation, the percentage of progressive motility (fresh vs frozen-thawed), live cell counts, morphological abnormalities, acrosome integrity, membrane stability and DNA integrity were found to decrease significantly ( $P < 0.01$ ) with a motility recovery rate of  $75 \pm 8.5\%$ . Transcripts encoding a serine/threonine testis-specific protein kinase (TSSK6) and a metalloproteinase non coding RNA (ADAM5P) were found to be associated with high-motility status ( $P < 0.01$ ) and their relative expressions were higher in fresh than frozen-thawed sperm. There were no differences in relative expressions for the transcripts related to fertility (PRM1, PRM2, PRM3, Tnp1 and Tnp2) between fresh and frozen-thawed sperm indicating no change of fertility of mithun epididymal sperm after cryopreservation. Taken together, results of our study provide a foundation of collection and cryopreservation of epididymal sperm from dead mithun bulls. Furthermore, the post-thaw quality



in terms of percentage of progressive motility, live cell counts, morphological abnormalities, acrosome integrity, membrane stability and DNA integrity were sufficient for genetic improvement of this rare species through AI and conservation of the valuable germplasm for future.

NSBC- 2015- T01- LDA – 03

## **Village duck production for sustainable livelihood and women empowerment in tribal districts of Odisha.**

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Duck production in village ponds are common practices in many districts of Odisha, West-Bengal, Assam and other North-eastern states. However, participation of women farmers in village duck production is a key issue which needs to be addressed. Experiment was conducted with the participation of more than 120 women farmers of Odisha who reared ducks of two different varieties (Khaki Campbell and Native variety) in village ponds. Sensitisation cum training on various aspects of duck production was imparted to them. Low-cost duck houses were constructed with available resources. Dry sand was used as litter material. Critical input i.e. day old ducklings (30 no's) of Khaki Campbell / Native variety, 10 kg duck mash (22 per cent CP and 2800 kcal/kg ME), a plastic tray as feeder and one chick waterer were provided to initiate the programme. Ducklings were brooded up-to 15 days followed by outside scavenging was practised. Clean drinking water in plastic troughs was offered outside for dipping their head. Month old growing ducks were allowed to enter the pond. Farmers offered kitchen wastes, left-over food, vegetable peels, fish offal and scales as external feeding source. Monthly body weight, age at sexual maturity, mortality rate, average egg weight (g) by 35<sup>th</sup> week and total egg production by one year of age were recorded. It was found Khaki Campbell grew faster up to 8 weeks and native ducks gained more body weight in later phase. Khaki Campbell attained early sexual maturity whereas higher egg wt was found in native ducks. Total egg production up-to 1 year was significantly higher in Khaki Campbell. Further, it was observed that mortality was more in Khaki which was limited to brooding period. Disposal of drake before 5 months facilitated better feeding source for laying ducks. Majority of the farmers earned more than twelve thousand rupees per unit within a year which played significant role towards a sustainable livelihood as well as women empowerment through duck production.

NSBC- 2015- T01- LDA – 04

## **Food borne diseases**

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Food borne illness is an infection or irritation of the gastrointestinal (GI) tract caused by food and beverage that contain harmful bacteria (present in food, meat, poultry, room temperature is ideal 40 and 140<sup>o</sup> F), viruses (present in stool and vomit of already infected patient, spread through food and contamination), parasites (by water contaminated with stool of infected animals or human or chemicals, mushroom). Infants and children, pregnant women and their unborn children, older adults and people with compromised immune system are more likely to develop foodborne illness. Symptoms such as vomiting, diarrhea or bloody diarrhea, abdominal pain, fever, chills. The toxins produced by *C.botulinum* and some chemicals affects the nervous system causing headache, tingling or numbness of skin weakness, dizziness, paralysis. Complications which occurred are dehydration, Hemolytic uremic syndrome (HUS). They can lead to acute food borne illness to chronic health problems or even death. Dehydration (cause serious health problem such as organ damage, shock, or coma). Infants, children, older adults and people with weak immune system carrying symptoms as excessive thirst, dizziness, high fever, sunken eyes,

dark coloured urine etc. HUS affects children younger than 10, develops when *E.coli* bacteria lodge in digestive tract make toxins that enter in bloodstream, destroy blood cells, paralysis of muscles by *Clostridium*, spontaneous abortion /still birth in pregnant women by *Listeria monocytogenes*. Chronic disorder including reactive arthritis from *Compylobacter jejuni* and *Salmonella*, irritable Bowel syndrome (IBS), Guillain – barre syndrome, by *Compylobacter jejuni*. Possible increased risk of high blood pressure, kidney problems and cardiovascular disease from *E.coli* 0157 :H7 infection. These can be diagnosed by medical history; foods and beverages recently consumed and a physical examination. Diagnostics test includes a stool culture or a culture of sample of vomit/suspected food may be performed. It can be treated by replacing lost fluids, and electrolytes to prevent dehydration. If diarrhea is caused by bacteria/parasites over –the-counter medications may prolong the problem. Dietary recommendations exclude drinking plenty of liquids, sipping small amount of clear liquids or sucking on ice chips, easy to digest foods. Prevention can be made by storing, cooking and cleaning. Hands should be washed at least 20seconds with warm, soapy water before and after handling of raw food. To sanitise utensils and surfaces - 1tea spoon of bleach in 1 quart of hot water may be used.

NSBC- 2015- T01- LDA – 05

### **Spermatozal abnormalities of Karan Fries (Tharparkar × Holstein Friesian) bulls in different seasons**

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Five adult healthy bulls (Karan Fries) were selected from Animal Breeding Research Centre (ABRC) of ICAR-NDRI, Karnal, Haryana for assessing sperm abnormalities during different seasons. Six ejaculates from each bull were collected using artificial vagina (42-45°C) during winter (December to Middle February), spring (Middle February to April), hot-dry (May to June) and hot- humid (July to August) seasons. Immediately after collection, the ejaculates were placed in a water bath (37°C). Eosin-nigrosin vital stain was used for assessing minor and major sperm abnormalities. 5µL of neat semen and 15µL of stain were placed in a pre-warm glass slide, it was mixed properly and very thin smear was made and air dried. The smear slides were examined under oil immersion (100X, LABOMAD). The major abnormalities were found to be significantly higher during hot-dry (10.46 ± 0.83 %) and hot-humid (11.24 ± 0.58 %) seasons, however, minor abnormalities were not found to be significantly differ between seasons. Based on our results it can be concluded that the hot-dry and hot-humid season is stressful to Karan Fries bulls. Therefore, sufficient measures should be taken to Karan Fries bulls from heat stress during summer season.

NSBC- 2015- T01- LDA – 06

### **Livelihood option in rural villages of Andaman through backyard poultry using dual purpose improved Nicobari fowl**

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Poultry farming is an emerging industry in India. Poultry farming in the present decades have made a remarkable progress among the commercial poultry farmers. In the Islands, People are rearing backyard poultry birds which are indigenous, nondescript, genetically poor and uneconomic to meet the family demand. Considering the higher feed cost of the commercial layer farming, backyard farming with dual purpose improved poultry breeds of relatively better egg and meat production capability and relatively higher immunity was found to be more economical and viable option for the farmers in these Islands. Rearing of dual purpose Nicobari fowl strains developed at ICAR-CIARI will improve the nutritional and socio economic status of the farming community through higher egg production and profitability in rural villages. To popularise the birds, a total of 5 units of improved Nicobari fowl at 7 week of age were supplied to the farmers in South Andaman. The birds were

fulfilled their nutritional requirement for maintenance and production by searching and consuming feed around the household through scavenging. The birds were compared with local desi birds which existed in the farmer's field in respect of feed consumption, cost of chicks, sale of eggs, mortality and their gross cost, gross return, net return and BCR calculated during the study. Annual egg production of improved Nicobari fowl was higher (180 eggs per annum) compared to local desi birds (75 eggs per annum). Net return from improved Nicobari fowl was Rs. 31,950 per annum which was higher than the local desi bird (Rs. 7,700). BCR was also higher in case of improved Nicobari fowl (3.4).

NSBC- 2015- T01- LDA – 07

### **Morpho-biometric traits of Andaman local goats**

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Local goat populations have a very valuable genetic potential for sustainable agriculture. The aim of this study was to develop a profile of the Andaman local goats in A&N Islands based on its morpho-biometric characteristics. Data from a total of 2628 goats were collected from different locations of South Andaman. Base line information on present status of morpho-biometrical and reproduction traits were recorded. The average mean body weight (in kg) at birth, 3, 6, 9 and 12 month of female goats was  $1.71 \pm 1.23$ ,  $4.9 \pm 0.37$ ,  $8.49 \pm 0.57$ ,  $11.15 \pm 0.97$  and  $15.11 \pm 0.73$  and the respective weights of male goat was  $1.99 \pm 0.15$ ,  $5.55 \pm 0.28$ ,  $10.19 \pm 0.73$ ,  $12.28 \pm 0.76$  and  $16.04 \pm 0.72$ . The biometric dimensions of Andaman local goats at different ages and sex have been recorded. The overall chest girth (CG in cm) for male goat at birth, 3, 6, 9 and 12 months was  $25.9 \pm 2.18$ ,  $37.45 \pm 1.53$ ,  $47.25 \pm 3.51$ ,  $53.07 \pm 2.10$  and  $60.12 \pm 1.89$ , respectively. Measurements for paunch girth (PG in cm) at birth, 3, 6, 9 and 12 months were  $26.19 \pm 3.02$ ,  $40.43 \pm 2.42$ ,  $53.42 \pm 5.01$ ,  $58.53 \pm 3.31$ , and  $64 \pm 2.62$ , respectively. Measurements for body length (BL in cm) at birth, 3, 6, 9 and 12 months were  $25.04 \pm 3.56$ ,  $36.02 \pm 1.45$ ,  $42.92 \pm 3.64$ ,  $46.76 \pm 2.67$  and  $49.25 \pm 2.25$ , respectively. Measurements for height at withers (HW in cm) at birth, 3, 6, 9 and 12 months were  $26.19 \pm 1.68$ ,  $36.07 \pm 2.91$ ,  $43.84 \pm 2.73$ ,  $49.35 \pm 1.47$  and  $53 \pm 1.56$ , respectively. Age at first mating, weight at first mating, age at first kidding, weight at first kidding, service period, kidding interval and gestation period was  $260 \pm 15.0$  days,  $8.49 \pm 0.89$  kg,  $420.0 \pm 12.0$  days,  $13.26 \pm 1.61$  kg,  $101.20 \pm 11.23$  days,  $300.0 \pm 20.0$  days and  $147.0 \pm 2.0$  days, respectively. The kidding rate of 1.07 was recorded in the present stock of Andaman local goats. Biometrical measures of Andaman local goats from other locations of North, Middle and Nicobar Islands will be the most discriminative variables to make clustering of the Andaman local goats based on geographical location.

NSBC- 2015- T01- LDA – 08

### **Effect of iron lactate supplementation on the development of haematological parameters of piglets in post natal period**

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A study was conducted to determine the effect of oral supplementation of iron lactate on post natal blood profile of piglets with an objective of preventing piglet anaemia. Twenty four piglets from three litters were subjected into treatments consisted of Control (without iron); Treatment -1: 100 mg Fe; Treatment -2: 200 mg Fe and Treatment-3: 250 mg Fe as Ferrous lactate fed orally on day 3 and 10<sup>th</sup> day after birth. After 7<sup>th</sup> day of the initiation of the treatment (10<sup>th</sup> day of birth) all the treatment groups Hb, PCV and MCHC values were higher than the control. However there was gradual decline of all the three traits (Hb, PCV and MCHC) were observed from 3<sup>rd</sup> day of birth upto end of the experiment in control group. However no significant difference was found among the Fe lactate groups. In control group, piglets develop anaemia on day 10 after birth. The oral supplementation of Fe lactate on days 3 and 10 of life positively influenced hematological values in the first three week of piglets' life.

## **The traditional indigenous poultry production and improvement strategies among tribal farming community in Nicobar Islands.**

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A study was conducted to analyse the actual production system and productivity of indigenous native Nicobari fowl at tribal farming community of Nicobar Islands with an aim of formulating strategies to improve the production system of rural indigenous Nicobari fowl would thus be a direct contribution to the first millennium development goal in the improvement of indigenous Nicobari fowl production at tribal farming community of A&N Islands. Samples of 10 homesteads were randomly chosen from each village making a sample size of 200 families. A suitable interview schedule was prepared and information was collected through personal interviews. The study revealed that every household of tribal farming community rear poultry with minimum inputs under scavenging system and family poultry is just a secondary source for meat and primary source for eggs for 95% of those interviewed. Tribal women were more involved in rural poultry farming. Among the birds maintained as family poultry, there were mainly desi birds and Nicobari fowls. The mean egg production of Nicobari fowl was 87.04 egg / annum. Data suggest a close association between awareness on importance of productivity of native chicken and egg consumption; however, it was found that knowledge on crucial role of eggs in their daily nutrition was negligible and creating awareness on nutritive value of eggs has a positive impact on the productivity of birds. Based on this we could assume that each family on an average receive a total of 200 to 500 eggs from an average flock of five birds; but this is too low to meet the ICAR recommendations of 180 eggs per person per annum. It was also observed, the birds not being provided with proper housing, feeding and vaccinated which lead to the major problem of high mortality and the native indigenous Nicobari fowl are becoming endangered. Based on the report from baseline survey, the major areas were identified for the development of rural poultry production.

1. Elevated housing : Since housing at ground level is the major predilection site to harbor infectious agents and water logging problem in rainy season;
2. Balanced feeding using locally available feed ingredients ;
3. Feeding management using locally made feeder and waterer : Due to spraying of cereals on the ground, wastage of feed as well as energy of birds in running to pick up the feed;
4. Knowledge on Artificial incubation: Natural incubation using broody hen limits the egg productivity of hen and further less numbers of chicks will be obtained in a year;
5. Vaccination: Formation of strategy for vaccination by themselves. Extension support for health care, input supply and other aspects should be made available at their level. They should be trained in such a way that the health care and breed development programme will be taken care by them. Small packs of R.D. vaccine containing preferably 100 or less doses to be used on sharing basis by themselves. Hence, tribes should be given awareness on the basics of poultry production and importance of conservation of local indigenous Nicobari fowl.





**NSBC 2015 - Track – I : BIODIVERSITY**

**1.5. Plant variety protection  
and farmer's right**







## Role of PPV&FRA in agro-biodiversity conservation: Salient achievements and challenges

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Since ages, farmers are involved in conservation of Plant Genetic Resource (PGR) and have valuable indigenous germplasm collections, which form a basis for development of new varieties. In the present scenario of global warming, growing food demand and due to population pressure, there is an urgent need to develop climate resilient varieties of different crops. India, being one of the 12 mega-diversity regions of the world accounts for 2.4 per cent of world's total land area and 7-8 per cent of recorded species of the world including 45,500 species of plants. Adoption of modern farming systems will create risk of losing the valuable agro-biodiversity. Although, The Protection and Plant Varieties and Farmers' Right Act (PPV&FRA), 2001 is not directly involved in biodiversity conservation but as one of its objective is to recognize and protect the rights of farmers involved in biodiversity conservation; every year, PPV&FRA gives award and reward to outstanding farmers and farming community involved in conservation and management of agro-biodiversity. So far, the Authority has awarded 16 farming communities and 35 individual farmers have also been rewarded and recognized for agro-biodiversity conservation from the National Gene Fund.

## Genetic diversity and variability studies of promising pigeonpea (*Cajanus cajan* L.) landraces of Bay Islands based on morphological markers

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Pigeonpea (*Cajanus cajan* L.) is a leguminous crop grown in many tropical and sub-tropical countries. The major pigeonpea producing areas in the world are India, Eastern Africa, Central and South America, the Carabian and West Indies. India with a total area of 3733 thousands hectares contributing the production of 2896 thousands tonnes registered the productivity of 776 kg/ha. This most important pulse crop of tropics has not much attractive in the Andaman & Nicobar Islands mainly due to dependence on unpredictable stress environment, repetitive in nature and lack of exploration of pigeonpea genetic resources of these islands. Farmers of these islands used their saved seeds. It also occupies very less area under cultivation as compared to other grain legumes as this crop is not predominantly cultivated in these islands and it has not received more research attention. However, the landraces of the Bay islands have attractive genetic potential with higher productivity of seed yield per plant and are able to tolerate abiotic stresses. Assessment of genetic diversity and identification of crop genotypes are essential for efficient utilization of germplasm resources. Thus, considering the genetic potential of the promising landraces, a study was carried out at the experimental field of CIARI, Garacharma during 2013-14 and 2014-15 for characterization of indigenous landraces along with advanced breeding lines. Genetic diversity and variability among the promising landraces were assessed using morphological parameters. Characterization of the promising landraces and advanced breeding lines revealed differential selection pressure over the imposed variability for growth period, which makes the crop more competitive for existence with in-built genetic capacity. The results revealed significant genetic difference for days to 50% flowering, days to 80% maturity, plant height, number of branches per plant, length of pods, number of seeds per pod, 100-seed weight and seed yield per plant. The accessions ANP-13-03, ANP-13-01, ANP-11-12, ANP-11-13, ANP-12-02 and IPAC-68 showed significantly superior performance over the best check with better adaptability in varying environmental conditions having tolerance against major insect and pests showing less damaged by pod borers and sucking pests. Although, agro-

morphological profiling using cluster analysis by unweighted pair group method with arithmetic mean method of accessions were grouped in to two distinct diversity groups separating on the basis of morphological traits and yield attributing traits. Genetic similarity values ranged from 30 - 96% with an average of 66%, which indicated the presence appreciable amount of genetic diversity. The 100-seed weight and seed yield per plant was the largest contributor towards the genetic diversity. The grouping may also form a basis of forming a core collection of this germplasm representing the variability available among the promising landraces which provides an ample scope for forward selection. The predominance of accessions with pubescent pods, a trait associated with resistance to pod damaging insects may provide an opportunity to identify the accessions for insect-pest resistance for use in breeding. The findings offer a scope for utilization of these promising lines for their utilization in advanced breeding trials for the future breeding program.

NSBC- 2015- T01- PPV – 03

### **Farmers Cooperation – Chhattisgarh state**

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Chhattisgarh state is endowed with rich cultural and ecological diversity. Bastar region of the state is considered as one of the major hotspot for biodiversity with largest flora and fauna. To add another feather on its crown, it is regarded as “rice bowl of central India” and it is important to mention that Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh state is maintaining largest rice germplasm collection to the tune of 23,000 varieties after International Rice Research Institute, Philippines. Very rarest varieties of rice with duration ranging from 60 to 180 days are being maintained at Dr. Richharia Rice Germplasm Bank. The farmers of this state are fame for their diligent nature and they encourage and ready to follow the modern agricultural technology in their fields. As a result of farmers’ painstaking effort and government pro-farmer activities, Chhattisgarh government could receive Krishi Karman Award for highest food grain production for the year 2012-13 and 2013-14. As on today, one of burning issue among us is climate change which may cause significant adverse impact on agricultural production as well as biological diversity of the state. Systematic analysis of rainfall of 58 stations spread over Chhattisgarh state indicated that the rainfall is showing declining by 35 percent at many stations and 5% increase at some stations which in turn bring changes in hydrological cycle over the period of the years (Sastri, 2009). He also found that in the recent years, the climate of some districts like Mahasamund, Durg, Rajnandgaon, Kanker has been changed to semi-arid from moist or dry sub-humid climate. Intergovernmental Panel on Climate Change of United Nations predicted that there would increase in frequency of dry spells/droughts, heat waves, heavy rainfall events over tropical areas of Asia. In this context, it is imperative to create awareness and inculcate knowledge on climate change and also train them for climate resilient agriculture to mitigate the ill-effect of climate change and to sustain agricultural production in future. On the other hand many progressive farmers are already aware the changes in climate and adapted to the current situation. For instance, almost all the farmers shifted to cultivation medium duration rice varieties during *kharif* season by avoiding long duration varieties due to failure of October month rainfall. Some young progressive vegetable farmers are using daily evaporation data and based on that they are irrigating their vegetable crops judiciously.

## Comparative studies of Indian seed laws with special reference to Protection of Plant Varieties and Farmers Rights Act

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Sustained increase in agriculture production and productivity is dependent, to a large extent on development of new and improved varieties of crops and an efficient system for timely supply of quality seeds to farmers. Agriculture as a livelihood, directly supports 59 % of Indian work force thus, any technological intervention will have multifold effect on millions of poor people engaged in agriculture and allied activities. However, adoption and dissemination of any technology is dependent on policy support and effective benefit sharing mechanism through apt regulations. In the changing context of commercialization of agriculture, India has developed and enacted various seed laws and seed policies to ensure the good quality seed supply to the farmers. The Seeds Act (1966), Seed Rules (1968) Seeds Control Order (1983), New Policy on Seed Development (1988), Plants, Fruits and Seeds (Regulation of import into India) 1989, Essential Commodities Act (1955), Protection of Plant Variety and Farmers Right Act (2001), Protection of Plant Varieties Rules (2003), National Seed Policy (2002), Seeds Bill (2010) etc. forms the basis of promotion and regulation of the Seed Industry. Different legislations are enacted to ensure quality seeds, right from the production to processing, certification, labelling and marketing. Seed legislations were initiated in the country by establishment of National Seed Corporation during 1963. However, major breakthrough came in 1966 by enacting the Seed Act in 1966, to regulate the growing seed industry. This act provides a system for seed quality control through independent State Seed Certification Agencies. The Seed Rules, 1969 provided regulatory framework for effective implementation of various provisions under Seed Act 1966. The inclusion of seeds as an essential commodity under the Essential Commodity Act, 1955 brought the Seeds (Control) Order. The New Policy on Seed Development (1988) was formulated to provide Indian farmers with access to the best available seeds and planting materials from domestic as well as overseas countries. Further, Plants, Fruits and Seeds Order (Regulation of Import into India order) 1989 was made to provides regulations during import based on post entry quarantine checks. Seed sector is in the process of rapid change in post WTO era and under TRIPS agreement it is obligatory for the member countries to provide for protection of plant varieties either by a patent or by an effective *sui generis* system or by any combination thereof. The *sui generis* system for protection of plant varieties was developed by India integrating the rights of breeders, farmers, and village communities. The Protection of Plant Varieties and Farmers Right Act were thus formulated in the year 2001. Further, National Seed Policy (2002) was formulated to raise India's share in the global seed trade by facilitating advanced scientific aspects to farmers. To replace the existing legislation on seeds (The Seeds Act, 1966- which regulates only the notified varieties of crops) Seeds Bill, 2004 was first introduced in the Rajya Sabha on 9<sup>th</sup> December, 2004 aimed at regulating the quality of seeds for sale, import and export; facilitate production and supply of quality seeds and addressing other matters related to seed. The bill was referred to Parliamentary Standing Committee on Agriculture and suggestions were made by PSCA which was approved by Union Cabinet in 2010. The revised bill (Seed Bill, 2010) is pending for consideration in the Upper House of the Parliament. The various seed law and policies are protecting the rights of researcher and farmers and taking care of quality seed from production to consumption points as farmers' gets best quality seed.

## Tailoring indigenous urdbean (*Vigna mungo* L. Hepper) landraces for enhancing yield through ideotype breeding, physiological interventions and adaptive selection

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Being a rich source of protein, it is important ingredients in the daily diet of the Andaman & Nicobar population, urdbean is one of the important pulse crops well suited for cultivation in a rice-pulse cropping system under rice fallow conditions primarily to conserve soil nutrients and utilized left over soil moisture having average meager yield per capita. In spite of their importance, the efforts done into the research and development have been insignificant, whereas problems confronting urdbean improvement are enormous for enhancing productivity. The genetic resources are the turning point on the accurate selection of parents from which to generate superior breeding populations, and the selection of high-yielding genotypes. Plant breeding is mostly based on “defect elimination” or “selection for yield”. A valuable additional approach is breeding for crop ideotype; plants with model characteristics known to influence photosynthesis, growth and (in cereals) grain production. An optimized crop ideotype will make a minimum demand on resources per unit of dry matter produced. Development of the ideotype concept has focused the attention of plant breeders on the identification of simple morphological characters which influence in determining yield. A major advantage in breeding for ideotype is that genes for certain characters can be easily introgressed from the related species. Characters for ideotype breeding such as plant height, number of branches, pod length and for physiological parameters such as days to flowering, days to maturity and leaf shape can be greatly influence crop canopy structure and radiation interception. Such characters could be rapidly modified by selection to increase crop photosynthesis and yield. Thus, for selection of suitable genotypes 16 promising urdbean landraces and genotypes was evaluated in an advanced breeding trial to estimate the genetic variability, interrelationship for yield and yield attributing traits under tropical islands conditions. The results revealed that there was sufficient genetic variability for plant height, number of branches per plant, number of pods per plant and seed yield per plant, due to high genotypic and phenotypic variances for these traits. Hence, yield improvement in urdbean would be achieved through selection for the above characters. The higher magnitudes of heritability, GCV and genetic advance were observed for plant height followed by number of branches per plant and seed yield per plant. High heritability values associated with high genetic advance were obtained for seed yield per plant, pods per plant and other yield attributing traits, except for number of seeds per pod. High heritability with moderate genetic advance was recorded for 100-seed weight and number of seed per pod. To increase yielding ability of indigenous landraces of urdbean (*Vigna mungo* L. Hepper) of Andaman & Nicobar Islands, an appropriate plant morphology based plant height, days to maturity on leaflet form was determined. Most of the existing urdbean promising landraces have ovate and cuneate while some of them lanceolate leaflets are also identified with erect and semi erect plant type. The classification of landraces gave rise to some elite lines for specific characters and it was observed that some of these accessions possessed desirable genes for more than one character and hence these could be utilized for selection and/or directly or indirectly in hybridization programme for varietal development. The landraces, ANU-11-19 (IC-0611675), ANU-11-10 (IC-0611672), ANU-11-29 (IC-0611675), ANU-11-34 (IC-0611679), ANU-11-11 (IC-0611673) and ANU-11-22 (IC-0611677) were identified as superior germplasm for yield attributing traits and plant ideotype. Generally short duration, ovate lanceolate leaf type and short statured plant type showed maximum yield advantage per plant as compared to other plant types. This study provides integrated information on these relationships and gives plant breeders a blueprint of the characteristics of high-yielding cultivars of rice in specified environments.

