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2006 – 2007

CENTRAL AGRICULTURAL RESEARCH INSTITUTE
CARI
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तमसो मा ज्योतिर्गमय

केन्द्रीय कृषि अनुसंधान संस्थान
पोर्ट ब्लेयर - ७४४ १०१, अण्डमान और निकोबार द्वीप
Central Agricultural Research Institute
Port Blair – 744 101, Andaman & Nicobar Islands

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Central Agricultural Research Institute

(I. C.A.R)

Port Blair – 744 101, Andaman & Nicobar Islands

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प्राक्कथन

केन्द्रीय कृषि अनुसंधान संस्थान की स्थापना 1978 में हुई थी और तब से यह द्वीपीय कृषि की समस्यायो के समग्र समाधान में संलग्न है। 26 दिसम्बर, 2004 को सुनामी ने इस द्वीप समूह के प्राकृतिक संसाधनों को हमेशा के लिए परिवर्तित कर दिया जिससे कृषि उत्पादन एवं उत्पादकता पर विपरीत प्रभाव पड़ा । अतः सुनामी उपरान्त चुनौती थी कि पहले उत्पादकता एवं उत्पादन को सुनामी पूर्व के स्तर पर लाया जाए और उसके बाद इसे और बढ़ाया जाए। केन्द्रीय कृषि अनुसंधान संस्थान ने इस चुनौती का सामना करने के लिए बदली हुई परिस्थितियो के अनुसार नई तकनीकों का विकास किया । साथ ही साथ सुनामी से प्रभावित किसानों के पुर्नस्थापन के लिए तकनीकों का प्रदर्शन भी किया ।

नई अर्थव्यवस्था में सबसे बड़ी चुनौती कृषक युवकों के लिए खेती को आकर्षक बनाना है । इसके लिए नौ तकनीकों को सूक्ष्म व्यापारिक माड़यूल में परिवर्तित कर बैकों एवं स्वयंसेवी संस्थाओं के सहयोग से कृषक युवक युवतियों के लिए एक आकर्षक जीविकोपार्जन के अवसर के रूप में प्रस्तुत किया गया । संस्थान ने मंजेरी गाँव में किसानों को जलस्रोतों के विकास एवं प्रबंधन के लिए जल प्रयोगकर्त्ता समिति के रूप में संगठित होने के लिए प्रेरित किया । यह इन द्वीप समूहो में पहला ऐसा प्रयत्न था जो काफी सफल रहा । समिति जल प्रबन्धन के अलावा सब्जियों की पौध उगाने, वर्मी कम्पोस्ट तथा कृषि उत्पादों के सीधे विपणन का भी काम कर रही है । समिति की सफलता से प्रभावित हो कर अन्य ग्राम भी इस दिशा में बढ़ रहे हैं । संस्थान ने अंडमान एवं निकोबार प्रशासन को भी सुनामी उपरान्त पुर्नवास कार्यक्रम में सहयोग प्रदान किया है । ऐसा संस्थान के वैज्ञानिकों तथा कृषि विज्ञान केन्द्र के स्टाफ द्वारा प्रशासन एवं स्वयंसेवी संस्थाओं के साथ अच्छे सम्बन्धों के कारण ही संभव हो पाया ।

मैं सम्मानीय डा.मंगला राय, सचिव कृषि अनुंसन्धान एवं शिक्षा विभाग तथा महानिदेशक भारतीय कृषि अनुंसधान परिषद का आभार व्यक्त करता हूँ जिन्होंने सुनामी के बाद की कठिन परिस्थितियों में हमें एक नई दिशा दी। मैं डा. गौतम कल्लू पूर्व उप महानिदेशक (बागवानी) को उनके सतत् दिशा निर्देश के लिए हार्दिक धन्यवाद देता हैं । मैं डा. एच.पी.सिहं, उप महानिदेशक (बागवानी) का आभारी हूँ जिनके गतिमान नेतृत्व में इस संस्थान ने नए सोपान छुए हैं । अन्त में मैं अपने सभी साथी वैज्ञानिकों, अधिकारियों एवं कर्मचारियों को धन्यवाद देता हूँ, जिनके सतत् परिश्रम से संस्थान ने सभी चुनौतियों का सफल सामना किया है ।