With the ever increasing population pressure and fast depletion of natural resources, it has now become necessary that required attention is paid to explore the possibilities of exploiting new plant resources in order to meet the growing needs of the human society, which incidentally has depended only on a small fraction of plant wealth.



## **NSBC 2015 - Track – I : BIODIVERSITY**

### **1.6. Wild Life management and innovation for sustainability**







## Avifaunal diversity in the proposed canopy Walkway at Chidiyatappu biological park, South Andaman

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We examined the avian communities in the proposed canopy walkway at Chidiyatappu Biological Park, South Andaman. The survey was conducted during the month of September 2014 and the census was concentrated in the vicinity of the proposed canopy walkway and their adjoining area using lines transect method. During the period of survey, we observed 97 species of birds including 16 endemic and 34 endemic species at subspecies level. Of the recorded species, Andaman Serpent-Eagle, Andaman Green-imperial Pigeon, White-bellied Sea-Eagle, Andaman Red-breasted Parakeet, Andaman Red-Cheeked Parakeet, Andaman Red Collared-Dove, Indian Hanging-Parrot, Alexandrine Parakeet Andaman Koel, Andaman Coucal, White-bellied Swiftlet, Andaman Blue-eared Kingfisher, Andaman Stork-billed Kingfisher, Andaman White-breasted Kingfisher, Andaman Collared Kingfisher, Andaman Chestnut-headed Bee-eater, House Swallow, Andaman Bulbul, Andaman Red-whiskered Bulbul, Asian Fairy-Bluebird, Andaman Orange-headed Thrush, Oriental Magpie-Robin, Andaman Shama, Andaman Black-naped Monarch-Flycatcher, Andaman Flowerpecker, Andaman Olive-backed Sunbird, Andaman White-rumped Munia, House Sparrow, White-headed Starling, Common Myna, Andaman Black-naped Oriole, Large Andaman Drongo, Small Andaman Drongo, Andaman Racket-tailed Drongo and Andaman Treepie were commonly observed in the proposed canopy walkway. The proposed canopy walkway site supports highest number of endemic and threatened species similar to other birding areas in South Andaman e.g. Mount Harriet, Shoal Bay and Ritchie's archipelago. Though the survey was the short duration, we added more number of species to the existing list of birds of Chidiyatappu Biological Park. The result shows that the proposed canopy walkway site support unique avian assemblages comprising many species of rare, threatened & endemic and consequently that this site may be local hotspots of avian diversity in this archipelago.

## Endemic avifauna of nicobar islands with special reference to Great Nicobar Biosphere Reserve

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The Andaman and Nicobar Islands, also often referred to as the Emerald Islands comprises 572 islands, islets and rocky outcrops and extending over 800 km. They form a major group of oceanic islands in the Bay of Bengal running between 6° 45'N and 13° 30' N latitudes and 90° 20'E and 93°56' E longitudes with extent of 8249 km<sup>2</sup>. The Andaman and Nicobar Archipelago can be broadly divided into two groups of islands, namely, the Andamans and the Nicobars. These two groups are separated by the Ten-degree Channel which is about 150 km wide 400 fathoms deep. The Nicobar groups of Islands further divided into three distinct subgroups namely, Great Nicobar, Nancowry group and Car Nicobar. The Tilangchong Island, Camorta Island, Katchal Island, Nancowry Island and Trinkat Island are the Important Bird Area identified by the Birdlife International. The aim of this study was to describe the species abundance, diversity and distribution pattern of endemic birds with species reference to Great Nicobar Biosphere Reserve. The species abundance and diversity was calculated using the census data

and field observations. The Nicobar group Islands support more than 50 species / sub species endemic avifauna. The Great Nicobar Biosphere Reserve support 32 species of endemic bird species namely, the important species are South Nicobar Scrubfowl *Megapodius nicobariensis abbotti*, Nicobar Parakeet *Psittacula caniceps*, Nicobar Long-tailed Parakeet *Psittacula Longicauda nicobarica*, Moluccan Scops Owl *Otus magicus*, Great Nicobar Hawk Owl *Ninox affinis rexpimenta*, Nicobar Wood Pigeon *Columba palumboides nicobarica*, Great Nicobar Cuckoo Dove *Macropygia rufipennis tiwarii*, Nicobar Emerald Dove *Chaleophaps indica augusta*, Great Nicobar Serpent Eagle *Spilornis minimus klossi*, Nicobar Paradise-Flycatcher *Terpsiphone paradise nocobarica*, Great Nicobar Hill Myna *Gracula religiosa helibrecta*, and Nicobar Crimson Sunbird *Aethopyga siparaja nicobarica*. The distribution of more number of endemic species of birds confirms that these islands are very important in terms of rarity and uniqueness. The patterns of diversity, distribution and endemism are discussed in terms of conservation priorities

NSBC- 2015- T01- WM – 03

### Empowerment of tribes in biodiversity of Chhattisgarh

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A socio-economic-participatory survey was made during 2011-12 and 2012-13 with emphasis on empowerment of STs in 3 different parts of Chhattisgarh. For this study 30 villages, 10 from each part and 300 respondents were selected. The number of respondents in each part was taken in proportion of the share of ST population viz. Northern part – 100, Central part – 120 and Southern part – 80. The findings of study revealed a very dismal scenario of empowerment of tribal community in the state. Their socio-economic-participatory pattern in the state is as interesting and varied as the tribes. Each tribe has its own dialect. Therefore, communication gap and low interaction exists with development schemes and developed society and also among different tribes. The land holding pattern among tribal is not much different to that of general population, the 6.96 lakhs tribal families out of 14.2 lakhs are BPL. It is true that their needs are limited but most of them are lacking the participation in various schemes/missions/programmes run by various departments of government such as tribal development board, agriculture and forest department and number of NGOs. STs were found to be sufferings from constraints of various intensities viz. naxalism (63.3%), alcoholism (74.3%), migration (27%), malnutrition (30%), unemployment (30.3%), communication gap (38%) and atrocities (23.7%).

NSBC- 2015- T01- WM – 04

### Endemic plants diversity of Great Nicobar Biosphere Reserve (GNBR) and conservation strategies

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The Great Nicobar Island is the southernmost island of Andaman and Nicobar archipelago, situated between 6°45' N and 7°15' N latitude and 93°38' E and 93°55' E longitude. The island presents varied natural panorama and is covered with virgin lush evergreen dense tropical forest extending from sea coast to the hill tops with marine impacts having warm and humid climate. The forest wealth is by far the richest natural endowment of the island. The Great Nicobar Biosphere Reserve (GNBR) of this island is one of the 18 Biosphere Reserve created under the Man and Biosphere Programme of MoEF & CC. The GNBR with a total area of 885 km<sup>2</sup> encompasses two National Parks, the Galathea National Park which resents Galathea river basin composed of low-lying hills not exceeding 250 M and the Campbell Bay National park with the high mountain ranges. The extremely high endemism and extraordinary diversity at the species and community levels make the Campbell Bay National Park one of the hottest hotspots in the world. About 655 species of flora are reported from Great Nicobar Island. Among them, 88 endemic species belonging to 75 genera, 41 families documented from different forests. Of which,



30 species are exclusively reported from Great Nicobar Island, while 18 species identified from entire Nicobar group of islands and 40 species from Andaman and Nicobar Islands. Some of the threatened factors such as over-exploitation of natural resources, climatic change, Tsunami and other anthropogenic activities adversely affect the existing ecosystem and it may lead to the rarity of many species in future because environmental conditions with combination of factors play a key role in defining the function and distribution of biodiversity. There is an urgent need for developing pragmatic conservation strategies for endemic plants in the Great Nicobar Biosphere Reserve (GNBR), which may lead to their effective protection.





## **NSBC 2015- Track – 2: CLIMATE CHANGE**

### **2.1. Climate change adaptation in agriculture and natural resource management**







## Soil and plant nutrient status as influenced by organic farming in long pepper (*Piper longum* L.)

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The concept of organic farming is relevant to the field of medicinal and aromatic plants as it could help in reducing the pesticide residues from the final drugs and maintain the ecological balance. Systematic efforts could help in understanding the effect of organic inputs on plant and soil health. An experiment was thus carried out for three years in long pepper, an important medicinal, to study the effect of various combinations of organic manures and bio-fertilizers on crop growth, nutrition and soil fertility status including microbial population after crop harvest. Varied levels of farm yard manure (FYM - 30 and 40 t ha<sup>-1</sup>), vermicompost (VC - 1 and 2 t ha<sup>-1</sup>), neem cake (NC - 1 and 2 t ha<sup>-1</sup>) and bio-fertilizers (BF) viz. *Azospirillum*, phosphate solubilizing bacteria and vesicular arbuscular mycorrhizae (each at 10 kg ha<sup>-1</sup>) were tried in sixteen different combinations. Results revealed that application of organic manures had a significant impact on plant and soil nutrient status after three years of cropping. The highest tissue nutrient content and nutrient uptake were recorded in the treatment FYM 40 t + VC 2.0 t + NC 2.0 t + BF 10 kg ha<sup>-1</sup>, wherein the inputs were applied at highest level. Increase in organic carbon, available nutrients (nitrogen, phosphorus and potassium) and microbial count in the soil after three years of cropping were also recorded in the same treatment. Thus, it could be concluded that application of organic manures and bio-fertilizers help to improve the soil fertility in long term.

## Livestock production adapting to climate change

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Climate change is one of the most serious long-term challenges facing farmers and livestock owners in India. The continuous heat waves and drought as a result of climate change has impacted livestock production resulting in severe economic loss to the poor and marginal farmers in India. In the present changing climate scenario, there are numerous stresses other than the heat stress which constrain the livestock and severely hampers their production. It is therefore imperative that animal agriculture practices and the welfare of animals be considered keeping in view the multiple stresses impacting livestock production when developing climate change policies and programs. Many of the adaptive strategies for managing climate change directly or indirectly involve technology. The process of adaptation of livestock production system to climate change involves (i) defining different adaptation options; (ii) technological interventions and (iii) supporting adaptive capacities. The different livestock adaptation strategy under ensuing climate change scenario includes (i) breeding strategies; (ii) livestock management systems; (iii) institutional and policy changes; (iv) science and technology development; and (v) capacity building for livestock keepers. Research must continue developing new techniques for effective management of livestock production system to changing climate. New indices that are more complete than THI to evaluate the climatic effects on each animal species must be developed and weather forecast reports must also be developed with these indices, to inform the farmers in advance. Above all to beat the climate change or in any case not to let the climate beat livestock systems, researchers must be very aware of technologies of water conservation. The integration of new technologies into the research and technology transfer systems potentially offers many opportunities for further development of climate change adaptation strategies.

## **Correlation studies on available calcium and soil properties in different soil type of Malkharauda block under Janjgir-Champa District in Chhattisgarh**

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The study was carried out to evaluate the soil fertility status with respect to available calcium nutrient status and its relationship with important physico-chemical characteristics in different soils of Malkharauda block under Janjgir-Champa district of Chhattisgarh during 2013-14. Grid based 1975 surface (0-15 cm depth) soil samples were collected using Global positioning system (GPS) from 110 villages of Malkharauda block. The soil samples were analyzed for pH, EC, OC and calcium. Most of the soils, pH varied from 4.2 – 8.0 and indicated that soils were found to be moderately to slightly acidic in reaction. The organic carbon content in these soils varied from 0.14 – 1.00 per cent which was observed to be medium to low in status. The electrical conductivity (EC) varied from 0.01-0.97 dS m<sup>-1</sup> with a mean value of 0.16 dS m<sup>-1</sup> at 25°C of the Malkharauda block. The available calcium status varied from 448-9856 kg ha<sup>-1</sup> with a mean value of 5059 kg ha<sup>-1</sup>. Correlation studies amongst available calcium nutrients and soil properties (pH, EC and OC) revealed significant positive correlations between soil pH and available calcium.

## **Impact of crop residues of direct seeded & transplanted rice and nutrient management on soil moisture regimes and productivity of chickpea under rice chickpea cropping system in Vertisols under rainfed conditions.**

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Field experiment was conducted during *rabi* seasons 2012-13 and 2013-2014 at research farm of IGKV, Raipur Chhattisgarh. To study the Impact of crop residues of direct seeded & transplanted rice and nutrient management on soil moisture regimes and productivity of chickpea under rice chickpea cropping system in Vertisols. The experiment was laid out in split plot design with three replication. Transplanting of paddy seedlings is common method of crop establishment in the irrigated rice systems of Asia but transplanting is labour intensive. The preparation of land for transplanting paddy (puddling) consumes about 20-40 % of the total water required for growing of crop and subsequently poses difficulties in seed bed preparation for succeeding wheat crop in rotation. It also promotes the formation of hard pan which effects rooting depth of next crop. So, discussed the residual effect of different methods of rice establishment on chickpea production as well as the moisture conservation and water use efficiency significantly higher in transplanted rice and root depth and volume higher in the direct seeded rice.

## **Influence of weather parameters on quality of rice**

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India has achieved self sufficiency in production of major food crops including rice. Rice production in India has witnessed a spectacular increase over decades from 34.6 (1960-61) to 103 million tonnes (2012-13). Having achieved self sufficiency in production, emphasis on breeding for improved rice grain quality has received increased attention in recent years. The demand for high quality rice is continually increasing, especially on cooking and eating qualities as well as nutritional quality. However, quality traits are complex in nature and are highly difficult to deal although not impossible. Knowledge accumulated in the past three decades clearly shows that the eating and cooking qualities are related to the physical and chemical properties of the rice grain. Rice grain quality can be affected by variety, environment, and processing. People from different regions have different tastes and preferences which depend partly on historical and socio-cultural factors. Based on the consumer preference, quality of one geographic region may be different from the other. Top quality rice in one region may be considered different in quality in another region. It is possible to translate consumer preference for cooking quality into measurable chemical properties. Cooking quality depends on a number of characteristics: amylose content, gelatinization temperature, gel consistency, grain elongation and aroma. The effect of environmental factors on starch is likely to exert the biggest influence on cooking properties. Every year breeders include standards in their trials for monitoring on the agronomic performance of breeding material. We collected quality evaluation data on those standards to develop a database for the effect on quality of different weather conditions. There are literally few studies addressing the effect of weather parameters influencing the rice quality. The present study is aimed to understand the environmental effect on the quality parameters in rice. The present study involved popular aromatic short grain rice, Badshabhog grown at Raipur, Chhattisgarh during 2006 – 2013 and quality analysis performed at ICAR – Indian Institute of Rice Research (formerly Directorate of Rice Research) following the standard methods. Influence of six weather variables on seven key quality parameters is determined following the regression analysis. Results indicate the effect of total rainfall and rainy days on head rice yield, water uptake and volume expansion ratio; effect of temperature on amylose content and elongation ratio; wind velocity on gel consistency and alkali spreading value. These weather variables influenced the quality during panicle initiation to harvest in the months of August, September and October. It is to be hoped that the knowledge and interest generated here will provide further stimulus to work in these areas, and help raise the research priority on the qualities of rice of the different varieties to be developed.

## **Impact of rice establishment method on moisture conservation and cracks on rice-chickpea cropping system on Vertisol in Chhattisgarh region**

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A field experiment was conducted during *rabi* seasons 2014-15 on vertisol at research farm IGKV, Raipur, Chhattisgarh to study the residual effect of rice establishment method on moisture dynamics and cracking pattern in rice-chickpea cropping system. The experiment on rice chickpea cropping system was initiated with chickpea crop with tree rice establishment method namely, puddled transplanting, unpuddled transplanting (mechanical method) and direct seeded rice. The effects of rice establishment methods were significant on the soil moisture content (soil moisture dynamics) and crack parameters. The mean weight diameter, cracks length, crack width and

crack volume were significantly higher in puddled transplanted rice method than unpuddled and direct seeded rice establishment method. However, the puddled transplanted rice showed higher soil moisture conservation in comparison of unpuddled transplanted and direct seeded rice establishment method.

NSBC- 2015- T02- CCA- 07

### **Impact of temperature on the productivity factors of apple under the present climatic scenario**

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In Himachal Pradesh, the climate has changed significantly over the last three decades. Change in climatic variables like temperature and precipitation in the form of rainfall and snow has influenced the distribution and production of temperate fruits. Apple is the major fruit crop of high hills of the state and its fluctuating production trends over the years has become a major concern to the farmers, scientists and policy makers. Based on the meteorological data of station which is located under the temperate zone has been observed that there has been significant increase in the maximum temperature at different intervals. Precipitation in the form of rainfall and snow received over the years has also shown considerable decline. Climatic conditions during winter play an important role in temperate fruit production particularly apple, as they require specific winter chilling to overcome winter dormancy. Winter chilling can be measured in the form of chilling hours or chill units. The relationship between mean temperature of winter months (December, January and February) and actual chilling accumulation was formulated in the form of regression equations. The regression equations were used to determine the projected impact of temperature increase in the winter months. The impact of spring temperatures i.e. March and April months on productivity and fruit shape of apple were also studied and has been reported in the paper.

NSBC- 2015- T02- CCA- 08

### **Improving soil quality and crop productivity minimization of soil disturbances**

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Productivity of crops directly related to soil health which means that soil is one of the most important natural resource which provides the nutrition to crops. Deterioration of soil health is one of the major constraints responsible for decreasing trends in agricultural production and productivity in specific. Managing soil health is an important component for sustainable crop production. In healthy soils, physical, chemical, and biological processes and functions drive the productivity of the soil. Environmental qualities are to be sustained for future generations. Increased inputs and technologies in modern agricultural production systems can often compensate for and mask losses in productivity associated with reductions in soil quality. However, increased agricultural inputs not only reduce economic sustainability but also increase the potential for negatively impacting environmental quality. The advent of reduced-and no-till systems has greatly influenced to capture and retain moisture in the soil during cropping non crop periods to a great extent and it made possible to reduce fallow intensity and in turn helped in increasing cropping intensity in the production systems. For the purpose of obtaining the maximum crop productivity and improve soil health importance has been given to integrated nutrient management to conserve soil moisture and improve fertility of nutrient poor agriculture soil.



## Price analysis of marine and freshwater fishes in North and Middle Andaman District- India

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Price and demand of perishable aquatic marine and fresh water fishes depends mostly on the availability during the seasons which controls the market. Over here an attempt has been made to study marketing behaviour in terms of selling price and market efficiency of two un regulated market at Diglipur in North and Middle district. Data were collected from two un organised market through structured interview and personal observation with the key informants at weekly intervals on the products available and sold during march 2009 to December 2014. The products were grouped as per the market price in the category i.e. Group I (Rs. > 150), Group II (Rs. 100 to 150) and Group III (Rs. <100) both for marine and fresh water fishes respectively. The average highest price in the category of the marine fishes was recorded to be Rs. 325 / kg for *Penaeus monodon* (Jinga big) followed by Rs.155 / kg for *Metapaeneus sp.* (Jinga small), Rs. 150 / kg for *Scomberomorus guttatus* (Surmai), Rs. 80 / kg for mud crab, *Scylla serrata* (Kekda), Rs. 76.67 / kg for *Liza tade* (Farsha), Rs. 73.75 / kg for *Plectorhynchus sp.* (Katla), Rs.58.89 / kg for *Portunus sp.* (Kekda), Rs. 61.67 / kg for *Mugil cephalus* (Farsha), Rs. 60 / kg for *Carangoids sp.* (Kokari), Rs. 55 / kg for *Sphyraena jello* (Dandus), Rs. 51.11/ kg for *Nemipterus japonicus* (Rani), Rs. 45.83 / kg for *Leiognathus sp.* (Chanda), Rs. 39.17 / kg for *Rastrelliger kanagurta* (Bangdi), Rs. 33.33 / kg for *Trachurus sp.* (Topi), Rs. 33.05 / kg for *Sardinella sp.* (Tarni), Rs. 30 / kg for *Skate and Rays* (Shankar) and Rs. 24.17 / kg for *Stolephorus sp.* (Maya). Among the fresh water fishes average price recorded as Rs.272/kg for *Heteropneustes fossilis* (Singhi), followed by Rs.270/ kg for *Clarias batrachus* (Magur), Rs. 260 / kg for *Pangasius* (Pangasius), Rs. 235.5 / kg for *Catla*, Rs. 198.5 / kg for *Labio rohita* (Rohu), Rs. 190 / kg for *Cirrhinus mrigala* (Mrigal), Rs. 183.73 / kg for *Puntius javanicus* (Potti), Rs. 180 / kg for *Cyprinus carpio* (Common Carp), Rs.155.83 / kg for *Hypophthalmichthys molitrix* (Silver Carp), Rs. 115.5 / kg for *Oreochromis sp.* (Telapiya), and Rs. 85 / kg for *Ctenopharyngodon idella* (Grass Carp) was recorded during the period. The market efficiency of the fresh market fish ranged from 0.65 in group I, 0.70 in group II and in group III it was 0.62 while in marine fish market efficiency in group I was 0.82, group II was 0.84 and group III was 0.70 respectively. The study infers that regulated market can be established at Diglipur which will protect the consumer's interest and encourage producers with remunerative prices which will add to better livelihood in changing climate of this Island ecosystem.

## Micro-propagation studies on *Eulophia andamanensis* – A potential tropical orchid of Bay Island

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*Eulophia andamanensis* is one of the highly evolved terrestrial orchid species, known worldwide for its longest spike length and long lasting nature. The rare greenish white flowers with maroon stripe have made it exceptionally popular as a cut flower. This orchid is commonly propagated by division of pseudobulbs. The vegetative propagation is slow as the 3-4 years old mother plants yield very few pseudobulbs. Therefore an effort was made to develop efficient regeneration system through micro-propagation with different explants of *E. andamanensis*. Pseudobulbs, leaf bud and juvenile shoot were used as the different explants in the experiment. The surface sterilized explants were cultured on MS medium supplemented with different concentrations of 1 mg/l



BAP + 0.5 mg/l NAA, 2 mg/l BAP + 0.5 mg/l NAA, 2 mg/l BAP + 1 mg/l NAA, 1 mg/l Kinetin + 1 mg/l NAA, 2 mg/l Kinetin + 1 mg/l NAA, 3 mg/l Kinetin + 0.5 mg/l NAA to find out the best treatment combination for culture establishment. The results showed that explants of pseudobulb placed in MS medium supplemented with 1mg /l BAP + 0.5 mg/l NAA followed by 2 mg/l BAP + 0.5 mg/l NAA gave best response. The explants of pseudobulb showed better callus induction than the cultures of leaf buds. Callusing was not observed in leaf slices and buds explants.

NSBC- 2015- T02- CCA- 11

## Evaluation of virgin coconut oil extraction technologies

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Car Nicobar is one of the prominent producers of coconut in the Andaman and Nicobar Islands. Virgin coconut oil (VCO) is growing in popularity as functional food oil and the public awareness of it is increasing. It is expected that the demand of VCO will experience a dramatic increase in the market and it may be a livelihood option in future for coconut producers. Nicobari tribe of Andaman and Nicobar Islands extracted the coconut oil by its traditional method *i.e.* natural fermented method for its domestic consumption and religious purpose. The keeping quality of traditionally extracted VCO is very poor and unhygienic. It is not suitable for long term storage purposes. Traditional method of virgin coconut oil takes more time and labour and also more losses of oil were observed. The VCO is to be produced correctly under well-managed, hygienic conditions with the help of modern technology for tribal health and improving livelihoods of smallholder coconut processors. For above circumstances the study was conducted in randomized block design with 3 treatments viz. T<sub>1</sub>: Natural fermentation method T<sub>2</sub>: Low Pressure oil extraction method and T<sub>3</sub>: Modified Kitchen Method on 7 farmer field. The process was repeated three times at each replication. The result revealed that, the oil recovery from T<sub>1</sub>: 25.3 litre per 100 kg fresh grated coconut kernel, T<sub>2</sub>: 30.7 litre per 100 kg fresh grated coconut kernel and T<sub>3</sub>: 34.9 litre per 100 kg fresh grated coconut kernel. Hence, it can be concluded from the above study that, the modified kitchen method is suitable home consumption, oil have transparent colour with low moisture content. Keeping in view the demand of virgin coconut oil, high pressure oil extraction machine were need to be introduced in this Islands.