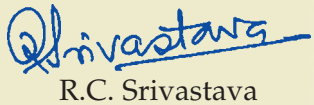
दिसम्बर, २००७
पोर्ट ब्लेयर

रमेश चन्द्र श्रीवास्तव
निदेशक

PREFACE

Central Agricultural Research Institute was established in 1978 and it has been instrumental in addressing to the problems of island agriculture in a holistic manner. Tsunami which struck these islands on 26th December, 2004 altered the natural resource scenario of the islands for ever. Thus, in post-tsunami scenario, the challenge is to bring back the production level to pre tsunami levels and then increase it to meet the demand of local population and tourists with specific reference to perishable products and flowers. CARI has risen to meet this challenge and has played a very proactive role in developing technologies for changed scenario in addition to demonstrating ability of existing technologies in rehabilitating affected farmers. To retain farm youth in agriculture, an innovative approach of translating nine selected technologies as a micro-business module has been initiated with close collaboration of banks and NGOs to provide a decent livelihood opportunity to the unemployed youth and SHGs. Facilitation of formation of Water User Association (WUA) at Manjeri village is first of its kind in these islands for creating and management of water resource. The association has also taken up work of raising vegetable seedlings, preparation of vermi-compost and direct marketing of products eliminating middlemen. The success of association has prompted other neighbouring villages to form such associations. The institute has also been involved in effective implementation of tsunami rehabilitation package by Andaman and Nicobar Administration. This task was achieved with active collaboration of institute Scientists and KVK staff and by keeping a cordial and functional linkage with administration, NGOs and other agencies.

I would like to express my deepest sense of gratitude to Hon'ble Dr. Mangala Rai, Secretary, Department of Agricultural Research and Education and Director General, ICAR for his inspiring guidance during this difficult post-tsunami period. I shall like to express my sincere thanks to Dr.G.Kalloo, Ex-DDG (Horticulture) for his guidance and support. I am grateful to Dr. H.P. Singh, DDG(Horticulture) for his unstinted support and encouragement. I express my sincere thanks to my Scientists and all staff members of the Institute who worked hard to meet new challenges of fast changing scenario.



December, 2007
Port Blair.

R.C. Srivastava
Director

सारांश

प्राकृतिक संसाधन प्रबन्ध

- छोटे तालाबों, जो कि किसानों के घरेलू संसाधनों का एक अनिवार्य हिस्सा है, को मानसून के पश्चात् पानी की आपूर्ति सुनिश्चित करने के लिए एक सम्पूर्ण उत्पादन पद्धति के रूप में विकसित किया जा सकता है ताकि सब्जियों, फलों, मसालों, मछली, अंडा तथा मांस का उत्पादन किया जा सके।
- दक्षिणी अंडमान के धान उगाने वाले क्षेत्रों के लिए पी.एच., ई.सी., धनायन विनियम क्षमता, विनिमेय क्षारों, मृदा अम्लता, क्षार तृप्तिकरण प्रतिशत्, उपलब्ध पोषक तत्वों तथा फसल उत्पादन के उर्वरता प्रतिबंधकों के आधार पर उर्वरता क्षमता वर्गीकरण किया गया।
- सुनामी द्वारा प्रभावित द्वीपीय कृषि को हुई क्षति का आंकलन करने पर विदित हुआ कि मानसून वर्षा के जल में अतिरिक्त घुलनशील लवणों के विक्षालन के फलस्वरूप मृदा पी.एच. में कालिक तथा स्थानिक भिन्नता, संतृप्त लेई की विद्युत संवाहकता तथा जीवाणुवीय भार अपने सुनामी से पूर्व की सामान्य अवस्था की ओर अग्रसर है।
- कच्छ वनस्पति पारिस्थितिकीय तंत्र की मृदाओं के भौगोलिक विक्षोभ के अध्ययन से विदित हुआ कि अविक्षोभित स्थलों की अपेक्षा विक्षोभित स्थलों के भौतिक-रासायनिक गुणों में परिवर्तन हुआ परन्तु जैव रासायनिक मानकों में कार्बनिक पदार्थ/तत्वों के स्तरों में सार्थक कमी आने के कारण यथेष्ट कमी आई।
- धान-मक्का फसल पद्धति के संपोषण के लिए स्थान-विशिष्ट पोषक तत्व प्रबंधन तथा उन्नत फसल उत्पादन आवश्यक है।
- सभी सूक्ष्म-कृषि परिस्थितियों के लिए समेकित फसल उत्पादन पद्धति के परीक्षण ने यह दर्शाया कि इसमें अधिक कुल प्राप्तियों तथा रोजगार सृजन के रूप में आकर्षक सामाजिक-आर्थिक सम्भावनायें है।
- कृषि पद्धति में मछली-मुर्गी व बत्तख सह-पालन को अंतर्निहित करते समय तालाब का पानी घरेलू उद्देश्यों के लिए प्रयोग नहीं करना चाहिए क्योंकि गर्मी के मौसम में तालाब के अंदर जीवाणु भार अत्यधिक बढ़ा हो सकता है।