NSBC- 2015- T02- CCA- 12

## Extraction and quantitation of chitin, chitosan and chito oligo saccharides from shrimp waste

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Chitin is an important organic component of exoskeleton of crustaceans, insects and fungi. The fish processing industry produce large amount of shell waste which is a major cause of pollution. The fishery waste can be utilized for production of value added products such as chitin, chitosan etc. Compositional analysis of shrimp shells waste was carried out. Demineralization of shrimp shell was done by using 2N HCl for 2 hour at solid to solvent ratio 1:15 in an incubator shaker. Later deproteination was carried out by using 2N NaOH for 2 hour at solid to solvent ratio 1:20 in an incubator shaker at 50-60°C. Conversion of chitin to chitosan was achieved through deacetylation using 50% NaOH (1:50) in the presence of steam at 121°C for 30 minutes. Extracted chitosan was subjected to solubility test using 1% acetic acid and quantified. Chitosan was hydrolysed by 7 N HCl at 90°C for 6 hour to produce Chito oligo saccharides and the concentration was estimated by reducing sugar method *i.e.* by Nelsons - Somogyi method. The compositional analysis of shrimp shell waste revealed, dry matter 96.32 ± 0.02%, ash content

20.02 ± 0.09 %, ether extract 4.51 ± 0.09%, crude protein 50.83 ± 0.18%. Dried grounded shrimp sample enabled a total recovery of 13-15% chitin after demineralization and deproteinization. The extracted chitin was subjected to deacetylation using 50% NaOH and 80-85% chitin was transformed into chitosan. Chitosan was confirmed by solubility test using 1% acetic acid and quantified using colorimetric test, which showed the concentration of chitosan 53.9 ± 0.73 µg/ ml. Chitooligosaccharides was quantified by reducing sugar method and concentration was 4.4 ± 0.12 mg/ml. Chitin, chitosan and chitooligosaccharides can be produced using simple and easy to scaled up methods. These processes could be used for turning fish waste into value added products.

NSBC- 2015- T02- CCA- 13

## Water management technologies for higher crop and water productivity under Island ecosystem

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In Andaman & Nicobar Islands, impeded drainage in the low-lying areas and inadequate soil moisture in the uplands results in lower land and water productivity. In order to increase the farm production and water use efficiency, location specific water harvesting and management technologies were demonstrated at selected farmers field through Farmers Participatory Action Research Programme (FPARP). Five technologies viz. crop diversification through broad bed and furrow system (25 demonstrations), micro irrigation (10 demonstrations), pond based integrated farming system (15 demonstrations), plantation based integrated farming system (15 demonstrations) and moisture management in ground nut under coconut plantation (25 demonstrations) were demonstrated on 0.20 ha covering a total of 18 ha spread over 35 villages across Andaman Islands. Under Broad Bed and Furrow System, net income of Rs. 40,000/year was obtained through cultivation of vegetables in the beds and fish culture in the furrows with water use efficiency of Rs. 15/m<sup>3</sup>. In pond based integrated farming system, Rs. 35,000/year was obtained as net income with water use efficiency of Rs. 65/m<sup>3</sup>. Similarly, under plantation based integrated farming system, Rs. 45,000/year was obtained with water use efficiency of Rs. 85/m<sup>3</sup>, whereas, ground nut cultivation in coconut plantations gave net income of Rs. 8,000/year with water productivity of Rs 40/m<sup>3</sup>. Drip irrigation resulted in 20-30 % yield increase and 50-60 % water saving at all the locations with water use efficiency of Rs. 75-85 /m<sup>3</sup>. Among the technologies, broad bed and furrow system was found to be the best option for crop diversification in water logged areas, while integrated farming performed better in hilly and undulated terrain. Implementation of these technologies through participatory mode proved to be highly successful and benefited the farmers by enhancing the farm income besides meeting their nutritional requirements.

NSBC- 2015- T02- CCA- 14

## The species *Puntius javanicus* (Bleeker), growth model in tropical fresh water of West Bengal condition and may sustain in wide fresh water environments in India

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*Puntius javanicus* (Bleeker) growth model is presented in tropical fresh water of West Bengal condition. The species may sustain in wide fresh water environments of tropical and subtropical India. The exotic species growth model  $Y = 55.882 \ln(X) + 1$ ,  $R^2 \sim$  close to unity, of Java punti *Puntius javanicus* in Indian is described here. Where 'Y' indicates weight gain in gram and 'X' indicates age in months. The experiment was conducted in congenial micro-

ecology of *Beel* water condition in West Bengal. This species apart from *Tilapia* may become a ecobomic quality fish. The species is heavily feed on phyto-plankton; growth is dependant on such available plankton as well as dissolved oxygen. Depth of water may even shallow ( $\geq 3$  feet) for this species stocking density @ 10,000 when 30 percentage species is *P. javanicus* stocking density @33,300 for mere species. Yield may become 10 kg per cubic metre of ecological waters. Pictorial *Puntius javanicus* growth model and the species photograph are also included in this scientific communication.

NSBC- 2015- T02- CCA– 15

## Climate Change: Impact and Adaptive Strategies for Seed Spices

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Seed spices are most important commercial crops of India which are having high domestic and international demand with special reference to cumin and coriander are the major seed spices produced and export from India to many countries. Since these crops are seasonal crops and grown in Rajasthan, Gujarat, Uttar Pradesh, Madhya Pradesh and few South Indian States. These crops are grown during winter season having mild dry climate without much variation in day and night temperature. These crops prefers dry climate with sufficient residual soil moisture for better vegetative growth. Wide variation in day and night temperature adversely affects the growth and development of these crops. In seed spices frost damage in cumin, coriander, fenugreek; incidence of aphids and powdery mildew in coriander and fenugreek; unseasonal rainfall & hailstorm damage and soil degradation etc. are the challenges for their successful cultivation. To mitigate all these abiotic and biotic adversities there is a need to develop and adopt efficient crop cultivation practices that includes, selection of appropriate area for cultivation of particular seed spice crop, suitable and climate resilient varieties, adoption of protected cultivation practices like temporary plastic walls against frost, walk in tunnel & high plastic/insect proof nylon net covered tunnels for rains and hail storms, use of IPM and IDM forecast models for effective management of pest and diseases. Looking to present climate change scenario there is a immediate need for intensive research to study the impact of climate change on yield and quality of seed spices, to identify nontraditional areas for cultivation, widening genetic base and evaluation of germplasm for adoptability, protected cultivation practices etc. Improved varieties of seed spice crops like ACr-1 of coriander, AA-93 of ajwain, AFg-4 of fenugreek, ACel-1 of celery are highly suitable under varied climate conditions and adversities

NSBC- 2015- T02- CCA– 16

## Socio- economic study of scheduled tribes of Andaman and Nicobar Islands and their future prospects

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An archipelago of 572 Islands , covering an area of 8249 square kilometers are spread over about 780 kilometers from North to South in the Bay of Bengal and its extreme width, however is nowhere more than 32 miles. These islands inhabited for several thousand years. The earlier archaeological evidence yet documented goes back some 2,200 years; but few indications from genetic, cultural and linguistic isolation studies point to habitation going back 30,000 to 60,000 years well into the Middle Paleolithic. The Island's tribal people maintained their separated existence through the vast majority of time, diversifying into distinct linguistic cultural and territorial groups. By the 1850 when they first came into sustained contact by the outside group British people here. They are two categories as (1) Negrito types – Great Andamanese, Jarawas, Onges, Sentinelese. They inhabited in Andaman groups of Islands (2) Mongoloid types are Shompens and Nicobarese inhabited Nicobar group of Islands. Only Nicobarese

scheduled tribe is developing his socio economic status and little improvement in Andamanese primitive tribe. People remaining four tribes are primitive till today. Total population of tribal Person is 28530, in which 27168 Nicobarese and 769 are other primitive tribes. As per census 2011 the scheduled tribes of Andaman & Nicobar Islands are engaged as 0.9% agricultural labourers , 1.2% cultivators, 21.0% household industries and 76.9% in other works. Total scheduled tribes literates are 18,658 person in these Islands which means literacy rate 75.6% out of which 99% Nicobarese and remaining less than 1% is other primitive tribes. Nicobarese inhabit 12 out of the 22 Islands in the Nicobar district. The major concentration of the Nicobarese is at Car Nicobar Islands while the other Islands are sparsely populated. Nowadays most of the child deliveries take place in hospitals and primary health centres. A sizable number of Nicobarese are holding responsible jobs in different government offices and in private organisations as Administrators, Doctors, Teachers, Clerks, Nurses, Extension Officers, Police, Army, Air Force and Navy. At present 22 great Andamanese children are studying and 21 great Andamanese are employed in various government departments and remaining tribes Jarawas, Sentinelese, Onges , Shompens spend their life in hunting fishing, gathering forest products . Andaman & Nicobar Administration is providing different types of facilities to the tribal peoples time to time and protect their livelihood, rights and revenue. Police of Andaman & Nicobar Administration has taken strict action against Poachers, intruders and those who committed crimes on the tribal people.

NSBC- 2015- T02- CCA- 17

### **Bamboo straw– an Eco Friendly straw for climate change**

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A drinking straw is a short tube intended for transferring a beverage from its container to the mouth of the drinker by use of suction. A thin tube of plastic such as polypropylene and polystyrene or other material, straight or with an accordion - like living hinge, it is employed by being held with one end in the mouth and another end in the drink. Muscular action reduces air pressure in the mouth, whereupon atmospheric pressure forces the drink up the straw. One particular advantage of using a straw when drinking is the reduction of tooth decay. Many soft drinks have acidic properties, and using a straw reduces the liquid contact with the teeth, reducing tooth decay and the risk of cavities. If you're interested in green living, try to remember to stop drinking out of a plastic straw. Drinking plastic straws are bad for the environment – first because the plastic straws, itself, doesn't biodegradable; and second, each straw usually comes wrapped in wasteful paper. Plastic straws aren't recyclable and end up in landfills or the ocean. However, alternatives to plastic straws, which people use once and then throw away, easily degradable and free pollution i.e. Bamboo (*Schizostachyum* sp) found in the forest of Andaman and Nicobar Islands. Particularly the said species are more favorable for this natural straw because of the uniform size with a diameter of 3-6 mm and length 28-33 cm (node to node). Small farmers can adopt this plantation as well as small scale industries and SHGs can focus on marketing channel for coconut water (tender nuts) drinks, fruit juice and health drinks. From a cultivated plantation probably 19,99,800 numbers of bamboo straw can be produced from 3,333 clumps ( 3culms per clump) at the spacing of 3 X 3 m per ha with the economic value of Rs`1,99,980 per year. If it is progressed, gradually it started creating sustainable employment generation, provided diversified direct and indirect income to the local villagers, improved the farming potentials, developed village marketing and provide much needed entrepreneurial attitude. As a whole there was a change in generation of livelihood and sustainability of the people and the place respectively. It created environmental well-being, social well-being, cultural well-being and economic well-being.



## Remediation of heavy metals contaminated soil by use of flowering plants

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The investigation was carried out in micro-plots (1.5 x 1.0 x 0.5 m<sup>3</sup>) at Micronutrient Project (ICAR), B. A. College of Agriculture, AAU, Anand. Three levels of heavy metals loading was kept through external addition of heavy metals mixture (Cu, Cr, Cd, Pb and Ni) for low level (L-HM *i.e.* initial content in soil), medium level (M-HM) and high level of heavy metals mixtures (H-HM). The soil was incubated for one month. After one month, four different flowering plant species [Marigold (MG), Gaillardia (GL), Balsam (BL) and Bataniya (BT)] were grown on heavy metals contaminated soil to study their effect on plant growth and yield as direct effect in first season (kharif) and residual effect in second season (winter). The flowers, stem, leaf and root yield of the flower plants was adversely affected due to higher level of heavy metals loading in both the seasons. In general, the marigold recorded maximum overall total biomass yield. The heavy metals removal was also higher in marigold than other flower plants under direct effect of heavy metals loading. In general, the overall results indicated that the removal of heavy metals by different parts of plants followed the order as: Cu Flower<sub>MG</sub> > Stem<sub>MG</sub> > Root<sub>BT</sub> > Leaf<sub>MG</sub>; for Cd Flower<sub>MG</sub> > Stem<sub>BT</sub> > Root<sub>MG</sub> > Leaf<sub>BT</sub>; for Ni Flower<sub>MG</sub> > Stem<sub>BT</sub> > Root<sub>BT</sub> > Leaf<sub>GL</sub>; for Cr Flower<sub>MG</sub> > Root<sub>BT</sub> > Stem<sub>MG</sub> > Leaf<sub>BT</sub> and for Pb Flower<sub>MG</sub> > Root<sub>BL</sub> > Leaf<sub>BT</sub> > Stem<sub>MG</sub>. The overall removal of the different heavy metals by the flower plants followed by the order as: for marigold Cu > Ni > Pb > Cr > Cd; for Balsam Ni > Cu > Pb > Cr > Cd, for Bataniya Ni > Cu > Pb > Cr > Cd and for Gaillardia Ni > Cu > Pb > Cr > Cd. The phyto-extraction capacity of the flower plants in removing sum of total heavy metals (Cu+Cd+Pb+Ni+Cr) removal on absolute quantity basis was in the order as: MARIGOLD > BALSAM > BATANIYA > GAILLARDIA. Thus, the overall results of the study indicated that amongst the flower plants, marigold or balsam could be grown to remediate the soil contaminated with low (*i.e.*, lower than threshold toxic limits for Cd- 3, Ni- 50, Pb- 100, Cr- 100 and Cu- 100 mg kg<sup>-1</sup>) to medium level (*i.e.*, near threshold toxic limits for Cd- 3, Ni- 50, Pb- 100, Cr- 100 and Cu- 100 mg kg<sup>-1</sup>), while bataniya could be a better option when the contamination level in soil is high (*i.e.*, above threshold toxic limits for Cd- 3, Ni- 50, Pb- 100, Cr- 100 and Cu- 100 mg kg<sup>-1</sup>). In general, the marigold could be suggested for growing on heavy metals contaminated soil for speedy bioremediation.


## Scenario of Cole crops in North & Middle Andaman

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Cole crops are important group of vegetables being popularized for cultivation in the Andaman and Nicobar Islands (ANI). Due to introduction of hybrids of cabbage and cauliflower to the Islands, its cultivation has picked up in past few years. About 200 ha. Area is under cole crops in North Andaman mainly in the river tract of Diglipur, Kalipur, V.S. Pally, D.B. Gram, Sitanagar, Madhupur and Nabagram villages. Also in Middle Andaman, an area of about 150 ha in the villages of Chainpur, Tugapur, Basantipur, Hari Nagar, Shantipur, Beta Pur, Dasarathpur, Kadamtala, and Rangat villages is under cole crops cultivation. It has been observed that only tropical and early variety of cabbage can grow successfully in this region. White Marble, Tokiata and Fujiyama are the major Japanese hybrids of cauliflower while Kaneko Cross and Lucky Ball are the important cabbage varieties grown in islands. Average yield of 4.8 t/ha (cauliflower), 4.5 t/ha (cabbage) and 5 t/ha (knolkhol) has been achieved by the farmers. However, the production is threatened by a number of factors, which need to be addressed. The farming community in island face problems in getting right kind of quality seeds at right time. Suitable institutional linkages need to be developed for ensuring proper seed supply to the needy farmers. Cost effective protected structures in the form of rain shelters, net houses, shade nets, plant covers, row covers and walk-in-tunnels and poly tunnels need to be promoted for cultivation of these crops. Islands have seasonal glut of vegetables, which causes problem of marketing the produce at right prices. For this, a vegetable storage unit and proper transportation facility need to be established to ensure fair prices to both grower as well as consumer.



## **NSBC 2015- Track – 2: CLIMATE CHANGE**

### **2.2. Coastal zone management in the ERA of climate change**







## Ring net operation from Junglighat Fish landing Centre (JFLC), South Andaman

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A study was carried out on the present status of ring net operation from Junglighat fish landing centre, South Andaman from July 2013 to June 2014 to know the status of major fish catches through ring net since 99% operations occurs from this Fish Landing Centre (FLC). The specifications of the operating ring net are: thread 1.5/2, mesh, 18 mm with 50 m depth and 1000 m length. A total of 172 visits took place during one year period and observed about 335 operations with a monthly average of  $27.7 \pm 5.2$ . Similarly the total catch was 376290 kg with a monthly average  $31357.5 \pm 5746.7$  kg. The maximum operation (59) was occurred during August 2013 with 18.8 % of catch and the minimum operation (6) was occurred during June 2014 with 2.4 % of catch. The major fish catch of ring nets were Mackerels (*Rastrelliger kanagurta*), followed by Sardines (*Sardinella* spp.), small Carangids (*Atule* sp., *Decapterus* spp., *Selar* spp., and *Megalospis* sp), Anchovies (*Stolephorus*), Milk fish (*Chanos chanos*), big carangids (*Caranx* sp., & *Carangoides* sp.), Yellow fin tuna (*Thunnus albacares*), Skipjack tuna (*Katsuwonus pelamis*) and rarely Devil Ray (*Manta birostris*). The maximum operations were carried out at around Havelock Island, followed by Chidiatappu, Long Island, Betapur, Mayabundar east and Baratang east.

## Landings of prawns (*Penaeus* sp.) at Junglighat fish landing centre, South Andaman

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An investigation was carried out on the landings of prawns (*Penaeus* spp.) at Junglighat fish landings in South Andaman from July 2013 to June 2014 to identify the status availability of the same. There are no any special gears among the fishermen of Andaman for large catch since trawl netters are catching along with other fishes like *Leiognathus* sp., *Nemipterus* sp, *Carangoids* sp., *Stolephorus* sp., *Saurida* sp., *Sphyræna* sp., Cuttle fishes, Shark, Sting ray, Eel etc., especially from Junglighat Fish Landing Centre (FLC). The specification of the operating trawl net size (from bottom to top 4 different mesh size nets jointed together) 0.75/2, mesh 30 mm with 100 md (meter depth -Counting of mesh from top to bottom), 1.5/2, mesh 60 mm with 100 md, 2.5/2 mesh 180 mm 100 m depth and 2.5/2 mesh 200 mm with 100 m depth. During one year period observed about 63 operations carried out with a monthly average of  $5.73 \pm 0.85$  (during May month no fishing due to ban for 45 days). The total catches of prawn were 5,272 kg with a monthly average  $479.3 \pm 84.6$  kg. The maximum trawl net operation (10) was occurred during December 2013 with the catch of prawn were 10.6% and the minimum operation (6) was occurred during June 2014 with 0.2 %. The maximum catch 18 % observed during September, 2013 from 7 operations. The maximum operations were carried out around Havelock Island, followed by Neil Island, Long Island, near Baratang and Near Interview Island.

## Tuna (Yellow fin & Skipjack) landings in South Andaman

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A survey was carried out on the fish catch of Yellow fin tuna (*Thunnus albacares*) & Skipjack tuna (*Katsuwonus pelamis*) landings in South Andaman from July 2013 to June 2014. There are no any special gears among the fishermen of Andaman for Tuna fishing since they are using Gill (drift) nets to catch the tuna fishes with other pelagic fishes like *Caranx* sp., *Sphyraena* sp., Shark, Marline, Devil Ray etc., especially from Junglighat Fish Landing Centre (FLC). The specification of the operating drift net in size 8/3, mesh 118 mm with 110 meter depth (counting of mesh from top to bottom), depth (width) -13 m and length-1000 kg (5 km). A total of 172 visits took place during one year period and observed about 283 operations with a monthly average of  $24.1 \pm 5.7$ . The catches of Yellow fin & Skipjack tuna were 25074 kg with a monthly average  $2089.5 \pm 422.5$  kg and 12352 kg with a monthly average  $1029.3 \pm 353.6$  kg respectively. The maximum drift net operation (81) was occurred during August 2013 with the catch of Yellow fin and Skipjack tuna were 22.3 % & 36.4% and the minimum operation (6) was occurred during May 2014 with 2.3 % & 1.5% respectively. The maximum operations were carried out at Near Ross Island, Cinque Island, Diglipur, Land fall Light house, Mayabunder Betapur, Pachim Sahar, Interview Island & Havelock Island.

## A Preliminary study on solid waste and Ghost Nets and their impact on the biotic community of Andaman Islands

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This study highlights the status of solid waste and ghost nets from some selected beaches and coral reefs of Andaman Islands. Solid waste and ghosts nets were identified, quantified and their impacts on the biotic community were analyzed from six study areas. Plastic items were the dominant waste in all the beaches with more than 60% of waste originating from plastic. Plastic bags alone comprised 21% of all solid wastes while cloth was the least prevalent waste with just 2%. Station wise, North Bay has the most solid waste with 22% and Chidiyatapu the least with 12% amongst the six beaches. It is to be noted that North Bay is a popular tourist spot and fishing activity is high in the area. Chidiyatapu is also a tourist spot but it is under a forest reserve and so dumping of solid waste is checked. While snorkeling close to these beaches, solid wastes are clearly seen which have been carried away by rain or wind into the sea. Ghost nets are a common sight in reef areas of South Andaman especially North Bay, Hut Bay etc. where fishing activity is more. It was observed that ghost nets lying over reefs easily entangled branching corals especially *Acropora* sp. and hampered their natural growth. 25 and 15 number of colonies were seen entangled to corals in North Bay and Hut Bay respectively and in lesser number in other stations. A total of 21 ghost nets were recorded out of which 7 were recorded from North Bay alone. Macroalge was seen overgrown in most discarded nets over coral reefs. Some crustaceans (juveniles of crabs and prawns) and fishes (eels, juveniles of Apogonidae, Pemphridae, etc.) were observed taking shelter inside ghost nets. *Lambis* sp. (spider couch) was found entangled in ghost nets at North Bay and Burmanullah. Much is still needed to be understood and further work and awareness campaigns are necessary to counter the menace of solid waste and ghost nets in these coastal areas.

## Aquatic and wetland plant diversity and climate change in Andaman and Nicobar Islands

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The natural water bodies and wetlands constitute the wetland ecosystem which acts as indicators of deterioration of ecological balance. The plants which are growing in aquatic and wetland situations play a very important role in maintaining the ecological balance on earth. Their decrease in number is directly proportional to the climatic change. Aquatic plants, i.e. either floating on water surface or rooted at base of water reservoirs are the first victim of climatic change. Another group is growing in semi-aquatic situations where water is being inundated for some period of time and get dried but kept moistened for rest of the months. There is one more group of plants included in this category that are well adapted to grow both in aquatic and dry habitats. The Union Territory of Andaman and Nicobar Islands are well known for their unique forest ecosystem including a number of wetlands and permanent water bodies with rich plant diversity. Due to the various developmental activities made by human being and climatic change, the number of these habitats is getting diminished day by day not only in these Islands but also at global level. If this condition continues, it will lead to the loss of biodiversity and bring a drastic change in the climate of these Islands.

## Broodstock management and captive breeding of Anemone fishes in Andaman and Nicobar Islands

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There is a great dependence of wild caught marine ornamental fishes which sustains the marine ornamental industry owing to the increasingly popular hobby of marine aquarium keeping. The habitually destructive and unsustainable exploitation of coral reefs to fuel the trade has already raised concerns in the scientific world. Therefore, urgent actions need to be taken to limit destructive exploitation of coral reefs, and to ensure the sustainability of the marine ornamental industry. Keeping this in mind, Marine Research Laboratory of Fisheries Science Division, CIARI, Port Blair has initiated research efforts in captive breeding and seed production of marine ornamental fish. This will be of assistance to supplement or replace the supply of wild caught specimens for the marine ornamental trade and potentially help to boost recovery of already delicate reef ecosystem of Andaman & Nicobar Islands through restocking. Successful captive breeding of Sebae anemone fish, *Amphiprion sebae*, Skunk anemone fish, *Amphiprion akallopisos*, Red Saddle anemone fish, *Amphiprion ephippium* has been achieved for the first time in ANI. Through various management procedures right from broodstock collection to larviculture, mass production of anemone fish juveniles can be initiated in the Islands. Broodstock management of all the three fishes were carried out in 500 L FRP tanks along with its host sea anemones, *Stichodactyla haddoni* for *A. sebae*, *Entacmaea quadricolor* for *A. ephippium* and *Heteractis magnifica* for *A. akallopisos*. Initial breeding of all the three fishes in captivity were observed within 36 days of brood stock management. Nutrient rich broodstock diet including fresh fish meat, shrimp meat and live adult *Artemia* was given timely in required quantities. Water quality parameters in the tanks were maintained as temperature  $26 \pm 1$  °C, salinity  $34 \pm 1$  ppt and pH  $8 \pm 0.2$  with a photoperiod of 12 hours (06:00 to 18:00). Incubation period was observed to be  $8 \pm 1$  days at  $28 \pm 1$  °C. Culture of micro algae and live feed organisms like *Brachionus sp.* and *Artemia* for larviculture of anemone fishes were carried out in MRL. Even though, the initial survival of larvae were very less, major bottlenecks in marine finfish breeding like egg hatching, first feeding and weaning of different larval diets have now been successfully overcome through repeated experiments.

The fast growth rate of captive bred anemone fishes which reaches marketable size within 5-6 months has attracted young entrepreneurs to adopt the technology in Islands. Unavailability of local market and expensive freight charges to airlift live fishes to mainland are some of the factors limiting the extension of this technology.

NSBC- 2015- T02- CZM- 07

## **Marine jetties as artificial reefs: A study on the fish assemblage structure from Port Blair, South Andaman**

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Artificial Reefs (ARs) are those man made structures (including marine jetties) which can support a number of native populations both moving and sessile in marine ecosystem. The present study investigated the fish assemblage structure in the marine jetties at Marina Park (MP), Panighat (PG), Chatham (CT) and Dundus Point (DP) around Port Blair, South Andaman coast. The most number of pillars in the water was found in CT (26) and MP (22) while the longest marine jetties in length were MP and PG (60 m). The average temperature ranged between 32 to 35 °C while average salinity varied from 30 to 33 ppt. The average pH was found to be alkaline (8.43 to 8.60), whereas the dissolved Oxygen (ml/l) varied from 4.42 - 5.78 and Biological Oxygen Demand (ml/l) was found to be highest in Dundus Point i.e. 1.07 and lowest was in Panighat (0.75). Sedentary organisms like oysters, barnacles, chiton, gastropods, algae etc. were recorded in all the stations, while soft corals were present only in Marina Park and Panighat. A total of 1971 individuals of fishes belonging to 38 species, 29 genera and 22 families were observed during the study. Lutjanids, Pomacentrids and Chaetodontiids were the abundant in all the jetties. The diversity indices viz. Shannon Weaver's species diversity index, Margalef's species richness index, Simpson's species evenness index and Pielou Species evenness index have shown that Marina Park Jetty is more diverse as well as abundant in fish species (1.82, 4.27, 0.72, and 0.54) even though the anthropogenic activities like tourism were observed very high compared to other jetties, while the lowest in diversity and abundance was Dundus Point Jetty (0.71, 0.74, 0.37, and 0.44, respectively). The percentage of plastic waste was maximum in all the study sites i.e. 61.1 (MP), 15.5 (PG), 71.4 (CT) and 54.5 (DP). While the minimum percentage was found to be of fishing nets i.e. 2.7 (MP), 3.8 (PG), 1.8 (DP) and Nil in Chatham. The other waste items included glass bottles, footwear, polythene covers and clothes. The results of the present study have shown that the abundance and species diversity of fishes is related mostly to the length of the jetty as well as number of pillars in the water which can act as an artificial habitat.

NSBC- 2015- T02- CZM- 08

## **Plant diversity and climate change in the coastal zone of the Andaman and Nicobar Islands**

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The earth has experienced a constantly changing climate in the time since plants first evolved. In recent history, biodiversity in the Andaman and Nicobar Islands has suffered from heavy natural disasters especially tsunami and cyclones as well as human disturbances and scorched by droughts, and soil, waters, etc. are polluted by salt. Although Andaman and Nicobar Islands constitute one of the hotspots of biodiversity with a variety of ecosystems, viz. tropical evergreen forests, wetlands, mangroves forest and coral reefs. The phytodiversity of these islands is one of the richest in the country in terms of biodiversity with remarkable degree of genetic variation. Its plant diversity comprises 3219 species under 1251 genera and 299 families belonging to Angiosperms, Gymnosperms, Pteridophytes, Bryophytes, Lichens and Algae. Mangroves and Coral Reefs across the region are two key coastal ecosystems that are expected to be significantly impacted by climate change. The climate change



not only affects the biodiversity but also devastates the entire system. In addition, Environmental conditions play a key role in defining the function and distribution of plants, in combination with other factors. Changes in long term environmental conditions that can be collectively coined climate change are known to have had enormous impacts on plant diversity patterns in the future and are seen as having significant current impacts. The ongoing climate change is a looming danger for the coastal systems, especially the mangroves which are highly vulnerable to climate change. Adverse effects on mangroves extend its serious consequence to the adjoining fragile and important ecosystems such as coral reef and sea grass bed. It is predicted that climate change will remain one of the major drivers of biodiversity patterns in the future not only in these Islands but also at global level.

NSBC- 2015- T02- CZM- 09

### **Need for an integrated coastal zone management in the Islands**

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The natural cycle of periodic climate change has been pushed by anthropogenic activities; to cause profound impact on the coastal zone affecting the biodiversity & socio-economic aspects depending on the former. Coastal zone is the buffer that dilutes the impacts from both sides and well managed coastal zone is something we need never like before. One of the major threats is subsidence of coastal lands due to sea level rising; especially for oceanic Island chains like Andaman & Nicobar. There have been many efforts from individual government bodies, NGOs and other groups to counteract the impacts of climate change. Management of coastal zones is imperative for several reasons: proper management can minimize or prevent development in vulnerable areas, ensure the health and function of critical natural systems, and protect lives, property and economic activities from hazards related to climate change and coastal zones. So, what is needed is a comprehensive integrated coastal zone management plan to nourish the coastal zone. A well-integrated approach can minimize the resource requirement and at the same time encourage community participation; ensuring maximum result. One of the key factors for a successful management plan is to have a regional base line data. During our study it was found that a base line data regarding the types, nature and status for most of the Andaman beaches are not available. Hence, it should be one of the priorities to generate a database with beach type, seasonal changes and sediment budget.

NSBC- 2015- T02- CZM- 10

### **Dynamics of coral community and ecosystems of Andaman & Nicobar Islands**

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The Andaman & Nicobar Islands form a long / narrow broken chain of Islands spread over in length of more than 700 kilometers from north to south, occupying an area of 8249 km<sup>2</sup>. These Islands are famous for nature's beauty and underwater paradise. Corals are tiny organism belonging to group Anthozoa of phylum Cnidaria. The coral is formed by creatures which are very like the sea anemones. These coral polyps are of many colours- red, yellow, green, pink, purple and white and are many shapes. These Islands are the richest of India in coral diversity with as many as 179 species belonging to 69 genera, coral colonies are near about Ross Island, North Bay, Back ride of G.B. Pant Hospital, Wandoor, Mahatma Gandhi National Park, Rangachang, Chidiyatapu, Kamorta, Nancowry, Campbell Bay and North Andaman. The Coral reef inhabitant fauna and flora of these Islands include 750 species of fishes, 1422 species of Molluses, 430 species of echinoderm, 112 species of sponges, 235 species of hard corals and 41 species of soft corals, 44 species of crustaceans, 64 species of algae and few species of reptiles and mammals. The coral named *Elentherobia*, a rare species of soft coral is a potential drug for breast and ovarian cancer. The corals of these Islands are facing two types of threats Natural and Anthropogenic. So all of us should save and protect the corals and ecosystem of marine life of these Islands, which are rare in country and world so that future generation can also enjoy underwater paradise of these Islands.



## The assemblages of benthic foraminifera in the muddy and sandy sediments of Andaman Islands

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Six core sediments and two surface sediments from seven locations were studied to understand the assemblages of benthic foraminifera in the mangrove muddy and adjacent sandy sediments from the Andaman Islands. Twenty eight species had been identified from these environments. Out of twenty eight species, fourteen species are calcareous forms and rest of fourteen species belongs to agglutinated forms. All these sandy sediments were highly subjected with the calcareous species while the mangrove fine sediments were showed predominant assemblages of agglutinated forms. Furthermore, the association of *Elphidium advenum* of calcareous hyaline form with the mangrove agglutinated species was considered as significant because of its high resistant to organic carbon environment. Similarly, *Trochammina inflata*, the agglutinated form in the sandy environment suggested that it may be due to the transport history or paleo environmental condition of high organic nature. So, the species *Elphidium advenum* and *Trochammina inflata* may be considered as a specific indicator for environmental significance.

## Meiofauna succession in a tsunami affected environment and its climatic concern in intertidal environment of Port Blair, Andaman Island, India

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This article presents the results of the distribution of meiofauna in the newly formed marine environment after the 26<sup>th</sup> December 2004 earthquake at Port Blair, Andaman, due to the subsidence of terrestrial land about 0.97 m. At this juncture, studies on the meiofaunal distribution would provide an opportunity to understand the establishment of meiofaunal community in the new environment which reflects the significant on benthos. The study was carried out at Port Blair coast at five different sites Dollygunj, Siphighat, Carbyns Cove, Wandoor, and Chidiyatappu. This study, reports forty three meiofaunal species falling under eleven groups and nematodes were the dominant group in all the stations. The cursory analysis of the past records of the cyclone and earthquake and found during the year 1980 there was a cyclone affected the Port Blair region and damaged this coast by a storm surges. Later, the regeneration of meiofauna might be occurred in a new kind of distribution and within six years (1986) it reaches to the level of 13 species and nine years duration (1989) it reaches to 47 species. The present results shows a similar kind of process repeating in this study area after the tsunami occurs in the year 2004, i.e. after four years duration this environment regenerate with 10 species which almost equal to the time duration and reciprocal level of meiofaunal assemblage. Conclusion drawn is that the meiofaunal assemblage showed fastest regeneration with higher species diversity due to the availability of nutrients, derived from the decaying plant and animal materials from the subsidence of coastal lands, even though catastrophic events occurs in these environments.

## Community on coral reef data buoy deployed near Grub Island, South Andaman

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Andaman and Nicobar Islands is one of the global biodiversity hotspots since the marine ecosystem of these Islands endowed with rich species diversities of coral reef, invertebrates, seagrass, seaweeds, mangroves, mammals etc. During 2010, increased seawater temperature (up to 34°C) led to the bleaching of about 74 to 77% of coral reef in South Andaman. After this phenomenon, we deployed a data buoy near Grub Island, South Andaman for monitoring the physico-chemical and atmospheric parameters in coral reef environment. In this present study, observations were undertaken to evaluate the macro fouling floral and faunal communities on coral reef data buoy during three years 2013, 2014 and 2015. Each year the data buoy was replaced with new one and the study was under taken during the replacement by collecting the attached organisms. Totally, 41 species were identified belonging to macroalgae (9 species), porifera (1 species), cnidaria (5 species), annelida (2 species), bryozoa (3 species), crustacea (5 species), mollusca (6 species), echinodermata (1 species) and tunicata (6 species). The biomass (5.94 kg), population density (654 individuals /m<sup>2</sup>) and Margalef's index species richness (2.46) were recorded during the year 2015. The physico-chemical parameters (pH, temperature, salinity, dissolved oxygen, total suspended solid, nitrite, nitrate, ammonia, total nitrogen, inorganic phosphate, total phosphate, and silicate) during these three years in the surrounding water column have no significant yearly variations. The present study gives an insight of fouling community on the coral reef data buoy during the three year deployments.

## Shoreline Changes and Coastal Erosion in the Marine Terraces of Port Blair, South Andaman: An Indicator of Long Term Holocene Climate Change

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The shoreline changes are attributed to Sea level changes which have fluctuated in different geological periods of different climatic conditions. In the last 100 years, a sea level rise of 10 to 25 cm is observed and Since 1993, a 3 mm rise is reported. According to IPCC, 52 to 98 cm of sea level rise is projected by 2100. The sea level rise cause great havoc by coastal erosion and sea water intrusion into coastal aquifers thus consuming the land area. While the tectonic upliftment and subsidence cause shoreline retreat and advancement respectively, the shoreline retreat and advancement cause sea level rise and fall respectively. The sea level rise is accompanied by coastal erosion that happened during different episodic tectonic subsidence and climatic periods.

The spatio-temporal changes of shoreline changes is a matter of concern in the wake of sea level changes as a result of global warming. In this context, an attempt has been made to map the marine terraces which is a geomorphic indicator of shoreline retreat near science centre, South Point and Ross Island using Total Station. Two terraces of 3 m displacement by upliftment during successive earthquakes is observed at Ross Island. Six upheaval of terraces are seen at South Point and the total displacement of the terraces is 18 m from the original

elevation of the terrace. The marine terraces were uplifted during successive earthquakes events and later sculptured by wave erosion forming a 500 m wide abration ramp at South Point. Using the Total station, these marine terraces were mapped to bring out the 2-D and 3-D geometry. The analysis has revealed that the shoreline retreat is approximately 100 m from the coast and the apparent rate of upliftment of marine terrace is relatively 0.096 m/Kyear. The rate of apparent sea level change is therefore 0.096/KYear. Therefore, the rate of absolute upliftment rate and long term sea level fluctuations induced by climate change that prevailed during and after the terrace formation need to be assessed by geochronological approach.

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## **Discovery of marine molluscs from the Andaman and Nicobar Islands: Past, present and prospects**


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Biological diversity becomes a well-known term in recent years even in the broader public, due to media reports on natural resources and increasing threats caused by the ongoing climate change. Similarly, over-exploitation of bioresources by humans caused reduction, isolation and extinction of species globally. As a result, awareness upon conservation became one of the major intents in recent years. Nevertheless, understanding biodiversity is the first step in terms of conservation. The marine ecosystem of Andaman and Nicobar islands provides shelter to diverse molluscan species. While species inventories in these islands have a history of more than a century for phylum Mollusca, considerable knowledge was gathered only in the past three decades. The recent cataloguing of 1282 species of marine molluscs from these islands does rely on longstanding accounts, and only few faunal groups are completely revised. The type specimens of representative collections of the past are presently belongings of museums of several countries and are not accessible by native scientists. Also, the anthropogenic influence over these years leading to local extinction, if any, is unknown. The recent new record also has increased the known species number. Therefore, revision of molluscan fauna is crucial to address the present status of diversity for conservation. This paper reviews the studies carried out in phylum Mollusca during the past 135 years to comprehend the overview of discovery of molluscan fauna in the Andaman and Nicobar islands and to provide a perception in ongoing programmes.



## **NSBC 2015- Track – 2: CLIMATE CHANGE**

### **2.3. Rights based approach to food and nutrition security**





## **An analysis of economic profitability and determinants of adoption in Pigeonpea seed production technology: A case study in Karnataka**

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Pigeonpea [*Cajanus cajan* (L.) Millsp.] is one of the protein rich legumes of the semi-arid tropics grown throughout the tropical and sub-tropical regions of the world. Pigeonpea ranks second after chickpea among all the pulses in the country and normally cultivated during *kharif* season. The farmers realizing the benefit of quality seed for increasing agricultural production and willing to pay price for the quality seed available in the market as the direct contribution of quality seed alone to the total production is about 15-20 per cent. The present study is based on primary data collected for 100 farmers from Gulbarga district of Karnataka during the agricultural year 2013-14. Tabular analysis was used to compare the different values of farm economy and other aspects of farm business. To identify and analyze the factors that governed the farmer's decision to adopt seed production technology, the logit model was applied. The analysis of data shows that the ratio of fixed and variable cost in pigeonpea certified seed production was 32:68. Human labour was the major component of cost on inputs applied for seed production of Pigeonpea. Its share in total costs was about 32.46 per cent. It was followed by bullock & machine labour accounting for about 12.29 per cent of the total cost. The total cost in certified seed production of pigeonpea was ` Rs. 39436 /ha. The gross return and net return was ` Rs.73300 and ` Rs.33864 /ha respectively. The decision of the farmer on adoption of seed production technology was positively influenced by his education, age, land holding, irrigated land, number of crops grown and extension contacts while family size influencing negatively on adoption of seed production technology. Only two out of seven variables included in the model were significant. Extension contacts were significant at 5 per cent probability level and land holding was significant at 10 per cent probability level. Higher yield and profitability in seed production may be popularized among the farming community to increase the certified seed production. The farmers may be encouraged to take up seed production of pigeonpea by providing the required quantity of breeder / foundation seed alongwith technical guidance.

## **Influence of rice stubble on moisture regimes, water use efficiency in Lathyrus under rice-pulse relay cropping system in vertisols**

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A field experiment was conducted at Instructional farm IGKV, Raipur during rabi season of 2012-13 to study the Influence of rice stubble on moisture regimes, microbial dynamics and water use efficiency in Lathyrus under rice-pulse relay cropping system in vertisols. The experiment was laid out in split-split plot design where rice habit group (Tall rice and Dwarf rice) were assigned to main plot and height of stubble in sub plot treatment and lathyrus variety in sub- sub plot. The moisture depletion pattern significantly influenced various depths in tall rice cultivar. The microbial dynamics and water use efficiency were favorably influenced by tall rice standing stubble 30 cm. In present study, higher moisture depletion, water use efficiency and microbial dynamics was observed and yield was observed with dwarf rice stubbles height 30 cm variety 'Ratan'.



## Climate change adaptation through agricultural diversification in tribal areas of Nicobar Islands

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Predicted changes in climatic parameters pose a threat to agricultural production and livelihoods of millions of people in the developing countries. This necessitates adaptation measures by making changes in farming and land management decisions to minimise the negative consequences associated with changing climate particularly in small islands. Agricultural diversification by incorporating local elements is a key for small holder farms in tribal areas as they are constrained by remoteness and limited resource base. Integrated farming system helps in diversification and allows synergy between the different components to increase production and productivity. A homestead integrated farming system model comprising home garden (400 m<sup>2</sup>), backyard poultry (20 no's), goatary (2 no's) and composting were evaluated for achieving diet diversity of the tribal household besides increasing the farm production. The frequency of consumption of meat, poultry, egg, fruits and vegetables by the farm family increased to the extent of 71 to 380 % after the intervention. The vegetables including greens, fruits and egg consumption increased significantly due to on farm production and the diet diversity of tribal family increased from only 4 to 5 food items to more than 7 indicating improvements in diet diversity thus enabling nutritional security. The sale of surplus farm produce resulted in supplementary household income of about Rs.7500/- and 95 man days of employment were generated from the system. On farm composting of organic residues could benefit resilience of the system by way of increased soil nutrient availability and moisture retention. Water harvesting and moisture conservation measures coupled with drought tolerant crops helped to adapt to moisture stress during dry periods. The upscaling of this model to the entire tribal areas could enhance the capability of tribal farming to adapt to climate change.

## Quality characteristics of nutritious cookies of composite flour from legume, cereal, millet and oilseed for pro-poor farming community

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Snacks are convenient foods to satisfy the short term hunger. The consumer demand is increasing for composite flour based bakery products like biscuits to eliminate hunger and provide access to healthy, nutritious and affordable snack food for all age groups. This study was to investigate the effects of incorporation of legume flours of different chickpea varieties (2 Kabuli & 2 Desi varieties) with cereal, millets, & oilseeds and evaluate them for their physico-chemical and functional properties. The cookies were prepared from blending of 60% chickpea flour + 10 % Wheat +10% Sorghum+ 10 % Oat +10% Soybean. Cookies prepared from flours of different chickpea varieties differed only in crude fibre and ash content while, no significant differences exhibited for moisture, protein, fat, carbohydrate and calories content. The cookies of chickpea variety Kripa had maximum amount of moisture (5.33%), fat (16.29%) while RVJKG 101 was rich in crude fibre (6.52%), ash content (4.80%), and Carbohydrate (16.63%). Protein was highest in cookies of JAKI 9218 (56.89%) & calories (421.59 K/cal per 100 g. The cookies of Kripa exhibited higher water absorption capacity (178.00 ml/100g) and foaming capacity (52 %), while cookies made from flour of JG 130 exhibited higher fat absorption capacity (148 ml/100 g ) and emulsification capacity (42 ml/g). These snacks are easily homemade which are rich in nutrition and cheap in preparation, even for lower to middle class income groups. These would enable them to fight against malnutrition.

## Farmer (Tribal) participatory varietal evaluation of sweet potato (*Ipomoea batatas* L.) in Nicobar Islands

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The Nicobarese are one of the tribal groups inhabiting the Nicobar group of Islands in the Andaman Sea. Nicobari families are patriarchal and as a rule live jointly, which is called *Tuhet* (clan of many families make one *Tuhet*) and there is no individual ownership, but the *Tuhet* owns land, coconut and pigs. The Nicobari tribal community is generally conservative as far as food resources are concerned. Their customary practices (they share among each other) “local control” towards food resources is not only appreciable but also worth to emulate. Tuber and root crops are the major component in the daily diet of tribal community of Andaman and Nicobar preferably Nicobari tribal community. Sweet potato is relatively high in calories. They are rich in beta-carotene, having five times the recommended daily allowance of vitamin A in one sweet potato, as well as loaded with potassium. They cultivated tuber and root crops *viz.* *Dioscorea*, sweet potato, *Colocasia*, Tapioca and *Alocasia* in alder based mixed farming system in traditional homegardens called as *tuhet garden* along with coconut, papaya, banana, pineapple sugarcane, vegetables, etc. Among them sweet potato is one of the most preferred root crop in tribal farming system under the coconut plantation. But the yield of the native landraces of sweet potato is low under traditional farming system. Hence the experiment was conducted during rainy season 2013-14 using randomized block design in four replication with five cultivars *i.e.* three local cultivar used by Nicobarese for long time and two released variety CARI SP-1 and CARI SP-2 with four replication for identification, evaluation and assessment of sweet potato cultivars under rainfed conditions of Nicobar district with scientific cultivation techniques at four farmers’ field of Car Nicobar Island in a participatory mode. The highest mean yield was obtained from Local Cultivar-2 (16.06 t/ha) CARI SP-1 as compared to as compared to Local Cultivar-1 (15.14 t/ha), CARI-SP-2 (14.09 t/ha), CARI-SP-1 (13.46 t/ha) and Local Cultivar-3 (11.59 t/ha). The maximum benefit cost ratio (2.5) as compared to Local Cultivar-1 (2.4), CARI-SP-2 (2.2), CARI-SP-1 (2.1) and Local Cultivar-3 (1.8).

## Socio-economics of fishermen community around the Junglighat fish landing center, South Andaman – A case study

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In Junglighat, most of the members of fishermen families (44.4%) were falling under the age group of 15 - 34. About 48.8% of the families were with 4 - 6 members and only 6.6 % of families were with more than 10 members. 89.65% children are attending government schools while, 10.34 % are attending private schools. The literacy rate was found to be higher (30.68%) and attended middle school level and 0.5 % is graduates. Most of the fishermen from Junglighat landing centre (87.09%) are coming under above poverty line (APL) status and only 12.9% are coming in below poverty line (BPL) status. According to the monthly income status, 36% of the members are earning between Rs. 3001 - 4000 and 13% are earning between Rs. 4001 - 5000. Most of the families are residing in Semi pucca (Asbestos) houses (73.07%) and fewer families (7.69%) were living in Kutcha (thatched) houses. Hygienic status of the fishermen population was found to be better and most of the fishermen families use latrine facilities (97.29%) and only 2.7% of the populations were found without latrine.

## Tank production of *Artemia* juveniles and adults from agricultural waste

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The nutritional quality of on grown *Artemia* produced in tanks is superior to nauplii and is especially richer in essential amino acids. The protein content of adult *Artemia* is also appreciably higher than nauplii stage irrespective of culture conditions or food. *Artemia* juveniles and adults are used as a nursery diet not only for their optimal nutritional value but also for energetic advantages as well. The nutritional requirements of larvae will be met with ingestion of less number of higher sized preys and also it will reduce time spent to capture prey. The waste product from agriculture industry can be used as a suitable feed source for tank ongrown culture of newly hatched *Artemia* nauplii due to its low cost and availability. Also the suspension of agri wastes could meet the particle size requirements for *Artemia*. Rice bran was used for feeding nauplii of *Artemia* for ongrowing it to juvenile and adult stage in the Marine Hill Research Laboratory of ICAR-CIARI. Freshly harvested *Artemia* nauplii were stocked in 35 ppt salinity seawater in rectangular FRP tanks with vigorous aeration. Rice bran was mixed in a plastic tub filled with water and continuous aeration was provided for an hour. The mixture was then sieved through 100  $\mu$  net and the filtered water was fed to *Artemia* nauplii. Water exchange to remove metabolites and debris and feeding with filtered rice bran water was done daily. Specific stages (juveniles, preadult, adults) with uniform size of *Artemia* can be fed, depending upon the size preferences of the larvae and even adults of marine ornamental fishes for brood stock development.

## Azolla (*Azolla pinnata*) - Alternate feed supplement for pigs in Car Nicobar

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The Nicobar district comprises of 12 inhabited islands scattered in Bay of Bengal between 6°-10° N latitude and 92°- 94° E longitude with a total area of 1841 km<sup>2</sup> separated from Andaman group of Islands by 10° Channel. The major livestock comprises of pig, goat and cattle which are reared in extensive as well as semi intensive system by the tribal community with no intension of business. Among the livestock, pigs enjoy a special place in the social, cultural and economic status of Nicobarese. Nicobarese rear pigs in traditional way (extensive farming system) and feed them daily or alternate days with 2 coconuts per adult pig per day. The coconuts are rich source of energy i.e. fat and carbohydrates but low in protein content. This condition forces the pig to scavenge and sometimes induce them to attack chicks or small animals to meet their protein requirements. The scarcity of locally available feeds hinders intensification of farming system. The scientific interventions like reproductive management, piglet care, hygiene and disease control etc. can be effectively done by intensifying the farming system for having better control on animal. As a step in this direction, Azolla was introduced in Car Nicobar by KVK-Nicobar. Azolla (*Azolla pinnata*) is a rapidly multiplying floating water fern belonging to the family Azollaceae. It hosts a symbiotic blue green algae *Anabaena azollae* which fixes and assimilates atmospheric nitrogen-in-turn Azolla provides the needed carbon source and favorable environment for the growth and development of the symbiont. Azolla is very rich in proteins, essential amino acids, vitamins (Vitamine A, B<sub>12</sub> etc.), growth promoter intermediaries and minerals like calcium, phosphorous, potassium, ferrous, copper, magnesium etc. Azolla on dry weight basis constitutes of 25-35% protein, 10-15% mineral and 7-10% a combination of amino acids, bio-active substances and bio-polymers.

Carbohydrates and oil content in Azolla is very low. Thus the bio-composition of Azolla makes it one of the most economic feed substitutes available for livestock and poultry with high digestibility. A study was conducted to evaluate the prospects of Azolla as feed supplement for pigs in Car Nicobar. Three different technical options were selected viz. TO-0 Farmer's Practice: Feeding Coconut, TO-1 Farmers feeding practice + Azolla (fresh) (7:3) and TO-2 Farmers feeding practice + Azolla (fresh) (1:1). During the study it was noticed that, in the backyard feeding condition for pigs, approximately 3:1 ratio is the maximum limit for including Azolla for feeding pigs in Nicobar. Increased ratio only leads to wastage of Azolla as leftover. Further it was found that replacing  $\frac{1}{4}$  (3:1) of coconut with Azolla has aided in maintaining the weight gain in piglets as par with the Farmers practice. Economic feasibility study based on assumptions viz. Rs. 8 per coconut and Azolla replacing half coconut per day per pig for 365 days will save an amount of Rs. 1460 per pig. The Azolla is now naturally available in the waterlogged areas of Car Nicobar and the pigs of this island may acquire higher palatability in the future times to come.