- निम्न भूमि क्षेत्रों में चौड़ी क्यारी तथा नाली पद्धति के अंगीकरण के फलस्वरूप फसल विविधिकरण के अवसर प्राप्त हुए हैं। क्यारियों में मूली तथा मिर्च उत्पादन से और नालियों में धान पेडी, {अजोला+मछली:सिंगी+मागुर}- मूंगफली के उत्पादन से रू0 198081 प्रति हे0 का शुद्ध लाभ प्राप्त हुआ है।
- बी.बी.एफ. पद्धति का उपयोग करते हुए क्यारियों में धान क्षेत्रों में फसल सघनता 100 प्रतिशत् से 300-500 प्रतिशत् तथा नालियों में 300 प्रतिशत् तक बढ़ाई जा सकती है।
- एस.आर.आई. विधि के कारण बीज तथा रोपण समय की बचत के अलावा पारम्परिक विधि {2400 कि0ग्रा0/हे0} की अपेक्षा सार्थक अधिक उपज {2613 कि0ग्रा0/हे0} प्राप्त हुई है।
- द्वीपीय पारिस्थितिकीय तंत्र में रोपण की एस.आर. आई. विधि पंक्ति रोपण तथा मशीनी रोपण की अपेक्षा अधिक शक्ति मितव्ययी तथा मूल्य प्रभावी पाई गई क्योंकि शक्ति अनुपात अधिक {3.9} तथा विशिष्ट शक्ति निवेश कम {7.1 मेगा जूल/कि.ग्रा.} तथा बी.सी. अनुपात 1.3 था।
- धान के उपरांत खाली क्षेत्रों में मूंगफली लाभदायक फसल के रूप में उगाई जा सकती है। मोटे बीज वाली किस्मों जैसे- SG-99, ICGS 76, TG37 A तथा GPBD 4 द्वारा रू. 19540 से 22980 प्रति हे0 तक का शुद्ध लाभ प्राप्त किया गया । इन किस्मों में बी. :सी. अनुपात एक से अधिक था।
- ग्लीरिसीडिया एलेय कृषि प्रणाली को इसके गहरे जड़ तंत्र के द्वारा पोषक तत्वों के पुन:उपयोग के लाभों, नाइट्रोजन स्थरीकरण तथा मृदा को जलक्षरण से बचाने के गुणों के कारण अंडमान में व्यवहार्य तथा दीर्घकालिक भू उपभोग के रूप में मान्यता प्रदान की गयी है।
- एग्रोबूम {कार्बनिक तरल खाद}द्वारा बीज उपचार + मृदा अनुप्रयोग + गोबर की खाद के साथ पत्तियों पर छिडकाव के कारण भिंडी की उपज में नियंत्रित तथा नाइट्रोजन की 100 प्रतिशत् संस्तुत मात्रा की अपेक्षा सार्थक अधिक उपज प्राप्त हुई है।
- मानसून पश्चात् मौसम में अधिक उपज तथा लाभदायिकता प्राप्त करने के लिए फसल की घुटनों तक ऊँचाई की अवस्थाओं में पूरक सिंचाई, मक्का में टसल प्रवर्तन तथा दाना भराव की अवस्थाओं, चने में फूल आने तथा फलियाँ लगने की अवस्थाओं, तिल की