NSBC- 2015- T02- RBA- 09

### **Studies on physico-chemical properties of Pandanus fruit: A traditional staple food of Nicobari tribals**

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Pandanus (*P. andamanesium*) fruit, a traditional Nicobarees staple food, belongs to family Pandanaceae with yellow-orange colouration suggested substantial amount of phytochemicals and micronutrients. This fruit is composed of a composite fruit, called a bunch (syncarp), which weigh about 10-15 kg. Pandanus trees are of cultural, health, and economic importance, second only to coconut in Nicobar. It is consumed by the tribals as a source of daily diet with other ingredients mainly making flour for preparation of breads and preparation of non-vegetarian foods etc. The inner soft and fibrous portion (attached to the core) is chewed and sucked or sometimes crushed for obtaining the sweet fruit juice and pulp. However, there is little or no information available on the phytochemical compounds present in mature pandanus fruit. In this regard, a study was made to reveal the physico-chemical properties of pandanus pulp and peel. The moisture content of pulp and peel was found to be 36 and 59% respectively. The total soluble solid (TSS), juice content and titrable acidity (TA) was found to be 7.4, 13 and 0.057% respectively. Total carbohydrate of pulp and peel was measured to be 67 and 16% respectively. Total phenolic content of peel was highest (39.6 mg/100 g) in acetone extract while in the pulp fraction, it was highest (42.01 mg/100 g) in ethanol extract. Highest flavonoid content was found in peel fraction (368 mg/100g) than pulp fraction which was highest (200 mg/100 g) in hexane extract. Using ABTS method, highest free radical scavenging activity (RSA) of 73.2 % (IC 50 of 480  $\mu$ g/ml) and 70.7 % (IC of 1.153 mg/ml) was measured in peel and pulp fraction respectively. Similarly, Pulp contains highest FRAP activity (994  $\mu$ M FeSo<sub>4</sub>) in hexane extract where as it is lowest (705. 22  $\mu$ M FeSo<sub>4</sub>) in acetone extract. on contrary, peel contained highest FRAP activity (1229  $\mu$ M FeSo<sub>4</sub>) in acetone extract and lowest (638.82  $\mu$ M FeSo<sub>4</sub>) in hexane extract. A significant correlation ( $p \leq 0.05$ ) was found between phenolic content with antioxidant activity. Owing to high level of antioxidants due to phenolics and flavonoids, the fruits may be exploited scientifically for the development of blended value added products, food-stuffs and medicines etc.



## Scientific kitchen garden for food and nutritional security of Island farmers

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Malnutrition is a major problem among different age groups of population in Islands which leads to many disorders. This is probably due to lack of awareness about nutrition and balance diet and low intake of vegetables and fruits in daily diet. Kitchen garden provides opportunity to grow vegetables, fruits and herbs for household consumption. The fruits and vegetables are important component in kitchen garden and are known as 'protective foods' for their richness in dietary micronutrients and phytochemicals. The concept has been realized by a large number of households in these Islands, due to high price of vegetables in market and heavy use of insecticides and pesticides in commercial farming. Growing of nutrient rich indigenous vegetables and fruits in kitchen garden can contribute significantly in reducing the micronutrient derived malnutrition. Kitchen gardening also contributes in food security through direct access of nutritionally-rich foods by increasing purchasing power by savings the food bills and sometimes contribute in household income from the sale of garden produce. A total of 40 household kitchen gardens were surveyed in South Andaman district. The result showed that the predominant working hands in kitchen garden are 90 per cent women. Majority of respondents (70%) grow vegetables in kitchen garden because of high market price however, only 30 percent respondents did kitchen garden for quality vegetables. Eighty five percent respondents grows choice crops in kitchen garden such as okra, bottle gourd, bitter guard, cucumber, pumpkin, ridge gourd, brinjal, chillies, amaranthus, Indian spinach, papaya and burma dhanian. Most of kitchen gardens are growing vegetables in conventional methods where the quality of the vegetables is as expected by household and yield was also very less as compared to commercial cultivation. Keeping in view, KVK, CIARI, Port Blair promoted the concept of scientific kitchen garden with organic farming for putting efforts towards food & nutritional security of Island farmers. A total of 12 kitchen garden models on scientific lines were introduced as On Farm Trial (OFT) in South Andaman District during 2011-13. The scientific kitchen gardens were kept women intensive in nature. The waste of these vegetables contributed in feed and fodder of poultry and animal components. It was found that the yield of vegetables was high in scientific method of cultivation than conventional method. The consumption pattern of vegetables of households increased significantly over the conventional kitchen garden. The scientific kitchen garden contributed 73.80 per cent of the total vegetable requirement of the farm families. Scientific kitchen garden provides maximum output and a continuous supply of fresh vegetables for round the year and fulfils the family demand for vegetables, enhanced the nutritional status of family, contributed in family income and also plays an important role in mitigating malnutrition of the rural households of the Island.

## Mapping of mangrove patches of Kerala using satellite remote sensing based images and their ground truth validation

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Mangroves in India covers a total area of 4639 km<sup>2</sup>, occupying 5% of the global mangroves and is the fourth largest mangrove area in the world. Mangroves in Kerala are highly fragmented and confined mostly to the estuaries of major rivers, lagoons, backwaters and creeks along the coastal belt. It was noted that out of the total of 2502 ha mangroves in Kerala, 1313 ha are with private holders. The present investigation was carried out to identify, prepare and collect of biological data of the contiguous patches of mangroves in Kerala coast during 2014-15. 65 contiguous mangrove patches were identified. The patches were mapped using QGIS. Secondary information with respect to the patches were collected. 16 true mangrove species were identified and documented. The true mangrove species were *Avicennia officinalis*, *A. marina*, *A. alba*, *Rhizophora apiculata*, *R. mucronata*, *Excoecaria agallocha*, *E. indica*, *Lumnitzera racemosa*, *Aegiceras corniculatum*, *Bruguiera cylindrica*, *B. gymnorrhiza*, *B. sexangula*, *Kandelia candel*, *Ceriops tangal*, *Sonneratia caseolaris* and *S. alba*. The abstract calls up on the relevance of identifying ecologically sensitive mangrove areas for effective coastal zone management.







## **NSBC 2015- Track – 2: CLIMATE CHANGE**

### **2.4. Integrated pest management**





## Scientific Validation of Indigenous Moringa varieties for Pest Management

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Investigations were carried out to assess the scientific validation of indigenous seven annual moringa accessions for pest management. Pest incidences on seven selected accessions were studied. Biodiversity analysis and Simpson index revealed that Pallapatti Alagarsamy Vellimazhai Murugan local (PAVM) harboured lower fauna of pests and higher number of natural enemies when compared to other indigenous local varieties. Biochemical analysis involving the test of nitrogen, phosphorus, potassium, calcium, magnesium, total phenols and tannins were estimated in the laboratory conditions. Biochemical constituents of the plants imposed with various organic sources of nutrients revealed that total phenols and tannins were high in PAVM which was applied with organic nutrients. The presence of higher phenols and tannins imparted considerable level of induced resistance through antibiosis mechanism to moringa pests which was clearly proved in terms of low population build up of major pests of moringa. The impact of the resistant sources with organic sources of nutrients on the prevalence of potential predators revealed that, irrespective of the varietal influence, the population of spiders, mirid bugs and ichneumon wasps were found prominent in the organic ecosystem.

## Alarming outbreak of wilt in flax caused by *F. oxysporum* f. sp. *Lini* Schlecht

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Flax (*Linum sitatissimum* L.) is an important bast fibre producing commercial cash crop grown in temperate as well as tropical countries including India. Flax has been introduced as allied fiber crops at CRIJAF, Barrackpore for germplasm evaluation, conservation and varietal development during the year 2009-2010. So far, flax wilt caused by *F. oxysporum* f. sp. *lini* (Schlecht) was rarely noticed at research farm of CRIJAF. But due to continuous monoculture of flax during last five years, localized outbreak of the disease was noticed at research plot during December 2012 - January 2013. Three types of wilt symptoms were observed; early wilt averaged up to 90%, late wilt up to 80% and partial wilt up to 10%. Out of seven genotypes, JRF2 was the most susceptible (80%) followed by JRF-1 (60%) and JRF-3 (40%). However, wilt incidence was least on genotypes. JRF-4, FT-850, FT-896 and FT 897. The incidence was drastically increased with the age of the crop and varietal response to moisture as well as to temperature. The pathogen was isolated from the stem section of the infected plant but not from root, pure culture was established and the pathogen was identified as *F. oxysporum* f. sp. *lini*. This documentation may play an important role aiming for detail investigation of the disease, breeding/developing resistance varieties and development of disease management strategies under field condition.

## **Bio- efficacy of Taegro Eco (Bio fungicide) against late blight of tomato (*Phytophthora infestans*)**

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A field experiment was conducted on late blight of tomato at College of Agriculture Hanumanamatti, Ranebennur taluk, Haveri district. Bio-fungicide NZBBA1106 at different concentrations (180, 370 and 500 g in 500 liters of water per hectare) along with Mancozeb 75% WP (2 g per liter water) were tested for effective control of late blight of tomato with respect to disease severity and yield. Three times bio-fungicide and Mancozeb sprays were taken alternatively at weekly interval in one treatment and one Mancozeb spray followed by 3 bio-fungicides sprays were carried out in another treatment along with untreated control. Among the different treatments, least Percent Disease Index (PDI), 18.30 per cent was observed in the treatment Mancozeb alternating with bio fungicide NZBBA 1106 @ 370 g. This treatment was found most effective compared to 3 continues sprays of bio-fungicide @ 370 g (PDI 20.25%) and eight times spraying of Mancozeb alone (PDI 20.85%). The highest late blight disease severity was recorded in untreated control (PDI 50.25%). The maximum yield (22.75 t/ha) was recorded Macozeb alternating with bio- fungicide @ 370 g followed by Mancozeb and three time continuous spray of bio fungicide @ 370 g (21.40 t/ha). The minimum yield was recorded in untreated control (15.85 t/ha).

## **Conserving the less – charismatic: Making conservation inclusive for conserving the ecosystem services**

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Insects form the bulk of the biodiversity and play crucial roles in ecosystem functioning, like pollination, herbivory, decomposition and are important prey base for wide range of animals right from insects, birds and to even mammals. Simplification of Stand diversity and structure of uncultivated areas adjacent to cultivated land can create imbalance on pest and natural enemy guilds. Many species of insects are being discovered from extremely small areas of tropics. So the potential diversity of these lesser-known taxa in the tropics will be very high. Many species of insects are highly endemic and are sensitive to any habitat disturbances and even to microclimatic changes. Some recent studies show that insects in the tropics are already living at the limit of their temperature range and could be among the first species to become extinct as a result of global warming. The prevalent trend in conservation has been to overlook insects and other invertebrates which form the vast majority of the biodiversity due to their smaller size and taxonomic impediment. While formulating conservation policies and legislations, insects and other invertebrates, which comprise more than 95% of the species, are overlooked. Instead of graduating to an interdisciplinary inclusive approach, conservation is still pivoting around the patriarchal protectionist paradigms. This makes the conservation species-focal and redundant around a few charismatic species like tiger or elephant. Conservation of biodiversity cannot be encompassed and the goals of convention on biological diversity cannot be accomplished by conserving a few taxa, but requires a consensus from various taxa and need to conserve the heterogeneity of habitat to assure the ecosystems function and continue providing its services for the supporting the life on earth. Because of their small size and modest needs, most insects and other invertebrates occupy ecological niches that are more numerous and smaller in all dimensions and more sensitive than those of vertebrates. So every ecosystem, every fragment small or large is important for conserving insects. Since the majority of species remain undescribed and data on the distribution and abundance of only a very few

described species are available, assessing the threat status of each species according current day conservation norms may not be practical. So very little is known about the degree of loss in insect diversity and the extent to which tropical forest management can minimize their loss. So for effectively conserving the insect diversity, rather than species-focal approach, a conservation paradigm prioritizing habitat heterogeneity and ecosystem health should be devised.

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## Pesticide formulations using plant extracts-an overview

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Plant-based botanical insecticides offer an effective, low toxicity and environmentally friendly alternative to conventional pesticides. They are derived from various part of the plants, such as flowers, fruits, leaves, wood etc. Due to high cost of synthetic pesticides and concern over environmental pollution associated with the continuous use of these chemicals, there is a renewed interest in the use of botanicals for crop protection. They are used as natural pesticides to repel and kill certain pests. Until recently the availability of plant-based insecticides were limited to a few products like neem oil and pyrethrum. These products are effective and exhibit very low environmental impact and they have a limited range of uses. For becoming truly effective alternative to conventional insecticides, botanicals must be available in a range of formulations that can be used in a variety of pest control situations. The choice of a pesticide formulation is mainly based on its biological performance, development convenience and cost. But as agriculture has become more sophisticated, considerations to the needs of user of pesticide in addition to the biological requirements of crop and pest has also gained considerable significance. Scientists world over are actively engaged in research into the use of plant derived products to fight and reduce the losses caused by agricultural pests. Further, the current trend in replacing older persistent pesticides like wettable powder (WP), emulsifiable concentrates (EC) etc. has paved way for development of new, less toxic, short lived, reduced application rate and safe handling formulations like microemulsion, cream gel etc. In the present study, extraction of *Ageratum conyzoides* Linn. (Asteraceae), *Melia azedarach* L. (Bakain) etc. using different solvents, formulations from these extracts and their evaluation have been carried out. *Ageratum conyzoides* Linn. (Asteraceae) commonly known as Kubhi is distributed throughout India. This plant is quite useful in fever and the root of this plant possesses antihelmintic and anti-dysenteric properties. The plant extract has been found to have insecticidal and larvicidal properties. *Melia azedarach* L. (Bakain) belongs to the Meliaceae family and the different plant parts such as leaf, fruit, and young branches have been traditionally used by the medicinal practitioners for the treatment of malaria, diabetes, purgative, cough, skin disease, and so on in the Indian sub-continent. The plant has been reported to have antioxidant, antimicrobial, anti-inflammatory, cardio-protective, analgesic, anticancer, antiulcer, antipyretic, antiplasmodial and male contraceptive properties. From these plant extracts, 5-10% (w/w) E.C. (Emulsifiable Concentrate) was developed using biodegradable solvents and emulsifiers. The physico-chemical studies of the EC were carried out as per standard method. 5 % (w/w) microemulsion (ME) was also developed from these extracts using biodegradable surfactants and their evaluation was carried out. Excess use of pesticides have caused environmental problems which have brought attention to scientists and public in recent years. It has been estimated that approximately 2.5 million tonnes of pesticides are used on crops each year and the worldwide damage caused by pesticides reaches \$100 billion annually. This is due to (1) high toxicity and non-biodegradable of pesticides and (2) lack of scientific formulations. Thus, one needs to search the new highly selective and biodegradable pesticide formulation which can solve the environmental problem, long term toxicity to mammal and can reduce pesticide use while maintaining crop yields.



## Screening rhizobacteria for biological control of *Ralstonia solanacearum* in Andaman Islands

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Bacterial wilt of solanaceous vegetables caused by *Ralstonia solanacearum* (Smith) is serious problem in vegetable cultivation of Andaman and Nicobar Islands. Every year farmers are facing 20-50% yield loss in brinjal, chilli and tomato crops solely due to this disease. To explore possibilities for the development of biological control for the disease, 120 rhizobacteria (most of them collected from rhizosphere soils of vegetable and spice crops) were screened against a highly virulent *R. solanacearum* strain. On the basis of *in vitro* screening, 20 PGPR strains showed good antagonism against this pathogen. All these 20 PGPR strains were subjected to molecular identification using 16SrDNA method and found the dominance of the bacterial genus *Bacillus*. Eight PGPR that have showed high *in vitro* antagonism by both of perforated plate method and perpendicular streak method were selected for *in vitro* growth promotion studies using paper towel method which revealed four PGPR strains (SB21, BAM13, BL3 and SM3) were showed best in *in vitro* growth promotion in chillies. In the greenhouse, 25 days chilli seedlings were co inoculated with the selected antagonists and pathogen, their interactions effects were studied. The results showed that all the four strains were effective in reducing disease incidence when compared to control among which BAM13 and BL3 strains were showed better disease resistance and growth promotion in chilli plants. The results of enzyme studies revealed all the PGPR strains could induce high peroxidase (PO), polyphenol oxidase (PPO), phenyl ammonia lyase (PAL), total phenol and protein level in chilli plants when compared to control. The overall results from the above studies revealed that these four PGPR strains from Andaman Islands have better potential for their utilization as effective bio agents for management of bacterial wilt disease in different formulations either alone or as consortia.

## Insect pests of significance in the post flowering phase of red gram in South Andamans


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Red gram, one of the major grain legumes grown as *rabi* crop in the Andaman and Nicobar islands is infested by at least 20 insect species. However, for over three decades the species complex of insect pests infesting red gram in the islands remain obscure. Factual knowledge on different pest species infesting a plant arms the cultivator with precise knowledge on taking up cost effective control measures which in turn is also environmentally safe. Red gram grown in the Central Island Agricultural Research Institute, Port Blair, South Andamans during the *rabi* season of 2014 -2015 was periodically observed to document the different pest species. The following insect pests were found to be major yield detorating factors. The cowpea aphid, *Aphis craccivora* Koch and flower thrips (specimen to be identified) colonizes the crop in the advent of flowering phase when the crop is 150 days old. At least 20-30 thrips per flowering shoot were found. The flower buds quickly lost their turgidity and dropped off. Spotted pod borer, *Maruca testulalis* (Geyer), plume moth, *Sphenarches anisodactylus* (Walker) and the blue butterfly, *Euchrysops cnejus* (Fabricius) started attacking the crop as flower borers and later they bored into pods. The gram pod borer, *Helicoverpa armigera* (Hubner) occurred in numbers of 3-4 per 10 plants. The larvae preferred matured pods and consumed 2-3 seeds per pod accounting for maximum damage among the pod borer complex. The unconsumed seeds of the infested pod developed secondary microbial infection and rotted in no time. The pod maturation stage was marked by the arrival of the pod sucking bugs, *Riptortus pedestris* (F.), *Clavigralla* sp., *Nezara viridula* (L.) and *Coptosoma* sp. The first three species are specifically restricted to pods and matured seeds. The

nymphs and adults insert their stylets through the pod wall and suck the sap leaving the pods dry and shriveled. The damaged seeds lose weight and become unfit for seed or culinary purpose. *Coptosoma* sp., however though found in large numbers, feeds only on tender shoots and buds. Population counts of *Riptortus* sp., *Clavigralla* sp., *N. viridula* and *Coptosoma* sp., ranged between 5-10, 1-2, 3-5, and 25-50 per plant respectively. *Coptosoma* sp. though found in large numbers feed only on tender shoots and buds and hence do not inflict any direct damage to the marketable produce. Pod infesting insects which occur in the post flowering phase of red gram cause maximum damage to the crop. Hence, pest control strategies have to be planned accordingly well in advance of this susceptible stage.





## **NSBC 2015- Track – 2: CLIMATE CHANGE**

### **2.5. Managing risk in the face of climate change**





## Search for heat tolerant tomato genotypes and crosses suited for temperature variations

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Tomato is usually produced during the winter season in India and fruit production is gradually dropped as the temperature increases by the end of the winter season. In summer due to high temperatures, tomato production almost ceases, resulting the shortage of tomatoes. To identify high yielding varieties/ crosses possessing desirable qualities which can thrive well under high temperature, ten elite homozygous genotypes were crossed in all possible combinations among themselves (excluding reciprocals) in diallel fashion. Ten elite lines and  $F_1$ s were evaluated for per cent fruit set and high temperature sensitivity traits. Data were recorded on pollen viability per cent, pollen germination per cent, corolla tip burning per cent, stigma exertion per cent and fruit set per cent. On the basis of characters studied, it was concluded that the three tomato genotypes, i.e., Pusa Sadabahar, FLA-7171 and NDTVR-60 as also the cross combinations FLA-7171 x Selection-7, Pusa Sadabahar x H-88-74-1, Pusa Sadabahar x FLA-7171, FLA-7171 x NDTVR-60 and NDTVR-60 x Selection-7 are potential heat tolerant genotypes which could be utilized in further tomato breeding programme.

## Spatial and temporal variations in benthic diversity in relation to sediment parameters in an urban eutrophic lake

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The spatial and temporal variations in diversity of benthic fauna in relation to physico-chemical parameters of bottom sediments were studied in an urban eutrophic lake (Naushad Ali Sarovar, Maharashtra, popularly known as Powailake). Out of 15 species of benthic organisms (belonging to 5 classes), that were recorded in the lake, highest number of individuals per square metre were recorded for class Insecta (11,846), represented by 4 genera followed by Gastropoda (11,666), also represented by 4 genera. Polychaeta (6,712) and Oligochaeta (4,293) were represented by 3 genera each and the group Maxillopoda was represented by a single genus, consisting of 576 individuals / m<sup>2</sup>. Species diversity was low during monsoon and highest during postmonsoon, whereas the situation was reverse in terms of biomass. Highest and lowest biomasses were recorded in monsoon (7.41 g m<sup>-2</sup>) and premonsoon months during the months of January to March (0.72-1.53 g m<sup>-2</sup>). In terms of numbers, higher number of benthic organisms was recorded in premonsoon and postmonsoon seasons, when organic carbon percentages in the lake sediments were high (2.44 – 3.08%). *Tipula* sp. and *Chironomus* sp. (bioindicators of organic pollution) were most dominant and were represented in all months. Presence of *Limnodrilus* sp. also a bioindicator of pollution in all seasons in station 5 is significant. Regression analysis indicated that percentage of silt (which is a major component of nutrient run offs from catchment soils) as well as soil organic carbon are the most important factors influencing the seasonal pattern of benthic invertebrate population in Powai lake. Cluster analysis using Bray Curtis similarity and Non parametric multidimensional scaling (MDS) with superimposed species richness of indicator species'



showed distinct clustering of stations 4 and 5 in terms of abundance of benthic invertebrates and further confirmed the organically polluted nature of these sites. Principal Component Analysis yielded 4 components, where in the major environmental factors correlating the composition and spatio-temporal variation of benthic invertebrates were, temperature of air and water, dissolved oxygen, pH, carbon dioxide and water hardness.

NSBC- 2015- T02- MRCC– 03

## **Climate variability and apple diversification towards low altitudinal gradients in Indian Himalayas**

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Apple farming has emerged as the most remunerative profession for the rural hill farming communities of Himachal Pradesh, Jammu & Kashmir, and Uttarakhand States of India. In Himachal Pradesh, it accounts for 46 per cent of total area under fruit crops and 76 per cent of the total fruits production and provides livelihoods for more than six lakhs growers of the State. The area under apple cultivation that was 712 hectares in 1950 has increased to 1.30 lakh hectares by 2013. However, the productivity still continues as low as 6.1 t/ha. The Himalayan agro-ecosystem is facing serious challenges posed by climate change due to increasing aridity, fluctuating winters, and variability in receiving precipitation and snow. Mean surface temperature in the Himalaya has risen by 1.5 °C from 1982 to 2006 compared to a 0.6 rise in the global mean from 1975 to 2005. Reports suggest that the traditional apple farming is under threat due to changes in climate where the farmers at low altitude and mid altitude have faced decline in apple cultivation. The decrease in the chilling units recorded between the altitudinal gradient of 1200 and 2400 meter above mean sea level. No doubt, the production of apple in the state has revolutionized the economy with Rs. 2500 crore. The fruit orchardists now are also concerned more with the impacts and adaptation to climate change rather than the nature and degree of climate change. In spite of facing threat of global warming, the high inter- and intra-seasonal variability in rainfall distribution, temperature fluctuations and rainfall events has also forced in the shift of its cultivation with low chill varieties towards lower altitudinal gradients. Such observations warrant new approaches for production of apple in the hilly regions to combat future climate change. Diversification of the low chill spur apples in the lower altitudinal gradients in a systematic manner on a regular basis is the need of the hour, besides understanding the variations in the patterns of climate change and the management practices and alternatives for farmers in order to cope up the vagaries of changing climate.

NSBC- 2015- T02- MRCC– 04

## **Ecological study of bird hazards at Airport in Andaman**

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Aircraft collisions with birds are an increasingly serious economic and safety problem related in part to increasing populations of various large-bird species. Since the early days of aviation, collisions of aircraft and birds have taken place, sometimes with fatal consequences. Bird aircraft strikes represent a major safety hazard to pilots and passengers of both commercial and defence aircraft. This study has been carried out in the *Veer Savarkar* Airport campus and outside the airport (10 km radius from aerodrome) in South Andaman to assess bird population in order to assess the bird hazards supported by INS-Utkrosh. The bird population was estimated by Total Count, Line Transect and Point Count method. One hundred and fifty seven surveys were conducted in the

following areas besides airport, viz. Sippighat, Choldhari, Ograbranj, Stewartgunj, Shoalbay, Whimberligunj and Chidyatappu. Three aerial surveys also were carried out to explore the breeding and roosting habitats of water birds. Overall 163 species of birds belongs to 51 families and 19 orders have been observed during the period of survey. Of these, 37 species were trans-continental migratory birds. Highest number of waders was recorded from Garacharma followed by Sippighat and Chouldhari. Species richness and abundance of birds varied in the airport campus. The highest species richness observed during the month of January 2014 and lowest in April 2013. Similarly, the species abundance also varied in the study area, the highest in the month of February 2014 and lowest during July 2013. The highest diversity index ( $H'$ ) recorded in the month of December 2013, followed by September and lowest in July 2013. In this paper, we discussed the control measures for bird hazards in the airport.

NSBC- 2015- T02- MRCC– 05

### **Role of Indian cattle for climate change: challenges and opportunity for India**

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Indian cattle are blamed for methane gas production by burping, belching and excreting copious amounts of methane a greenhouse gas (GHG) that traps 25 times more heat than carbon dioxide. Estimates on methane production from Indian ruminants by various outside agencies found higher as they were based on theoretical calculation without actual experimentation on Indian ruminant livestock. Need for proper analysis is crucial in digesting the blame and also to work on modules in minimizing GHGs emission and effective utilization of methane. India's 283 million cows highest in the world, producing 125 million tonnes of cow dung are playing menacing role since they have become part of the climate-change debate. Import of high yielding germplasm into native animals by artificial insemination without extending the knowledge of nutritional requirement and managerial practises in dairying has led to poor yield, poor animal health and higher methane production. Indian farmers demand for the support and funds from international agency for affording western technology and products to reduce GHGs emission. Indigenous cheaper solutions and products enhancing propionate or decreasing acetate production, decreasing  $H_2$  that would be converted to  $CH_4$  along with optimal nutrition, feeding management and genetics selection are to be practised and popularized. Methane from cattle collected into bags on the back with a collection pipe non invasively inserted along with community approaches in producing and using biogas as fuel for food and vehicles and for generation of electricity are to be focussed and encouraged. Imparting carbon crediting knowledge among Indians is important.

NSBC- 2015- T02- MRCC– 06

### **Physiological and cellular adaptations of zebu cattle to tropical climatic conditions**

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Climate change is expected to have maximum impact on extensive livestock production systems. Zebu cattle are uniquely suited to hot climates due to their unique characteristics viz. coat, hide, skin and hematological attributes. Body conformation, growth and physiological aspects are unique genetic attributes, which are different from those of *Bos taurus* cattle. Compared with *Bos taurus*, zebu cattle are valuable in cross breeding from adaptation point of view. In tropical countries, cross breeding between *Bos indicus* and *Bos taurus* is a common practice not only to increase production and reproduction, but also to maintain thermal balance. In this article various unique traits and characteristics of zebu cattle with reference to adaptation have been discussed.

## Water harvesting at farmer's field, to address climate change in Chhattisgarh

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The state of Chhattisgarh is rich in natural resources viz. land, water, abundant sunlight, bio diversity, human resources, farm power etc. The average growth rate of agriculture in the state is much higher (11%) than the national average. Conservation, storage and recycling of on farm rainfall/runoff holds key for successful agriculture, enhanced capability to combat drought and submergence of crop land as a result of climate change. The delayed onset of monsoon, occurrence of concentrated rainfall, reduced number of rainy days and consequent increased number of dry-spells in between the critical crop growth stages are some of the major factors affecting agricultural production to varying levels depending upon the severity of these factors and their interrelationship. Threat of increased demand under population pressure has to met out by adopting innovative techniques such as rainwater harvesting, drainage system, conjunctive use of surface and groundwater, SRI for rice and other crops, integration and incorporation of remunerative activities (such as fish, duck , animal and poultry rearing, rice fish culture) in regular crop plan. Keeping these in view water harvesting based integrated vertical farming model for 1 ha land was evaluated and presented in this paper. This model constitutes integration of animal (rabbit, duckery, poultry and fish rearing), horticulture and grain crops supported by water harvesting pond (0.10 ha), signifying utilization of *khet ka pani keht me*. Multistoried farming on pond bed compensated the forgone crop and cost of pond. Poultry shed and rabbit shed on SFR bed was constructed in such a way that their droppings could fall into SFR as organic manure and serve as feed for fish and ducks. Stored SFR water was used for growing fish fingerling, fish and duck rearing besides used for irrigation to *kharif* and *rabi* crops. Irrigation was given priority over fish culture in terms of water allocation and use. Dairying, agro-horti and agro-forestry were practiced on SFR embankment. Vegetables were grown on excavated/ shifted soil spread out in the vicinity of SFR. Non-rice crops were grown in 0.33 ha land with drainage system that has outlet in SFR. The lower (0.34 ha) land was used for rice cum fish culture provided with irrigation partly by SFR (by gravity) and partly by shallow dugwells (D/s of SFR), signifying the conjunctive use of surface and ground water. Optimization model can be applied to maximize the expected returns from different activities through selection of appropriate crops and area allocation for each activity commensurate with available capital, water and land resources. The investigations revealed that B/C ratio ranged from 3.0 to 5.9 in different farm holders, using water harvesting based integrated farming, either equal or higher to that of irrigated farming with practically no sign or resource base degradation. Employment generation (2200-2700 man-days per annum) and ground water recharge were some of the intangible benefits, addressing the issues of migration and water table decline in the state.

## Effects of climatic changes due to radiations released from the nuclear reactor accidents

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Most of the commercial nuclear power plants release gaseous and liquid radiological effluents into the environment as a byproduct of the radioactive elements. The planet at present where we are living have witnessed three major nuclear accidents have changed the environmental conditions of both biotic and abiotic. The first incidence occurred at Three Mile Island in 1970. The second accident took place at Chernobyl located in Ukraine in the year 1986. The finally, the Fukushima accident occurred in Japan due to tsunami in the year 2011 resulting in hydrogen gas explosions and partial meltdowns. The total amount of radioactivity released through this method depends on the nuclear power plants. The large-scale release of radioactivity resulted in the evacuation of

civilians away from 20 Km of the exclusive zone set up around the nuclear reactors. Civilians living within 80 km of a nuclear power plant typically receive about 0.1  $\mu\text{Sv}$  per year. The average person living at or above sea level receives at least 260  $\mu\text{Sv}$  from cosmic radiation. The nuclear energy is the direct cause of global warming and climate change in many ways. The heat released by the nuclear reactors. Once the energy is released from uranium, the fuels of the nuclear reactor then it radiates out in to the outer space as long wave radiation and the rest goes into the air, waterways, glaciers which intern increases the atmospheric temperature, thus it leads to the reasons for the Global warming. There are 400 nuclear plants all over the world to generate electric power all of them are generating considerable amount of nuclear wastes which increases the earth's atmospheric temperature to 2 to 3 $^{\circ}$  per year, which in turn results in rising of the sea level due to the melting of Antarctic glaciers.

NSBC- 2015- T02- MRCC- 09

### **Application of biochar to rainfed vertisol cotton crop: A boon or ban**

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Agriculture accounts considerable amount of  $\text{CO}_2$ ,  $\text{N}_2\text{O}$  and  $\text{CH}_4$  emission into the atmosphere through different soil and crop management practices. Soil, the medium of crop production, is one of the major sinks of global warming gases and it helps to sequester more carbon and cut the  $\text{N}_2\text{O}$  emission through smart soil and crop management techniques. Scientists' succinct biochar (produced by the combustion of biomass under oxygen-limited conditions) is one of the viable organic amendments to combat climate change and maintain the soil health for sustainable crop production. In this light of views, field experiments were conducted at Black Soil Farm, Agricultural Research Station, Kovilpatti to investigate the effect of different sources of biochar on cotton crop under rainfed vertisol condition. The *Bt* cotton was sown during *rabi* season in 2012 and 2013. The treatments *viz.*, application of FYM, enriched FYM, biocontrol agents, biochar from maize straw, cotton stalk and redgram stalk were imposed along with control. Application of biochar increased the soil pH and EC in the rainfed vertisol. During the crop growth period the rainfall was deficit which coincided with squaring and flowering stages of the crop and due to this very poor distribution of rainfall, crop growth and yield were drastically affected. Though the application of biochar increased the soil moisture content with certain extent, it did not significantly influence the yield. This reveals that clayey condition of the rainfed vertisol as well as increased soil pH may not be favourable for getting good yield when biochar was applied. Hence, reduced seed cotton yield was recorded with application of maize biochar @ 2.5 t/ ha, cotton biochar @ 2.5 t/ ha and redgram biochar @ 5 t / ha. This reveals that the extent of the effect of biochar on crop productivity is variable, due to different bio-physical interactions and processes that occur when biochar is applied to soil, which are not yet fully understood. The apparent contradiction between the high stability of biochar, soil organic matter accumulation and obvious enhancement of soil microbial activity needs to be dogged.

## Effect of weed management on growth and yield of paddy (*Oryza sativa*) under high rainfall area of Bay Island

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Field experiment was carried out during *khari* 2012 at Ferrargunj Tehsil of South Andaman, to study the effect of weed management practices on growth and yield of paddy under high rainfall area of Bay Island. Treatments consisted of three weed management practice ( $T_1$  – Hand weeding at 15 and 30 days after planting (DAP), pre emergence application of Butachlor @1.25 kg a.i.ha<sup>-1</sup> at 3 DAP followed by hand weeding at 30 DAP,  $T_2$  – brown manuring i.e. concurrent growing of daincha with rice followed by spray 2-4 DEE @ 0.5 kg a.i. ha<sup>-1</sup> to kill dhaincha) and farmers practice served as local check. The experiment was laid out in a randomized block design with five replications. Weed management practices significantly altered the weed characters. Significant variations were observed on total weed density and dry weight at 20 and 40 DAP due to adoption of weed management practices. The lowest weed dry weight was recorded in  $T_2$  which is on par with  $T_3$ . Among the weed management practices, concurrent growing of daincha followed by 2-4 DEE @ 0.5 kg a.i. ha<sup>-1</sup> performed better throughout the growth stages due to its suppressive nature of weed growth, weed dry matter accumulation and nutrient removal by weeds. Higher weed control efficiency of 68.9 % and 90.3 % was recorded at 20 DAT and 40 DAT in  $T_3$ . Concurrent growing of daincha and its subsequent incorporation significantly increased the yield of rice (52.3 q ha<sup>-1</sup>) compared to farmer practice (36.2 q ha<sup>-1</sup>). Higher gross return (Rs. 52,300 ha<sup>-1</sup>) and net return (Rs. 32,650 ha<sup>-1</sup>) with B: C ratio of 2.66 was recorded in  $T_3$  which is mainly due to enhanced N availability to rice crop at the most critical physiological stages of daincha brown manuring.

## Post monsoon water management for arecanut plants in Andamans through gravity fed drip irrigation

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Andaman and Nicobar group of islands receives an annual normal rainfall of 3080 mm, which is distributed from mid April to mid December of year. The remaining four months of dry period causes stress to horticultural crops in terms of water availability. Due to porous soil strata, the water holding capacity of soil on the hill slope is less which affects the yield and growth of areca nut plants grown. Hence for survival of the areca nut plants, life saving irrigation at longer duration and small quantity need to be applied. Energy requirement for the micro irrigation system is also high and their cost not affordable is farming community with small land holding. KVK, Port Blair has conducted on-farm trial in 2 locations on performance and evaluation of gravity fed drip irrigation for areca nut plants. Results of the trial indicated that the uniformity coefficient of irrigation in gravity fed drip irrigation is less as compared to other methods. This is due to the head loss in the system and wide pressure fluctuations. But the water saving in irrigation and equivalent energy cost parameters are better in gravity fed drip irrigation system. Considering irrigation during the 4 months of dry period, the yield of the areca nut plants enhanced marginally over the other three methods. The benefit of 1.063 times that of rainfed was obtained for gravity fed drip irrigation system higher than the benefit obtained from other methods of irrigation.



## Isolation and characterization of *Escherichia coli* from meat samples (Chevon)

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The aim of this study was to isolate and characterize *Escherichia coli* found in Chevon. *E.coli* is the facultative anaerobic gram negative rod shaped bacteria which is the member of family *Enterobacteriaceae* that live in intestinal tract of warm blooded animals. A total of five samples of meat were collected from local butcher shops in the city of Meerut. Samples were enriched in peptone water and *E.coli* was isolated by plating on MacConkey agar plates and EMB agar. Suspected isolates were identified as *E.coli* on the basis of various biochemical tests like Gram staining, TSI test, Simmons Citrate test, Catalase test and Acid fast staining. In conclusion, the meat may cause a potential risk to public health and therefore hygienic precautions should be taken by determining critical control points in the phase of product storage and sale and regular checkups of meat and meat products should be performed at various critical control points according to food regulations.

## Protected cultivation technology for off-season vegetable production in Andaman and Nicobar Islands

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Andaman and Nicobar Islands located around 1200 km away from mainland India and have 3.79 lakhs population in addition to over 3.0 lakhs tourists. The islands have unique and fragile ecosystem and climate is typical tropical maritime with around 3300 mm annual rainfall, high humidity (70-90%) and temperature ranges from 18-34°C. Maximum rains occurs during May to December months (400-600 mm/month) and restricts open cultivation of heavy rain-sensitive vegetables including tomato, cauliflower, capsicum, French bean, palak, coriander, carrot, knolkhol etc. Hence, protected cultivation of vegetables showed positive sign for overcoming the damage caused by heavy rains and associated factors. Suitable varieties were identified in capsicum (Indra, California Wonder), cauliflower (White Marble and White Shot), tomato (Ayush and Arka Smarat, G-600, DC Cherry), palak (All Green) and French bean (Arka Komal, Arka Anoop). The bacterial wilt is a major problem in tomato (65-90%) and sweet pepper (40-75%). The trials with tomato on grafting technique (rootstock as wild brinjal- *S. torvum* and CARI Brinjal-1 of *S. melongena*) and growing media (Cocopith + vermicompost + lime in 1:1:0.01 ratio) resulted into '0' and 10-20% wilt incidence, respectively. In intervention on design and development of cost effective structures, the modified rain shelters, low cost shade net and net house were designed and developed for island conditions. Further modifications in polyhouse designs (ventilation and shade effect) were found effective in reducing inside temperature from 35 - 47°C (in conventional polyhouse structure) to 27-34°C. Further, misting was also found to be effective in reducing the temperature particularly in peak hours of in day. Further, round the year production technology of cauliflower was developed by integrating suitable varieties, rain shelter, suitable crop spacing levels and growing method. The modified rain shelters were found attractive among the tribal and local farmers at Car Nicobar (6), Hut Bay (2), Nancowry islands (2) and Campbell Bay (3). While protected cultivation of palak got wide acceptance among the local farmer in Neil Island and South Andaman Island and tomato cultivation in rainy season is getting acceptance among the local polyhouses in Diglipur region of North Andaman during rainy season. However, there are some technical and management constraints which needs due attention for further strengthening the vegetable sector in islands and bringing it to self-sufficiency level at least for perishable vegetables. Therefore, the present paper highlights the mixed outcomes from the protected cultivation of vegetables in tropical climate of Andaman and Nicobar Islands and suggests for more efforts to standardize and popularize the protected cultivation technology in islands.



## Serological status of Foot and Mouth Disease in cattle and buffalo of Andaman and Nicobar Islands of India

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Foot and mouth disease (FMD) is a highly contagious disease of cloven hoofed animals including cattle, buffalo, goat, sheep and pigs. It is one of the most important viral diseases of the livestock causing heavy economic losses to the livestock sector on account of direct and indirect losses. The disease was reported from Andaman & Nicobar Islands in 2005 and for the first time serotype "O" was isolated as the causative agent. Since then under the FMD control programme, vaccination have been carried out in the South Andaman district of A & N Islands and no cases of FMD has been reported. To keep strict serosurveillance and monitoring, routine blood samples of the animals are being collected and screened for protective antibody titer in the vaccinated animals and antibodies against NSPs for the infected animals. Samples of pre and post vaccinated FMD animals (cattle & buffalo) were collected from the South Andaman district for the period from 2011-2014. The samples were screened for protective antibody titre by indirect liquid phase blocked ELISA. The random samples collected from animals were screened for anti NSP protein by DIVA-ELISA to know the status of the infected animals. The result of the DIVA-ELISA revealed the prevalence of 9.52 % , 7.42 % and 9.21 % for the year 2011-12, 2012-13 and 2013-14, respectively. The trend of the DIVA +ve samples indicated that the animals are still showing DIVA+ve, without showing any clinical symptoms or outbreak since the last outbreak reported in 2005. The result of the LPB-ELISA indicated that, since 2012 there is sharp increase in the trend of pre and post protective antibody titre in the pre and post vaccinated animals. The result of the 16<sup>th</sup> round post vaccination indicated the prevalence of 62.15%, 79.28% and 74.33% protection antibody titre for the serotype O, A and Asia-1, respectively. The analysis of the protective antibody titre with respect to herd immunity indicated the protection level of 88% for serotype O, 86% for serotype A and 93 % for serotype Asia-I. Based on the LPB-ELISA seroprevalence, it is concluded that the level of immunity for the serotype O, A and Asia -I has increased manifold over the years, however, the seroprevalence of NSP +ve cases is high without any infection or outbreak.

## Evaluation of different Growth Promoter in Backyard Poultry in Car Nicobar

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The Nicobari tribe feeds their backyard poultry with only coconut and occasionally with rice and termites (brings from forest) and thereby, the birds have lower body weight gain and egg production. Hence, the study was carried out to study the effect of different growth promoter viz. Probiotics, Morinda juice and its combination on weight gain and mortality for improving the backyard poultry farming in Nicobar. Five farmers were selected and provided each with 24 numbers of grower chicks. The chicks were provided with night-shelter and in each farmer field 4 treatments were carried-out. The T<sub>1</sub>: Farmers Practice (Coconut / Rice), T<sub>2</sub>: Farmer Practice supplemented with Morinda fruit juice (1ml / bird/day), T<sub>3</sub>: Farmer Practice supplemented with Probiotics (0.5 g weekly), T<sub>4</sub>: Farmer Practice supplemented with Morinda fruit juice (1ml / bird/day) and Probiotics (0.5 g weekly). The body weight gain and mortality in the birds were recorded at regular intervals. The data obtained were analyzed by simple statistical methods and logical conclusions were derived. The results revealed that, the average weight at 20<sup>th</sup> week of age was higher in the group T<sub>4</sub> of 1236 g followed by T<sub>3</sub> (1066 g), T<sub>2</sub> (982 g) and T<sub>1</sub> (834 g). Whereas the mortality percentage at 20 weeks of age was higher in T<sub>1</sub> (44%) followed by T<sub>3</sub> (32%), T<sub>2</sub> (28%) and T<sub>4</sub> (20%).

It was also found that the B: C ratio was highest in  $T_4$  of 2.07 and lowest in  $T_1$  (1.19). The B: C ratios of  $T_2$  and  $T_3$  were relatively similar with the value of 1.51 and 1.52. Hence, it can be concluded from the above study that the inclusion of Morinda juice and Probiotic in the feed helped in obtaining higher weight gain and also reduced mortality. Further, the Nicobarese tribe can utilize the wild harvest of Morinda for increasing the profitability from backyard poultry farming.

NSBC- 2015- T02- MRCC– 16

### **Minimizing the Carbon dioxide emission through Direct Seeded Rice at NICRA village Kharghna**

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Under national initiative climate resilience in agriculture, deep ploughing during summer and directed seeded rice treatments were performed at Khargahna village in the year 2013-14 and 2014-15 in order to minimize  $CO_2$  emission. During the trials, intervention of above said treatments was reducing about 23.4 kg of  $CO_2/m^2$  area. In addition, the total weed population per meter square area was reduced by 40-45 counts, specially for *Cynodon dactylon* (Summer ploughing = 12 counts and unplowed field = 35 counts Hence, it can be concluded that the intervention of engineering techniques (Deep ploughing and direct seeded rice) reduces the  $CO_2$  emission and weed population as well.

NSBC- 2015- T02- MRCC– 17

### **Evaluation of secondary nutrients status of red and yellow soils of Sakti block in Janjgir-Champa District of Chhattisgarh**

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This study was conducted to evaluate the soil fertility status with respect to available Ca, Mg and S in red and yellow soils of Sakti block in Janjgir-Champa district of Chhattisgarh. Grid based surface (0-15 cm depth) soil samples were collected using Global Positioning System (GPS) from all 130 villages of Sakti block. The soil samples were analyzed for Ca, Mg and S. The soils were found high in available Ca content. The status of available calcium varied from 224 to 8960 kg ha<sup>-1</sup> with a mean value of 5037 kg ha<sup>-1</sup> 97.31 % and 2.68 % soil samples from the study area were classified as high and low fertility class, respectively. The available Magnesium ranged from 134.4 to 6988.8 kg ha<sup>-1</sup> with a mean value of 1605.86 kg ha<sup>-1</sup>. More than 95 % soil samples were grouped as high fertility class of Magnesium whereas 4.66 % of the soil sample were graded as low class of Mg. The available Sulphur varied from 7.56 to 136.08 kg ha<sup>-1</sup> with a mean value of 42.35 kg ha<sup>-1</sup>. More than 53 % soil samples were graded as high fertility class of Sulphur.

## Effect of spacing on growth, flowering and seed yield of Mexican Sunflower (*Tithonia rotundifolia* Blake.) in Andaman

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Mexican Sunflower (*Tithonia rotundifolia* Blake.) is a tall growing plant with coarse, large heart shaped leaves and deep orange-red, single dahlia like flowers with tufted yellow centers. It is commonly grown as ornamental plant in the Islands. The plants are free flowering and mostly grown during summer season. It is one of the most heat and drought tolerant plants growing reasonably well in low fertility soil. *Tithonia* can be grown effectively for backgrounds and hedges. It is ideal for growing as a screen or along the hedge and garden wall and also for cut flowers. Therefore, a need was felt to study the effect of seven spacing levels (30 cm x 45 cm, 45cm x 45 cm, 45cm x 60 cm, 60cm x 60 cm, 60 cm x 75 cm, 75cm x 75 cm and 75cm x 90cm) to standardize the optimum spacing for better growth, flowering and seed yield of Mexican Sunflower. The results showed that maximum plant height(107.7cm), plant spread (81.7 cm), number of branches (9.0), number of leaves (71.3), number of flowers (12.7), flower stalk length (41.3), number of ray florets (14.0), size of flower (8.8 cm), flower disc diameter (3.1cm) and number of seeds per capitulum (100.3) was recorded with a row to row spacing of 45cm and plant to plant spacing of 45 cm compared to the other treatments.

## Effect of sub lethal concentration of salinity on growth and physiological responds of *Labeo rohita* (Hamilton, 1822)

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Toxicity studies were conducted to study the effect of saline water on growth and mortality of Indian major carp, *Labeo rohita* under experimental condition. Fishes (23.1±1.86g) were procured from the institute farm and were acclimatized for 15 days in laboratory conditions before using them for the experiment. The experiment was conducted in plastic tubs (100 L capacity) and 50 L of test solutions were maintained throughout the experiment. For the study four treatments were selected viz. 2.5 ppt, 3.5 ppt and 4.5 ppt and fishes were exposed to different treatments for a period of 90 days. The test solutions were prepared by dissolving raw common salts in normal waters. Monthly length, weight, and regular water quality parameters were recorded. Normal paletted feed were given at the rate of 5% of the body weight throughout acclimation period and also during experiment. At the end of study period it was recorded that percentage gain in weight was in the order of control > 2.5 ppt > 3.5 > 4.5 ppt. Similarly percentage survival was also highest in control (93.7%) and least at 4.5 ppt (56.3%) salt treatment. Similar trend also followed in case of average daily gain in weight and specific growth rate percentage. To assess the biochemical alteration, ascorbic acid in brain, liver and muscle were estimated and was found to decrease significantly with increasing salinity, which can be attributed to stress mitigation effect of vitamin C. From the present study, it can be concluded that exposure to higher salinity significantly affects the growth and physiological response of *Labeo rohita*.

## **Recent trends in climatic variability: A case study of Andamans**

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Climate change has emerged as an important issue ever to confront humanity. This concern arises from the fact that our everyday activities are leading to changes in the Earth's atmosphere that have the potential to significantly alter the planet's shield and radiation balance. As per the IPCC Fifth Assessment Report 2014, each of the last three decades has been successively warmer than any preceding decade since 1850. The effects of the climatic change are expected to be greatest in the developing world, especially countries reliant on primary production as the major source of income. The present study is an effort to analyse the changing trend of various climatic variables, especially temperature and precipitation in an island ecosystem and is aimed to understand their impact which is essential to manage climate related risks to life and infrastructure besides developing resilience through adaptation strategies. The study has been carried out based on the data drawn from various sources which has been analysed and compiled using various statistical techniques. Results reveal that the annual mean temperature of Andamans has increased significantly. Accelerated warming has been observed in the period 1971–2014, mainly due to intense warming in the recent decade 2001-2010 and onwards. This warming is mainly contributed by the monsoon and post-monsoon seasons. During the period 1971-2014, it is observed that there has been a much steeper increase in the mean decadal minimum temperature than the mean decadal maximum temperature. Analysis of rainfall data for the same period shows a decreasing trend and this deviation can be attributed to the unique geographical setting of the region besides other climatic factors. Further, analysis of cyclone data suggests that the trend in the annual frequency of cyclones formed over North Indian Ocean as well as Bay of Bengal is showing a decreasing trend contrary to the popular belief that it increases with the temperature. But, there is an increasing trend in the intensification of cyclones to severe cyclones which validates the findings of this study.

## **Urbanization processes and environment: a spatio-temporal analysis of South Andaman Islands (1951-2011), using geo-spatial tools**

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Urbanization is a major driving force which alters and influence local and regional environments. The study of distribution, growth and extent of urban centers of a region is vital to create a sound economic base as urban centers are reflectors of overall development of a region. The Andaman and Nicobar Islands represent a very fragile ecosystem owing to their location and are thus tremendously vulnerable to various biotic pressures. Urbanization arising from the expansion of settlements and other economic activities has gradually encroached into the luxuriant forests thereby leading to the denudation of vegetation cover from lands and hill slopes. The present study has been carried out using Geographical Information System (GIS) to analyze the spatial distribution of population in Andaman and Nicobar Islands in general and South Andaman in particular, with emphasis on urbanization processes over the last six decades. The analysis has revealed that the urban area in the region has shown a fivefold increase from 7.87 km<sup>2</sup> in 1961 to 37.92 km<sup>2</sup> in 2011, thereby highlighting a pressure on the surrounding landscape owing to the limited resources, because of topography and terrain. Besides, the urban-rural ratio has changed from 33.5 in 1951 to 60.5 in 2011. It is clearly seen that Port Blair has emerged as the primate city and all other urban centers fall under its sphere of influence. This reveals that the urban development in the region is an imbalanced and lopsided one with the capital city witnessing fast growth in comparison to other urban areas which have shown a slow and sluggish growth. Though urbanization can bring out certain good changes, if it is unplanned and unregulated, many environmental changes are bound to take place which can be more intensive and hazardous in the ecologically sensitive island ecosystem. The continuous change in the urban landscape and its impact on the environment is thus, a major concern and this study will allow an understanding of growth mechanisms, underlying drivers of urban expansion, and their effects on local livelihoods so that equilibrium between urbanization and environment is created.