फूल आने तथा फलियां लगने की अवस्थाओं, भिंडी तथा मिर्च की शुरूआती कायिक अवस्थाओं, फूल आने तथा फल आने की प्रथम तथा द्वितीय अवस्थाओं का चिन्हीकरण किया गया है।

- द्वीपीय स्थितियों में कालमेघ की अधिक उपज तथा शुद्ध लाभ प्राप्त करने के लिए इसे गर्मी के मौसम में सिंचित अवस्था में 45 X 30 सें.मी. की दूरी पर गोबर की खाद के 12.5 टन/हे0 की दर से प्रारम्भिक उपयोग के साथ उगाना चाहिए।
- एक रूपान्तरित पादप गृह का विकास किया गया जिसमें दो निकास पंखों, छाया करने की जाली, ठंडा रखने की प्रणाली तथा आर्द्रता नियंत्रण प्रणाली आदि में 60 प्रतिशत् कम लागत आई। इसमें वर्तमान उपस्थित पादप गृह की अपेक्षा अंदर का तापमान 1^0C अधिक तथा सापेक्षिक आर्द्रता 23 प्रतिशत् कम पाई गयी जिसके कारण ऊर्जा तथा पानी की बचत सम्भव हो सकी।
- केन्द्रीय कृषि अनुसंधान संस्थान द्वारा विकसित पैरों द्वारा चालित, के.ए.यू. द्वारा विकसित हाथों द्वारा चालित नारियल का छिलका उतारने वाले यंत्र तथा स्थानीय यंत्र 'सब्बल' की क्षमता क्रमश: 119,68 तथा 170 नारियल/घंटा थी। केन्द्रीय कृषि अनुसंधान संस्थान द्वारा विकसित पैरों द्वारा चालित नारियल छिलका उतारने वाले यंत्र को कृषक महिलाओं ने प्रचालन में अधिक सुविधाजनक तथा सुरक्षित पाया।
- नारियल, काली मिर्च, मशरूम, हरी मिर्च, कटहल तथा मछली को सुखाने के लिए सूर्य चालित सुखाने के यंत्र में खुली धूप में सुखाने की अपेक्षा 33 प्रतिशत समय की बचत हुई। इसके कारण सूखे हुये उत्पाद की गुणवत्ता में भी सुधार हुआ क्योंकि मैगट तथा अन्य कीड़े-मकोड़ों का प्रकोप नहीं हो पाया ।
- पावर टिलर द्वारा चालित रोटावेटर तथा एंगल आयरन टाइप केज व्हील का उपयोग करने से अधिक उत्पादकता, लाभदायिकता तथा ऊर्जा बचत प्राप्त की गयी क्योंकि इसके द्वारा पडलिंग करने के कारण ऊर्जा आवश्यकता में 26 प्रतिशत् की कमी आई।

बागवानी एवं कृषि वानिकी

- 2.5 कि.ग्रा. वर्मी कम्पोस्ट प्रयोग करने पर फल कलिका प्रवर्तन शीघ्रता से हुआ है। मोरिन्डा के पौधों में ग्लीरिसीडिया और केले की पत्तियों की मल्चिंग कायिकीय तथा उपज मानकों की वृद्धि के लिये प्रभावशाली पाई गई।

- मोरिन्डा प्रजाति का मूल्यांकन करने पर *मोरिन्डा ट्रायमेरा* के साथ तुलना करने पर *मोरिन्डा सिट्रीफोलिया* में शीघ्रता से फूल आना देखा गया। अन्य विधियों की अपेक्षा कटिंग द्वारा मोरिन्डा का प्रवर्धन उत्तम पाया गया ।
- *मोरिन्डा सिट्रीफोलिया* के फल का वजन विभिन्न वनजों के मध्य सबसे अधिक वनज एच.डी.6 में देखा गया । महीने के अन्तराल में विभिन्न क्षेत्रों से एकत्रित किए गए मोरिन्डा सिट्रीफोलिया के बीज की बुवाई व अंकुरण का अध्ययन करने पर देखा गया कि अन्य महीनों में रोपाई की अपेक्षा सितंबर माह के दौरान बीज की रोपाई करने पर अंकुरण शीघ्रता से हुआ।
- *मोरिन्डा सिट्रीफोलिया* के फलों का शेल्फ लाइफ अध्ययन करने पर देखा गया कि बिना पुष्पवृन्त के फलों को भंडारित करने की अपेक्षा बडे एवं पके फल को पुष्पवृन्त सहित भंडारित करने पर 9 दिनों तक रहता है।
- पपीता की जी.एल.-1 और जी.एल-2 असेशन को अधिकतम उपज, गुणकारी लक्षण और स्थिरता के आधार पर चुना गया।
- इन द्वीपों की परिस्थिति के अंर्तगत सब्जियों की किस्मों का मूल्यांकन करने पर लोबिया में श्वेता किस्म, मिर्च में अर्का लोहित, बैंगन में पी.बी.-6 और फ्रैंचबीन में कन्टेन्डर किस्म से अधिकतम उपज के साथ अच्छा प्रदर्शन देखा गया।
- सुपारी की किस्मों {20 वर्ष पुरानी} के मॉरफोलॉजिक्ल और उपज मानकों को रिकार्ड करने पर देखा गया कि समृद्वि और मंगला किस्मों से प्रति वृक्ष अधिकतम संख्या में नट रिकार्ड की गई ।

क्षेत्रीय फसलें

- इनविट्रो परीक्षण द्वारा चयनित पांच फफूंदी प्रतिरोधियों के प्रदर्शनों का क्षेत्रीय जांच द्वारा मूल्यांकन किया गया। इनमें *टी.हारजियानम* तथा *टी.हामाटम* को मिर्च तथा बैंगन की अधिकतर बिमारियों को नियन्त्रित करने में प्रभावशाली पाया गया ।
- अंडमान-निकोबार द्वीप समूह में आलू कुल की सब्जी फसलों में लगभग 56.5 प्रतिशत् विल्ट रोगों के लिए *राल्सटोनिया सोलोनेसिरम* नामक जीवाणु तथा जड़ की गांठ में रहने वाले निमाटोड द्वारा निर्मित समूह को कारक के रूप में चिन्हित किया गया।

- इनविट्रो विधि द्वारा चयनित पी.जी.पी.आर. के आठ विलगों को क्षेत्र परीक्षणों के माध्यम से मूल्यांकन किया गया। इनमें सूडोमोनास के दो तथा बैसीलस प्रजाति के दो विलगों को मिर्च की मुख्य बिमारियों का नियंत्रण करने में प्रभावशाली पाया गया।
- दक्षिणी अंडमान के मुख्य सब्जी उत्पादक क्षेत्रों के सर्वेक्षण से यह ज्ञात हुआ कि इन क्षेत्रों में चार कुलों की 13 सब्जी फसलों में 26 बिमारियाँ उपस्थित थी। सर्वेक्षण की गयी फसलों में वर्षा के मौसम में बीमारियों की तीव्रता तथा घटना अत्यधिक थी। इनमें चिचिन्डा में घातक धब्बा रोग, बैंगन में मुरझान रोग, मिर्च का मेंढ़क की आंख के समान धब्बा रोग तथा टमाटर का पर्ण कुंचन रोग प्रमुख है।
- अंडमान-निकोबार द्वीप समूह के गर्म-आर्द्र-तटीय कृषि पारिस्थितिकी तंत्र से कुल 273 कृषि लाभदायी सूक्ष्मजीवीयों का विलगन किया गया।
- कुल विलगों में लगभग 194 राइजो बैक्टीरिया प्रतिरोधी, 22 माइकोपैरासिटिक फफूंद, 20 फफूंद रोग कारक तथा 25 जीवाणु रोग कारक थे जो कि सब्जी फसलों तथा मसालों से सम्बन्धित थे।
- शीशे के पादपगृह में टमाटर, बैंगन तथा मिर्च आदि फसलों के मुरझाने से सम्बन्धित 25 विलगित तथा आंशिक रूप से अभिलक्षित 25 रोल्स्टोनिया प्रजातियों का मूल्यांकन किया गया।
- चरम वातावरणों का सर्वेक्षण किया गया तथा इन वातावरणों में प्राकृतिक रूप से उत्पन्न होने वाले जंगली दलहनों को एकत्रित किया गया तथा इन दलहनों से सम्बन्धित कुल 12 राइजोबियम प्रजातियों का विलगन तथा आंशिक अभिलक्षण किया गया।
- अंडमान-निकोबार द्वीप समूह के पादप संसाधनों के डिजिटाईजेशन के लिए कुल 197 प्रकाशित संदर्भों का संकलन किया गया जिनमें 280 पादप किस्मों जैसे 22 शाकीय पौधों, 62 झाड़ियों, 137 वृक्षों, 29 आरोही पादपों, 17 कठलताओं, 11 अधिपादपों तथा 01 लिथोफाइट का विवरण है।
- अंडमान निकोबार द्वीप समूह के औषधीय पादपों का संकलन किया गया जिसमें जनजातियों तथा स्थानीय लोगों द्वारा उपयोग किये जाने वाले 120 औषधीय पादपों का समावेश किया गया।