## Outbreak of Ice-Ice disease in red seaweeds, *Kappaphycus alvarezii* cultivated in Palk Bay

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*Kappaphycus alvarezii* is being cultivated in commercial scale in the Palk Bay region since early 2000s. During Aug-Sep, 2013, there was an outbreak of ice-ice disease in the cultivated seaweeds, which resulted in loss of entire standing crop (about 19000 rafts). The study was conducted to analyse the changes in the sea surface temperature (SST), increase of which is a potential cause for the outbreak and also to assess the bacterial characteristics of the infected seaweeds.

Weekly averaged Global Level 3 Mapped Thermal IR SST products derived from the MODIS (MODERate Resolution Imaging Spectroradiometer) sensor onboard Aqua satellite (PODAAC, 2002) were processed using image processing software. The mean values of the SST observations taken at 15 points each around Mandapam and Thoothukkudi were used for plotting and interpretation. Weekly average SST imagery showed consistently higher temperatures (above 28°C) in the Palk Bay and North Gulf of Mannar region compared to the southern Gulf of Mannar (around Thoothukkudi). The ice-ice disease outbreak in *K. alvarezii* could be attributed to higher temperature (an increase of 2°C) in the seaweed cultivation areas, coupled with the high intensity of seaweed farming, owing to their physiological vulnerability to thermal stress. *Planococcus* sp (20%) dominated the bacterial flora in the infected seaweed samples followed by *Arthrobacter* sp and *Pseudomonas* sp. The study calls for optimization of intensity of seaweed cultivation through effective management of the culture space among the cultivators.

## New record of snowflake coral, *Carijoa riisei* from grand island, goa: A case of bio-invasion or re-establishment of a native species?

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Invasion of alien species is a major threat to reef ecosystem as it could result in the loss of gene pool that is unique to a particular geographical area and thus cause major imbalances in an ecosystem. Snowflake coral, *Carijoa riisei* is considered as a potential invasive species and its distribution is reported from various parts of the world including India. It inhabits both natural reefs and artificial substrates. Earlier studies on its occurrence in Gulf of Kachchh, Gulf of Mannar and Andaman & Nicobar Islands have reported the species as invasive. The present study reports the occurrence of the species in reefs of Grande Island, Goa for the first time. The paper argues that the wide range of distribution of *C. riisei* in Indian reefs could either explain a rapid spread of an invasive species or the re-establishment of a population that is in fact native to Indian waters and seeks to review the premise of designating *C. riisei* as invasive to Indian reefs, based on available scientific evidence.

## *Macrobrachium lar* – An endemic freshwater prawn species of Andaman

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The Union Territory of Andaman and Nicobar Islands located in the bay of Bengal between 60 45' N – 13041' N latitude and 92012' E – 93057' E longitude comprised of 572 oceanic islands, islets and rocks blessed with bounty of natural and fragile ecosystems and hotspots of biodiversity. The terrain of the islands is generally mountainous enclosing narrow vallies, thick evergreen tropical forest, limited flat lands and unpolluted water bodies in the shape of small pools, springs and nallahs. In the island ecosystem, *Macrobrachium lar* (Fabricious 1798), an endemic species found naturally in the freshwater flowing bodies from top of the hills to plain in the nallah. The specie is nocturnal and hardy in nature. Study revealed that an adult prawn (60 mm – 110 mm) can strive more than 4 hours in dry condition out of water whereas the juveniles (20 mm – 40 mm) can survive 5 – 6 hours outside water. The species has adaptability to wide range of climatic conditions like can tolerate water temperature of 20<sup>0</sup> - 35<sup>0</sup> C, salinity range of 25 – 30 ppt and low dissolved Oxygen of 3 mg/L. The species *M. lar* breeds twice in a year with two breeding peaks in the months of June and November. Male shows territorial behavior. Male prawn is bigger in size than female with an average weight of 30 g. Breeding in hatchery is possible whereas Seeds of *M. lar* can be collected from wild in the month of July and December for culture in freshwater ponds in the island.

Extended Summary (Supplementary)

## High yielding varieties of rice and farmer's participatory seed production in Andaman and Nicobar Islands

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Rice is the principal cereal crop of Andaman and Nicobar Islands and spread over 10 -12 inhabited Islands. It is grown on about 8,390 hectares of cultivated land which produces over 23,916 tons of paddy. However, the annual demand of rice in these Islands is around 60,000 tons. The huge gap between annual demand and production is fulfilled by shipment of rice from mainland.

The main reason of low productivity include cultivation of popular local landraces like C14-8 (Aath Number Dhan) which are photosensitive, tall, very late maturing and have admixture, low yield and non availability of improved HYVs, imbalanced and inadequate use of fertilizer, heavy and prolonged rainfall, constant warm temperature and high humidity that favour pest and disease incidence. In view of high demand of rice and existing climatic conditions of Bay Islands the desirable rice varieties should possess preferably long duration, high yield, fertilizer responsive, semi-tall stature, good grain and straw quality, resistance to biotic stresses and tolerance to salinity and submergence conditions. Productivity can be increased from about 3 t/ha to 6 t/ha either by introduction of HYVs or improving the yield of locally available rice cultivars by appropriate breeding methods.

Since its inception, lot of efforts have been made by Central Inland Agricultural Research Institute (CIARI) for collecting, identifying and developing improved rice varieties for normal and saline soils of Andaman and Nicobar Islands conditions. The concerted efforts led to the development and release of 5 rice varieties by CIARI. These varieties which have been recommended by A & N State Variety Release Committee are CARI Dhan-1, CARI Dhan-2, CARI Dhan-3, CARI Dhan-4, CARI and Dhan-5. Besides this, recent efforts have been made by the CIARI for identification of new high yielding, disease resistant and adaptable varieties for Andaman and Nicobar Islands conditions. Two new medium duration rice varieties (CARI Dhan 6 and CARI Dhan 7) have been developed and released by Institute Variety Release Committee (IVRC), which are high yielding (5.0 - 5.5 t/ha) and posses resistance to bacteria leaf blight (BLB) which is number one disease of rice in Andaman and Nicobar Islands.



Efforts have also been initiated to purify popular landraces like C14-8, Khushbuyya and Black Burma to offer pure and high yielding strains of these useful landraces to the farmers.

Availability of quality seed and varietal improvements have played a very vital role in increasing rice productivity through better utilization of inputs under different agro-climatic conditions of the country. It is estimated that improved varieties with good quality seed contribute to 40 - 50% to the crop production. The direct contribution of quality seed alone to total production has been estimated at around 15-20% depending upon the crops. The CIARI, Port Blair also continues to make availability of breeder seed and truthfully labeled seed of high yielding rice varieties as per the indents received from Directorate of Agriculture Andaman and Nicobar Islands, other state holders and farmers.

To enhance the quality seed production of agricultural crops both in terms of quality and quantity and to meet up the seed requirement of Andaman and Nicobar Islands, "ICAR Seed Project" was started in 2006 - 07 at Central Island Agricultural Research Institute, Port Blair. During the first phase (2006 -2012) of this project the CIARI has produced about 26.6 tons of quality seed of different field crops. Now seed replacement rate (SRR) of rice has increased from 1.5% to 5.3 % in the Islands. A total of 3.7 tons of Truthfully Labeled Seed of high yielding rice have been distributed/ sold to the Island farmers during current *Kharif* 2014. The seed was produced under farmers' participatory mode under Breeders supervision with the support of NABARD funded Out Reach Center at Diglipur, North and Middle Andaman. This has resulted in the remarkable addition and enhanced supply of quality seed to the Island farmers. Still, a substantial proportion of farm-saved seed is used by the farmers particularly in case of self-pollinated crops like rice, pulses etc. The quantity of farm-saved seed may be reduced by providing certified/ quality seeds to the farmers for yield improvement through higher seed replacement rate (SRR) and variety replacement rate (VRR) in the Islands.

## AUTHOR INDEX

S.No	Abstract No.	Title	Author	Page #
<b>Extended summary</b>				
1	NSBC- 2015- ES-01	Harnessing inter and intra varietal variation in traditional and popular rice cultivars for achieving higher productivity in Andaman & Nicobar Islands	R.K.Gautam, P.K.Singh, Awnindra K. Singh, K. Sakthivel, S.K. Zamir Ahmed, K.Shyam Sunder Rao and S.Dam Roy	3
2	NSBC- 2015- ES-02	Mitigation of nitrous oxide emissions in paddy through use of nitrification inhibitors	M.B.B. Prasad Babu, B. Gangaiah and P.C. Latha	4
3	NSBC- 2015- ES-03	Empowerment of Tribes in biodiversity of Chhattisgarh	Purnima Sahu and Jyoti Tiwari	5
4	NSBC- 2015- ES-04	Mungbean ( <i>Vigna radiata</i> L. Wilczek) genetic resources <i>vis-à-vis</i> farmers' variety of Bay Islands for traits of agronomic interest and its implication in breeding programme	Awnindra K. Singh, R.K. Gautam, P.K. Singh, Utpal Biswas, R. Rahul Kumar, S. Swain, A.K. Betal, T. Bharathimeena, K. Sakthivel, S.K. Zamir Ahmed and S. Dam Roy	6
5	NSBC- 2015- ES-05	Biodiversity and productivity of herbage species in silvopasture system	M.N.Naugraiya and K.K.Sahu	8
6	NSBC- 2015- ES-06	Agricultural diversification for climate change adaptation in an Island ecosystem	A.Velmurugan, T.P.Swarnam, T.Subramani, N.Ravisankar A.K.Singh and S.Dam Roy	9
7	NSBC- 2015- ES-07	Impact of climate change on coastal agricultural bio-diversity: Issues and strategies	Narendra Pratap Singh, Adavi Rao Desai and S Priya Devi	11
<b>NSBC 2015 - TRACK – I : BIODIVERSITY</b>				
<b>1.1. ADAPTIVE MANAGEMENT AND COMPETING CLAIMS ON NATURAL RESOURCES</b>				
8	NSBC- 2015- T01-AMCC – 01	Analysing lycopene content in tomato ( <i>Lycopersicon esculentum</i> Mill.) in response to pesticide toxicity	Manisha Gautam, Shefali Poonia and Purushottam	15
9	NSBC- 2015- T01-AMCC – 02	Diversified genetic resources for improving drought and heat tolerance in Chickpea	H. S. Yadava and A.L. Baghmare	15
10	NSBC- 2015- T01-AMCC – 03	Effect of bagging on mango peel colour and composition of pigments	G. R. Karanjalkar, K. S. Shivashankara, M. R. Dinesh, T. K. Roy and K. V. Ravishankar	16
11	NSBC- 2015- T01-AMCC – 04	Study of the Native <i>Rhizobium</i> of SVBPUAT and its nearby areas and its response on different attributes of black gram.	Purushottam, Nikita Singh, Akash Tomer, B.P.Dhyani and Shefali Poonia	16
12	NSBC- 2015- T01-AMCC – 05	Genetic divergence analysis for certain yield and quality traits in rice ( <i>Oryza sativa</i> L) under saline condition	Apsath Beevi. H and M. Venkatesan	17

13	NSBC- 2015- T01-AMCC – 06	Screening the natural populations of Madhunashini ( <i>Gymnema sylvestre</i> ) for morphological and biochemical parameters using reverse phase- high performance liquid chromatography	Ajit Arun Waman, P. Manivel, Tushar Dhanani, Richa Singh and Satyanshu Kumar	17
14	NSBC- 2015- T01-AMCC – 07	Assessing the suitability of ultrasound assisted solvent extraction method for extraction of gymnemagenin from <i>Gymnema sylvestre</i> leaves and quantification using reverse phase high performance liquid chromatography	Ajit Arun Waman, Tushar Dhanani, Manivel P. and Satyanshu Kumar	18
15	NSBC- 2015- T01-AMCC – 08	Effect of pinching on yield of African marigold ( <i>Tagetes erecta</i> L.) in tropical Island conditions	V.Baskaran, K. Abirami, R.K. Gautam and S. Dam Roy	18
16	NSBC- 2015- T01-AMCC – 09	Yield performance of legume vegetable crops in Andaman and Nicobar Islands	Shrawan Singh, V. B. Pandey and S. Dam Roy	19
17	NSBC- 2015- T01-AMCC – 10	Determination of the conservation value of mangroves of Andaman	Kiruba Sankar, R, K. Lohith Kumar, Raymond Jani Angel, M.P. Goutham-Bharathi, Aluri Swapna, P. Krishnan and S. Dam Roy	19
18	NSBC- 2015- T01-AMCC – 11	Heterotic expression and combining ability analysis for yield and yield components maize ( <i>Zea mays</i> L.)	Anjani Kumar Singh S.B. Singh and A.K. Sharma	20
19	NSBC- 2015- T01-AMCC – 12	Breeding fruit trees for fruit quality improvement	Karanjalker Gourish and Nesara Begane	20
20	NSBC- 2015- T01-AMCC – 13	Follicolous lichen diversity in the Andaman and Nicobar Islands	T.A.M. Jagadeesh Ram	21
21	NSBC- 2015- T01-AMCC – 14	Micro-propagation of <i>Costus</i> sp - important medicinal plants of the Andaman and Nicobar Islands	K. Abirami, V. Baskaran and Nutan Roy	21
22	NSBC- 2015- T01-AMCC – 15	Rodent menace in storage and their management in South Andamans	T. Bharathimeena, A.K. Singh and P. K. Singh	22
23	NSBC- 2015- T01-AMCC – 16	Evaluation of Jamun ( <i>Syzygium cumini</i> L.) germplasm for major biochemical constituents	Shamina Azeez, Pooja Bohra, Shivaramu K and Anuradha Sane	23
24	NSBC- 2015- T01-AMCC – 17	Assessing the variability amongst seedling population of Jamun ( <i>Syzygium cumini</i> L.) for morphometric parameters	Shivaramu K, Pooja Bohra, Anuradha Sane and Ganesh N. Khadke	23
25	NSBC- 2015- T01-AMCC – 18	Genetic diversity assessment in certain heirloom varieties of Mango ( <i>Mangifera indica</i> L.)	Pooja Bohra, M.R. Dinesh, B.S. Sandhya and K.V. Ravishankar	24
26	NSBC- 2015- T01-AMCC – 19	Physico-chemical and phytochemical changes in Malay apple ( <i>Syzygium malaccense</i> (L.) during storage	K. Abirami, Sachidananda Swain, V. Baskaran, Yogeshwari, R. K. Gautam and S. Dam Roy	24
27	NSBC- 2015- T01-AMCC – 20	Changes in the biochemical quality of processed products of aonla during storage	Kamalkumaran, P.R., R.M. Vijayakumar, K. Boomiraj and N. Sritharan	25

28	NSBC- 2015- T01-AMCC – 21	Comparative analysis of nutrient composition and physicochemical properties of selected local and newly introduced rice varieties grown in Andaman Islands	Sachidananda Swain, R. K. Gautam, M.V. Nagalaxmi, T. Subramani, T.P. Swarnam, A. Velmurugan, B. Gangaiah and S. Dam Roy	25
<b>NSBC 2015 - TRACK – I : BIODIVERSITY</b>				
<b>1.2.CONTEMPORARY APPROACHES TO GENETIC RESOURCES CONSERVATION AND USE</b>				
29	NSBC- 2015- T01-CAGR – 01	Database design and documentation of agricultural crop diversity conservation in Andhra Pradesh and Telangana	M.Balakrishnan, S.K.Soam and P.D.Sreekanth	29
30	NSBC- 2015- T01-CAGR – 02	Carotenoids and anthocyanin composition in mango ( <i>Mangifera indica</i> L.) fruit peel	G. R. Karanjalker, K.S. Shivashankara, T. K. Roy, M.R. Dinesh and K.V. Ravishankar	29
31	NSBC- 2015- T01-CAGR – 03	Diversity of mushrooms in Indo-Bangladesh region of North-East India	Jayashree Bhattacharjee, Debashre Bhattacharjee, Tapas Paul, Arvind Kumar and Samik Chowdhury	30
32	NSBC- 2015- T01-CAGR – 04	Endemic insects of Bay Islands	Kailash Chandra	31
33	NSBC- 2015- T01-CAGR – 05	Growth, yield attributing parameters and seed quality of summer mungbean ( <i>Vigna radiata</i> L.) as influenced by dates of sowing, spacing and fertilizer with seed treatment under North Indian conditions	Rajiv K. Singh, D.K. Agarwal, Hardev Ram, Govind Pal, S. Rajendra Prasad and R. K. Chauhan	31
34	NSBC- 2015- T01-CAGR – 06	An overview of fruit biodiversity in Himachal Pradesh with particular reference to temperate fruits	B.S. Thakur, M.S. Mankotia and Neena Chauhan	32
35	NSBC- 2015- T01-CAGR – 07	Genetic variation among Karnal bunt ( <i>Tilletia indica</i> ) isolates collected from Jammu and Kashmir using molecular tools	Singh Brajeshwar, M.S. Saharan, A.Vaid, V.K. Razdan and C.S. Kalha	33
36	NSBC- 2015- T01-CAGR – 08	Genetic diversity, germplasm collection and conservation of Rubber	V.Hemalatha, J. Dilip Babu, R.V.S.K. Reddy and M. Rajasekhar	33
37	NSBC- 2015- T01-CAGR – 09	Harnessing existing diversity in newly collected pigeonpea germplasm of Chhattisgarh origin	R.N. Sharma, Navneet Rana, H.C. Nanda, S.K. Nair and P.L. Johnson	34
38	NSBC- 2015- T01-CAGR – 10	A Review on <i>Trikatu</i> an Ayurvedic formulation with special reference to Andaman & Nicobar Islands	Chinmay Rath, Santosh S Mane, Anupam Mangal, G.V.R.Joseph and Abhimanyu Kumar	35
39	NSBC- 2015- T01-CAGR – 11	Exploitation of grasspea ( <i>Lathyrus sativus</i> L.) PGR in crop improvement at IGKV : A case view	H.C. Nanda, S.K. Nair, R.N. Sharma and D.K. Chandrakar	35
40	NSBC- 2015- T01-CAGR – 12	Clonal diversity in Banana varieties for bract anthocyanin content	Pooja Bohra, Ajit Arun Waman and Gourish Karanjalker	37
41	NSBC- 2015- T01-CAGR – 13	Biodiversity of Coastal areas of Nicobar Islands: <i>Canavalia rosea</i> (Sw.) DC	Viveka Nand Singh, Awnindra K. Singh, Nagesh Ram, Zachariah George, A. K. Pandey, C. Ram, S. K. Singh, S. K. Pandey and S. Dam Roy	37

42	NSBC- 2015- T01- CAGR – 14	<i>Coscinium fenestratum</i> , a critically endangered medicinal species: Ethno-botany, uses, conservation and multiplication	Yashaswini Sharma, Akkamahadevi Agasimani and M.R. Ravikumar	38
43	NSBC- 2015- T01- CAGR – 15	Diversity of tree borne oil seeds in Andaman and Nicobar Islands	I. Jaisankar, A. Velmurugan, T. P. Swarnam and S. Dam Roy	38
44	NSBC- 2015- T01- CAGR – 16	New high yielding and disease resistant medium duration rice varieties for Andaman and Nicobar Islands	P. K. Singh, R. K. Gautam, A. K. Singh, K. Sakthivel, T. Bharathimeena, S. K. Zamir Ahmed and S. Dam Roy	39
45	NSBC- 2015- T01- CAGR – 17	High yielding antioxidant rich varieties of Noni ( <i>Morinda citrifolia</i> L.) for livelihood and health improvement in tropical islands	Shrawan Singh, D. R. Singh and S. Dam Roy	39
46	NSBC- 2015- T01- CAGR – 18	Differential response of ney poovan banana ( <i>Musa ab</i> ) cultures to carbon sources and their concentrations during proliferation, and concurrent <i>ex vitro</i> rooting and hardening	Pooja Bohra, Ajit Arun Waman, B.N. Sathyanarayana and K. Umsha	40
47	NSBC- 2015- T01- CAGR – 19	Development of nectar from Pummelo ( <i>Citrus grandis</i> ), an underutilized fruit crop, by blending with kokum ( <i>Garcinia indica</i> ) and mango ginger ( <i>Curcuma amada</i> )	Pooja Bohra and K.N. Srinivas	41
48	NSBC- 2015- T01- CAGR – 20	Micronutrients and antioxidants in leaf and stem parts of Indian spinach variants	Shrawan Singh and V. Shajeeda Banu	41
49	NSBC- 2015- T01- CAGR – 21	Evaluation of pulse cultivation and resource optimization under coconut plantation	T. Subramani, A.Velmurugan, A.K. Singh, V. Damodaran, B.K. Nanda, T.P. Swarnam, S. Swain and B. Gangaiah	42
50	NSBC- 2015- T01- CAGR – 22	Isolation, purification and characterization of peroxidase from monocot cereals	Sneha Sawhney and M. Mahesh	42
51	NSBC- 2015- T01- CAGR – 23	Tuber crops based farming system for sustainable livelihood options of Nicobari Tribes in Andaman & Nicobar Islands	V. Damodaran, M. Sankaran, L.B. Singh, Viveka Nand Singh, T. Subramani, I. Jaisankar, James George <sup>2</sup> and S. Dam Roy	43
52	NSBC- 2015- T01- CAGR – 24	Multivariate approaches of assemblages of zooplankton distribution and abundance in the offshore waters of Andaman and Nicobar Islands	N. Jeyaraj, T. Sathish, S. Rajaguru, L. Anbu rajan, N.V. Vinithkumar, G. Dharani and R. Kirubakaran	44
53	NSBC- 2015- T01- CAGR-25	Front Line Demonstration on SRI Method by KVK at NICRA Village kharghana of district Bilaspur (CG)	Shilpa Kaushik, Khoobi Ram Sahu, Nivedita Pathak and R.dixit	44
54	NSBC- 2015- T01- CAGR-26	Conservation and utilization of cytoplasmic male sterile lines for development of short and medium duration Pigeonpea hybrids	A.N. Tikle, K.B. Saxena, H.S.Yadava and R.K.Singh	45
55	NSBC- 2015- T01- CAGR-27	Antagonistic activity of wild mushrooms against plant pathogenic fungi	Vivek Kumar Pandey and Y. S. Paul	45

<b>NSBC 2015 - TRACK – I : BIODIVERSITY</b>				
<b>1.3. FISHERIES GOVERNANCE FOR FOOD SECURITY</b>				
56	NSBC- 2015- T01-FG – 01	Portable FRP carp hatchery: a tool for biodiversity conservation in fisheries	B.C. Mohapatra, P.P. Chakrabarti, N.K. Barik, D. Majhi, S.K. Mahanta, H. Sahu, S. Lenka, A. Nanda, S. Mishra and P. Jayasankar	49
57	NSBC- 2015- T01-FG – 02	Seed production of Rohu, <i>Labeo rohita</i> and Bata, <i>L. bata</i> in FRP hatchery in Bali Island, Sundarban through brood stock and nutrient management	P.P. Chakrabarti, B.C. Mohapatra, A. Ghosh, S.C. Mandal and P. Jayasankar	49
58	NSBC- 2015- T01-FG – 03	Studies on orientation pattern of pseudofecal pellets of the sand bubbler crab, <i>Dotilla clepsydrodactylus</i> , Carbyns Cove, South Andaman	P.M. Mohan, Kalpana Chandel and Vibha V. Ubare	50
59	NSBC- 2015- T01-FG – 04	A study on the species composition of Rays (Order: Myliobatiforms) from the landings at Junglighat fish landing Centre and from onboard commercial trawler	Ganesh Basumatary, Rahul Nagesh, Bitopan Malakar, Ravi Ranjan Kumar, B. Santhosh Ram and S. Venu	50
60	NSBC- 2015- T01-FG – 05	Biochemical composition of Indian Mackerel <i>Rastrelliger kanagurta</i> from Andaman waters	J. Goutham and R. Mohanraju	51
61	NSBC- 2015- T01-FG – 06	Overview of aquatic animal diseases in andaman and nicobar islands	K. Saravanan, S. Dam Roy, R. Kiruba Sankar, A. Anuraj, J. Raymond Jani Angel, Venkatesh R Thakur, K. Lohith Kumar and S. Monalisha Devi	51
62	NSBC- 2015- T01-FG – 07	Systematics, diversity and abundance of Puffer fishes belonging to genera <i>Arothron</i> and <i>Canthigaster</i> from the South Coast of Andaman	Purbali Saha, Divya Singh, Santhosh Ram, Bitopan Malakar and S. Venu	52
63	NSBC- 2015- T01-FG – 08	Relative abundance of clown fishes from North Bay Island of Andaman Sea	Venkatesh R Thakur, S. Dam Roy, N.K. Chadha and Chandra Prakash	52
64	NSBC- 2015- T01-FG – 09	Symbiosis of anemone fish and sea anemones	Venkatesh R Thakur, S. Dam Roy, N. K. Chadha and Chandra Prakash	53
65	NSBC- 2015- T01-FG – 10	Distribution of Clupeoid fishes in Andaman waters	S. Monalisha Devi, A.K. Jaiswar, S.K. Chakraborty, Swapnil Shivadas Shirke	53
66	NSBC- 2015- T01-FG – 11	Distribution and abundance of <i>Pristipomoides spp.</i> from Andaman waters	S. Monalisha Devi, S. Dam Roy, Lohith Kumar and R. Kiruba Sankar	54
<b>NSBC 2015 - TRACK – I : BIODIVERSITY</b>				
<b>1.4. LIVESTOCK DIVERSITY APPROACHES FOR SUSTAINABLE AGRICULTURE</b>				
67	NSBC- 2015- T01-LDA – 01	Performance of Vanaraja breeder birds under Island climatic condition for strengthening livestock diversity	A. Kundu, T. Sujatha, Jai Sunder and M.S. Kundu	57
68	NSBC- 2015- T01-LDA – 02	<i>Ex situ</i> conservation of mithun ( <i>Bos frontalis</i> ) through cryopreservation of epididymal sperm collected from dead bulls	Mohan Mondal, K. K. Baruah, Bhaskar Bora and M. K. Ghosh	57



69	NSBC- 2015- T01-LDA – 03	Village duck production for sustainable livelihood and women empowerment in tribal districts of Odisha	S.C. Giri, S.K. Sahoo, K.V.H. Sastry, R.K.S. Bais and S. Saran	58
70	NSBC- 2015- T01-LDA – 04	Food borne diseases	Shruti Bajpayee, Pragya Trivedi, Purushottam, Akash Tomar, B.P. Dhyani and R. Kumar	58
71	NSBC- 2015- T01-LDA – 05	Spermatozal abnormalities of Karan Fries (Tharparkar × Holstein Friesian) bulls in different seasons	Simsom Soren, S.V. Singh, R.C. Upadhyay and Pawan Singh	59
72	NSBC- 2015- T01-LDA – 06	Livelihood option in rural villages of Andaman through backyard poultry using dual purpose improved Nicobari fowl	N. C. Choudhuri, Nagesh Ram, A. Kundu and S. Dam Roy	59
73	NSBC- 2015- T01-LDA – 07	Morpho-biometric traits of Andaman local goats	Jai Sunder, A. Kundu, M.S. Kundu and T. Sujatha	60
74	NSBC- 2015- T01-LDA – 08	Effect of iron lactate supplementation on the development of haematological parameters of piglets in post natal period	M.S. Kundu, A. Kundu, Jai Sunder and T.Sujatha	60
75	NSBC- 2015- T01-LDA – 09	The traditional indigenous poultry production and improvement strategies among tribal farming community in Nicobar Islands	T. Sujatha, A. Kundu, Jai Sunder and M.S. Kundu	61

**NSBC 2015 - TRACK – I : BIODIVERSITY**

**1.5. PLANT VARIETY PROTECTION AND FARMER'S RIGHT**

76	NSBC- 2015- T01-PPV – 01	Role of PPV&FRA in agro-biodiversity conservation: Salient achievements and challenges	Manoj Srivastava, Vijaya Chaudhary and Meenakshi Bharadwaj	65
77	NSBC- 2015- T01-PPV – 02	Genetic diversity and variability studies of promising pigeonpea ( <i>Cajanus cajan</i> L.) landraces of Bay Islands based on morphological markers	Awnindra K Singh, Utpal Biswas, Rahul Kumar, S. Swain, T. Bharathimeena, Ajay Pandey, K. Sakthivel, T. Subramani, P.K. Singh, R.K. Gautam and S. Dam Roy	65
78	NSBC- 2015- T01-PPV – 03	Farmers cooperation – Chhattisgarh state	Ganaram Sahu, K K Sahu and N. Manikandan	66
79	NSBC- 2015- T01-PPV – 04	Comparative studies of Indian seed laws with special reference to Protection of Plant Varieties and Farmers' Rights Act	Umesh R Kamble, Govind Pal, S. Rajendra Prasad, Udaya Bhaskar K and K.V. Sripathy	67
80	NSBC- 2015- T01-PPV-05	Tailoring indigenous urdbean ( <i>Vigna mungo</i> L. Hepper) landraces for enhancing yield through ideotype breeding, physiological interventions and adaptive selection	Awnindra K. Singh, R.K. Gautam, Utpal Biswas, R. Rahul Kumar, P.K. Singh, S. Swain, A.K. Betal, T. Bharathimeena, K. Sakthivel, S.K. Zamir Ahmed and S. Dam Roy	68

<b>NSBC 2015 - TRACK – I : BIODIVERSITY</b>				
<b>1.6. WILDLIFE MANAGEMENT AND INNOVATION FOR SUSTAINABILITY</b>				
81	NSBC- 2015- T01-WM – 01	Avifaunal diversity in the proposed canopy Walkway at Chidiyatappu biological park, South Andaman	C. Sivaperuman, P. Viswakannan, G. Gokulakrishnan and J. Dinesh	71
82	NSBC- 2015- T01-WM – 02	Endemic avifauna of Nicobar Islands with special reference to Great Nicobar Biosphere Reserve	C. Sivaperuman, J. Dinesh, G. Gokulakrishnan and K. Venkataraman	71
83	NSBC- 2015- T01-WM – 03	Empowerment of tribes in biodiversity of Chhattisgarh	Purnima Sahu and Jyoti Tiwari	72
84	NSBC- 2015- T01-WM – 04	Endemic plants diversity of Great Nicobar Biosphere Reserve (GNBR) and conservation strategies	S. Prabhu, R. Sathiyaseelan, S. Aron and Lal Ji Singh	72
<b>NSBC 2015- TRACK – 2: CLIMATE CHANGE.</b>				
<b>2.1. CLIMATE CHANGE ADAPTATION IN AGRICULTURE AND NATURAL RESOURCE MANAGEMENT</b>				
85	NSBC- 2015- T02-CCA– 01	Soil and plant nutrient status as influenced by organic farming in long pepper ( <i>Piper longum</i> L.)	G.R. Smitha, K. Umesha and A.A. Waman	77
86	NSBC- 2015- T02-CCA– 02	Livestock production adapting to climate change	Veerasamy Sejian, Raghavendra Bhatta, P.K. Malik and M. Bagath	77
87	NSBC- 2015- T02-CCA– 03	Correlation studies on available calcium and soil properties in different soil type of Malkharauda block under Janjgir-Champa District in Chhattisgarh	Hareesh Kumar, K.K. Sahu and P.K.Kurrey	78
88	NSBC- 2015- T02-CCA– 04	Impact of crop residues of direct seeded & transplanted rice and nutrient management on soil moisture regimes and productivity of chickpea under rice-chickpea cropping system in Vertisols under rainfed conditions	R.N.Singh, K.K.Sahu, S.S.Sengar, R.K.Bajpai, Alok Tiwari and Rahul Kumar	78
89	NSBC- 2015- T02-CCA– 05	Influence of weather parameters on quality of rice	G.S. Varaprasad, K. Suneetha, A.K. Sarawgi, B.N. Mandal, B. Gangaiah, D. Sanjeeva Rao and V. Ravindra Babu	79
90	NSBC- 2015- T02-CCA– 06	Impact of rice establishment method on moisture conservation and cracks on rice-chickpea cropping system on Vertisol in Chhattisgarh region	R.N.Singh, Rahul Kumar, K.K.Sahu, S.S. Sengar and Alok Tiwari	79
91	NSBC- 2015- T02-CCA– 07	Impact of temperature on the productivity factors of apple under the present climatic scenario	M.S. Mankotia, B.S. Thakur and Neena Chauhan	80
92	NSBC- 2015- T02-CCA– 08	Improving soil quality and crop productivity minimization of soil disturbances	Thaneshwar Kumar, K.Tedia, A.K Singh and R.G. Goswami	82

93	NSBC- 2015- T02-CCA– 09	Price analysis of marine and freshwater fishes in North and Middle Andaman District- India	S.K. Zamir Ahmed, P. Krishnan, S. Dam Roy, Nagesh Ram, R. Kiruba Sankar, T. Ravi Kumar, Amit Srivastava, Siba Mahato, T.R.G. Babu, V. Harish and A.K. Pandey	81
94	NSBC- 2015- T02-CCA– 10	Micro-propagation studies on <i>Eulophia andamanensis</i> – A potential tropical orchid of Bay Island	D.R. Singh, V. Baskaran, K. Abirami and P. Simhachalam	81
95	NSBC- 2015- T02-CCA– 11	Evaluation of virgin coconut oil extraction technologies	Chandrika Ram, Nagesh Ram, V. N. Singh, Z. George S. Swain, Manoj Kumar, A. K. Pandey, S.K. Singh and S. Dam Roy	82
96	NSBC- 2015- T02-CCA– 12	Extraction and quantitation of chitin, chitosan and chitooligo saccharides from shrimp waste	Tarun Kumar Varun and S. Senani	82
97	NSBC- 2015- T02-CCA– 13	Water management technologies for higher crop and water productivity under Island ecosystem	T. Subramani, S.K. Ambast, S. Jeyakumar, A.Velmurugan, T.P. Swarnam, S. Swain, B. Gangaiah and S. Dam Roy	83
98	NSBC- 2015- T02-CCA– 14	The species <i>Puntius javanicus</i> (Bleeker), growth model in tropical fresh water of West Bengal condition and may sustain in wide fresh water environments in India	Debabrata Das	83
99	NSBC- 2015- T02-CCA– 15	Climate Change: impact and adaptive strategies for seed spices	Balraj Singh, Arvind K. Verma, Harisha, C. B. and HonnappaAsangi	84
100	NSBC- 2015- T02-CCA– 16	Socio- economic study of scheduled tribes of Andaman and Nicobar Islands and their future prospects	S.C. Chaturvedi	84
101	NSBC- 2015- T02-CCA– 17	Bamboo straw– an eco friendly straw for climate change	L Brojendra Singh, Nagesh Ram and Goutam Paul	85
102	NSBC- 2015- T02-CCA– 18	Remediation of Heavy metals contaminated soil by use of flowering plants	Sao Yushma and Patel, K.P. and K.K. Sahu	86
103	NSBC- 2015- T02-CCA– 19	Scenario of Cole crops in North & Middle Andaman	D. Basantia, T. Paul, L.B. Singh, Nagesh Ram, B.L. Menna and Sailesh Kumar	86
<b>NSBC 2015- TRACK – 2: CLIMATE CHANGE.</b>				
<b>2.2.COASTAL ZONE MANAGEMENT IN THE ERA OF CLIMATE CHANGE</b>				
104	NSBC- 2015- T02-CZM– 01	Ring net operation from Junglighat fish landing Centre (JFLC), South Andaman	S. Dam Roy, R. Kiruba Sankar, M. Kaliyamoorthy, Mohammad Irfan Ali, G. Narshimulu, P. Krishnan and A. Anand	89
105	NSBC- 2015- T02-CZM– 02	Landings of prawns ( <i>Penaeus</i> sp.,) at Junglighat fish landing centre, South Andaman	S. Dam Roy, R. Kiruba Sankar, M. Kaliyamoorthy, Mohammad Irfan Ali, G. Narshimulu, Sukham Monalisha Devi, P. Krishnan and A. Anand	89

106	NSBC- 2015- T02-CZM- 03	Tuna (Yellow fin & Skipjack) landings in South Andaman	S. Dam Roy, R. Kiruba Sankar, M. Kaliyamoorthy, Mohammad Irfan Ali, G. Narshimulu, Sukham Monalisha Devi, P. Krishnan and A. Anand	90
107	NSBC- 2015- T02-CZM- 04	A Preliminary study on solid waste and ghost nets and their impact on the biotic community of Andaman Islands	Rahul Nagesh, Ganesh Basumatary, Bitopan Malakar and S. Venu	90
108	NSBC- 2015- T02-CZM- 05	Aquatic and wetland plant diversity and climate change in Andaman and Nicobar Islands	C.P. Vivek, Lal Ji Singh and M.Y. Kamble	91
109	NSBC- 2015- T02-CZM- 06	Broodstock management and captive breeding of Anemone fishes in Andaman and Nicobar Islands	J. Raymond Jani Angel, A. Anuraj, K. Saravanan, K. Lohith Kumar, Venkatesh R. Thakur, Benny Varghese, R. Kiruba Sankar and S. Dam Roy	91
110	NSBC- 2015- T02-CZM- 07	Marine jetties as artificial reefs – A study on the fish assemblage structure from Port Blair, South Andaman	P. Pranav, V. Sajin, Divya Singh, Bitopan Malakar and S. Venu	92
111	NSBC- 2015- T02-CZM- 08	Plant diversity and climate change in the coastal zone of the Andaman and Nicobar Islands	Gautam Anuj Ekka, Lal Ji Singh and M.Y. Kamble	92
112	NSBC- 2015- T02-CZM- 09	Need for an integrated coastal zone management in the Islands	K. Lohith Kumar Nitul Gogoi, S. Dam Roy, R. Kiruba Sankar and S. Monalisha Devi	93
113	NSBC- 2015- T02-CZM- 10	Dynamics of coral community and ecosystems of Andaman & Nicobar Islands	S.C. Chaturvedi	93
114	NSBC- 2015- T02-CZM- 11	The assemblages of benthic foraminifera in the muddy and sandy sediments of Andaman Islands	M.Muruganantham and P.M. Mohan	94
115	NSBC- 2015- T02-CZM- 12	Meiofauna succession in a tsunami affected environment and its climatic concern in intertidal environment of Port Blair, Andaman Island, India	P.M. Mohan and P. Dhivya	94
116	NSBC- 2015- T02-CZM- 13	Community on coral reef data buoy deployed near Grub Island, South Andaman	S. Deepa, M. Srikumar, P. Venkateshwaran, Apurba Kumar Das, N. V. VinithKumar, M. Arul Muthiah, R. Venkatesan and R. Kirubakaran	95
117	NSBC- 2015- T02-CZM-14	Shoreline changes and coastal erosion in the marine terraces of port blair, south andaman: an indicator of long term holocene climate change	S. Balaji, Gulam Rashool Bhat, Balakrishna, Mohsin Hameed, Showkath and Vazeem Iqbal	95
118	NSBC- 2015- T02-CZM-15	Discovery of marine molluscs from the andaman and nicobar islands: past, present and prospects	J. Benjamin Franklin, N. V. Vinithkumar and R. Kirubakaran	96

**NSBC 2015- TRACK – 2: CLIMATE CHANGE.**

**2.3. RIGHTS BASED APPROACH TO FOOD AND NUTRITION SECURITY**

119	NSBC- 2015- T02-RBA- 01	An analysis of economic profitability and determinants of adoption in Pigeonpea seed production technology: A case study in Karnataka	Govind Pal, Radhika C, R. K. Singh, Uday Bhaskar K., H. Ram and S. R. Prasad	99
120	NSBC- 2015- T02-RBA- 02	Influence of rice stubble on moisture regimes, water use efficiency in Lathyrus under rice-pulse relay cropping system in vertisols	Rahul Kumar, R.N. Singh. T. Chowdhury and Alok Tiwari	99
121	NSBC- 2015- T02-RBA- 03	Climate change adaptation through agricultural diversification in tribal areas of Nicobar Islands	T.P.Swarnam, A.Velmurugan, S.K. Pandey, Z. George, Tulsipawan Sai, T. Subramani, S. Dam Roy, S. Swain and B. Gangaiah	100
122	NSBC- 2015- T02-RBA- 04	Quality characteristics of nutritious cookies of composite flour from legume, cereal, millet and oilseed for pro-poor farming community	Ashwini Bhoware and Archana Mishra	100
123	NSBC- 2015- T02-RBA- 05	Farmer (Tribal) participatory varietal evaluation of sweet potato ( <i>Ipomoea batatas</i> L.) in Nicobar Islands	Viveka Nand Singh, Nagesh Ram, M. Sankaran, Awnindra K. Singh, A. K. Pandey, L. B. Singh, V. Damodaran Zachariah George Chandrika Ram and S. Dam Roy	101
124	NSBC- 2015- T02-RBA- 06	Socio-economics of fishermen community around the Junglighat fish landing center, South Andaman – A case study	B. Santhosh Ram, Ravi Ranjan Kumar and S. Venu	101
125	NSBC- 2015- T02-RBA- 07	Tank production of <i>Artemia</i> juveniles and adults from agricultural waste	A. Anuraj, J. Raymond Jani Angel, Venkatesh R Thakur, K. Saravanan, K. Lohith Kumar, R. Kiruba Sankar and S. Dam Roy	102
126	NSBC- 2015- T02-RBA- 08	<i>Azolla</i> ( <i>Azolla pinnata</i> ) - Alternate feed supplement for pigs in Car Nicobar	Zachariah George, Nagesh Ram, A. Kundu, M.S. Kundu, Jaisunder, T. Sujatha, Viveka Nand Singh, A. K. Pandey, C. Ram and S. Dam Roy	102
127	NSBC- 2015- T02-RBA- 09	Studies on physico-chemical properties of Pandanus fruit: A traditional staple food of Nicobari tribals	Sachidananda Swain, M.V. Nagalaxmi, Chandrika Ram, T. Subramani, T.P Swarnam, A. Velmurugan, B. Gangaiah and S. Dam Roy	103
128	NSBC- 2015- T02-TBA-10	Scientific kitchen garden for food and nutritional security of Island farmers	Harapriya Nayak, Nagesh Ram, Shrawan Singh, N. C. Choudhuri and S. Dam Roy	104
129	NSBC- 2015- T02-TBA-11	Mapping of mangrove patches of Kerala using satellite remote sensing based images and their ground truth validation	Monolisha, C.R Renjithkumar, Pranav P, Dennis A, Shyam S Salim, Mini K.G and Grinson George	105

**NSBC 2015- TRACK – 2: CLIMATE CHANGE.**

**2.4. INTEGRATED PEST MANAGEMENT**

130	NSBC- 2015- T02-IPM– 01	Scientific validation of Indigenous moringa varieties for pest management	Yogeshwari, N. Muthukrishnan, K. Premalatha, R.M. Rekha and Nagajothi	109
131	NSBC- 2015- T02-IPM– 02	Alarming outbreak of wilt in flax caused by <i>F. oxysporum</i> f. sp. <i>Lini</i> Schlecht	A.N. Tripathi and R.K. De	109
132	NSBC- 2015- T02-IPM– 03	Bio-efficacy of Taegro Eco (Bio fungicide) against late blight ( <i>Phytophthora infestans</i> ) of tomato	M.R.Ravikumar and Yashaswini Sharma	110
133	NSBC- 2015- T02-IPM– 04	Conserving the less Charismatic: Making conservation inclusive for conserving the Ecosystem Services	Priyadarsanan Dharma Rajan	110
134	NSBC- 2015- T02-IPM– 05	Pesticide formulations using plant extracts - an overview	Sandeep Dixit, Shivam Dixit, Kamal Kishor, Rajmani Prajapati, Sudeep Mishra , S.K. Raza and L.K. Thakur	111
135	NSBC- 2015- T02-IPM– 06	Screening rhizobacteria for biological control of <i>Ralstonia solanacearum</i> in Andaman Islands	K.Sakthivel, R.K. Gautam, P.K.Singh, Awnindra K. Singh, K. Manigundan and S. Dam Roy	112
136	NSBC- 2015- T02-IPM– 07	Insect pests of significance in the post flowering phase of red gram in South Andamans	T. Bharathimeena and A.K. Singh	112

**NSBC 2015- TRACK – 2: CLIMATE CHANGE.**

**2.5. MANAGING RISK IN THE FACE OF CLIMATE CHANGE**

137	NSBC- 2015- T02-MRCC– 01	Search for heat tolerant tomato genotypes and crosses suited for temperature variations	Kartikeya Srivastava, Sunil Kumar and A.Vaishampayan	117
138	NSBC- 2015- T02-MRCC– 02	Spatial and temporal variations in benthic diversity in relation to sediment parameters in an urban eutrophic lake	Paramita Banerjee Sawant, Chandra Prakash, N. K. Chadha, Bhawesh Sawant, Aritra Bera, S. Dam Roy, A.K. Jaiswar, Soniya Sukumaran and Sujitha Thomas	117
139	NSBC- 2015- T02-MRCC– 03	Climate variability and apple diversification towards low altitudinal gradients in Indian Himalayas	Pramod Kumar and Sangeeta Ahuja	118
140	NSBC- 2015- T02-MRCC– 04	Ecological study of bird hazards at Airport in Andaman	C. Sivaperuman, S. Biswas, J. Dinesh and G. Gokulakrishnan	118
141	NSBC- 2015- T02-MRCC– 05	Role of Indian cattle for climate change: challenges and opportunity for India	S.A. Shivaraj, S.A. Akshatha, Suma, Rittu, S. Honnapagol, D. Ratnamma and Chandranaiik	119
142	NSBC- 2015- T02-MRCC– 06	Physiological and cellular adaptations of zebu cattle to tropical climatic conditions	S.V. Singh and Uttarani Maibum	119
143	NSBC- 2015- T02-MRCC– 07	Water harvesting at farmer's field, to address climate change in Chhattisgarh	R.K. Sahu and K.K. Sahu	120
144	NSBC- 2015- T02-MRCC– 08	Effects of climatic changes due to radiations released from the nuclear reactor accidents	K. Sonamuthu	120
145	NSBC- 2015- T02-MRCC– 09	Application of biochar to rainfed vertisol cotton crop: A boon or ban	N. Sriharan, K. Boomiraj, C. Umamageswari, P.R. Kamalkumaran, D. Jawahar, S. Jeyaraman and K. Velayutham	121



146	NSBC- 2015- T02-MRCC- 10	Effect of weed management on growth and yield of paddy ( <i>Oryza sativa</i> ) under high rainfall area of Bay Island	N. Bommayasamy, Nagesh Ram, L.B. Singh and N.C. Choudhuri	122
147	NSBC- 2015- T02-MRCC- 11	Post monsoon water management for Arecanut plants in Andamans through gravity fed drip irrigation	B.K. Nanda, Nagesh Ram, L. B. Singh, N. C. Choudhuri and S. Damroy	122
148	NSBC- 2015- T02-MRCC- 12	Isolation and characterization of <i>Escherichia coli</i> from meat samples (Chevon)	Jyoti Gahlaut, Sandhya Maurya, Nisha Tiwari, Garima Gangwar, Purushottam and Akash Tomer.	123
149	NSBC- 2015- T02-MRCC- 13	Protected cultivation technology for off-season vegetable production in Andaman and Nicobar Islands	Shrawan Singh and S. Dam Roy	123
150	NSBC- 2015- T02-MRCC- 14	Serological status of foot and mouth disease in cattle and buffalo of andaman and Nicobar Islands of india	Jai Sunder, Satya K. Balasundaram, Gaurav Sharma and B. Pattnaik	124
151	NSBC- 2015- T02-MRCC- 15	Evaluation of different growth promoter in backyard poultry in car Nicobar	Zachariah George, Nagesh Ram, A. Kundu, Viveka Nanad Singh, Jaisunder, T. Sujatha, A. K. Pandey, C. Ram and S. Dam Roy	124
152	NSBC- 2015- T02-MRCC- 16	Minimizing the carbon dioxide emission through direct seeded rice at nicra village kharghna	Shilpa Kaushik, K. R. Sahu, V. K. Nirmalkar, Anurag Shukla and Jitendra Yadav	125
153	NSBC- 2015- T02-MRCC- 17	Evaluation of secondary nutrients status of red and yellow soils of Sakti block in Janjgir-Champa District of Chhattisgarh	Pawan Kumar Kurre, Hareesh Kumar and K. K. Sahu	125
154	NSBC- 2015- T02-MRCC-18	Effect of spacing on growth, flowering and seed yield of Mexican sunflower ( <i>Tithonia rotundifolia</i> Blake.) in Andaman	V.Baskaran, K. Abirami and Norman David	126
155	NSBC- 2015- T02-MRCC-19	Effect of sub lethal concentration of salinity on growth and physiological responds of <i>Labeo rohita</i> (Hamilton, 1822)	Kamal Sarma, A. Dey, Santosh Kumar and B.K. Chaudhary	126
156	NSBC- 2015- T02-MRCC-20	Recent trends in climatic variability: A case study of andamans	Showkat A. Bhat, Sanjay B. and Mohsin H. Dar	127
157	NSBC- 2015- T02-MRCC-21	Urbanization processes and Environment: A spatio-temporal analysis of South Andaman Islands (1951-2011), using geo-spatial tools	Mohsin H. Dar, Showkat A. Bhat and S. Balaji	127
158	NSBC- 2015- T02-MRCC-22	Outbreak of Ice-Ice disease in red seaweeds, <i>Kappaphycus alvarezii</i> cultivated in Palk Bay	P. Krishnan, C.R. Sreeraj, A. Anand, S.A. Shanmugam, A. Srinivasan, G. Sugumar, Purvaja Ramachandran and R. Ramesh	128
159	NSBC- 2015- T02-MRCC-23	New record of Snowflake coral, <i>Carijoa riisei</i> from grand Island, Goa: A case of bio-invasion or re-establishment of a native species?	Shesdev Patro, P. Krishnan, M. Gopi, S. Raja, C.R. Sreeraj, Purvaja Ramachandran and R. Ramesh	128
160	NSBC- 2015- T02-MRCC-24	<i>Macrobrachium lar</i> – An endemic Freshwater Prawn Species of Andaman	Nagesh Ram, Dam Roy, S., Sethi, S. N. and Chandraprakash	129
161	Extended Summary (Supplementary)	High yielding varieties of rice and farmer's participatory seed production in Andaman and Nicobar Islands	P. K. Singh, Awnindra K. Singh, R. K. Gautam, S. K. Zamir Ahmed and S. Dam Roy	129