पशु विज्ञान विभाग

- अंडमान निकोबार द्वीप समूह की बकरी की नस्लों जैसे टेरेसा, स्थानीय अंडमानी तथा मालाबारी बकरी LHB जीन के एक्सोन 2 तथा 3 के SSCP अध्ययन अभिलक्षण में दो विभिन्न रूपान्तरों को देखा गया।
- स्थानीय अंडमानी तथा मालाबारी बकरियों के देह भार तथा भौतिक मानकों में आंकडीय भिन्नता पाई गई। साथ ही साथ नस्लों के बीच में लैंगिक द्विरूपता भी पाई गई।
- टर्की तथा गिनी फाउल की विपणन आयु के समय अधिक परिच्छद् पाया गया।
- अंडमान-निकोबार द्वीप समूह में दुग्ध उत्पादन स्तर को सुधारने के लिए चारा संसाधनों में व्याप्त पोषकीय रिक्तता को चिन्हित किया गया ।
- *मोरिन्डा सिट्रिफोलिया* के सत्त {निचोड़} को पीने के पानी के माध्यम से मुर्गियों को देने पर उनकी उत्पादन क्षमता में कोई प्रतिकूल प्रभाव नहीं पाया गया।
- वृद्धिशील जापानी बटेरों में विपणन की आयु तक व्यवसायिक दाने को 2-3 प्रतिशत् तक अजोला से प्रतिस्थापित किया जा सकता है जिसके कारण दाने की लागत में 16 पैसा/ जापानी बटेर की कमी आई तथा अच्छी गुणवत्ता भी प्राप्त हुई। इसके अतिरिक्त मुर्गियों में प्रतिरक्षा प्रणाली वर्धक प्रभाव भी पाया गया।
- संकर गायों के उत्पादन तथा पुनर्उत्पाद प्रदर्शन के मानकों का अध्ययन किया गया तथा दुग्ध उपज तथा वातावरण मानकों के बीच कोई सार्थक सम्बन्ध नहीं देखा गया ।
- औसरों तथा ब्याई हुई गायों के पुनर्उत्पादन प्रबन्धन के लिए प्रजनन पंचाग विकसित किया गया ।
- विभिन्न द्वीपों में निकोबारी तथा देसी सूअर का पशु संख्या स्तर तथा भौतिकीय गुणों से सम्बन्धित आंकड़े भी दर्ज किये गये ।
- दक्षिणी अंडमान के विभिन्न गावों से लिए गये पानी मृदा, चारा तथा सीरम के नमूनों में मैकरो तथा सूक्ष्म खनिज लवण स्तर का अध्ययन किया गया।

मत्स्य पालन

- सम्भावित मछली पालन क्षेत्रों का पता लगाने के लिए सुनामी उपरांत सर्वेक्षण किया गया तथा यह ज्ञात हुआ कि लगभग 4000 हे. कृषि योग्य भूमि जलमग्न हो गयी तथा उसमें से 630.12 हे0 क्षेत्र को तटीय मछली पालन हेतु उपयुक्त पाया गया।
- अंडमान में पिंजडा मत्स्य पालन की अपार सम्भावनाओं को देखते हुए विभिन्न ग्रूपर प्रजातियों का संग्रहण किया गया तथा एम.आर.एल. में इनका पालन किया गया। वजन ग्रहण करके वृद्धि के आंकलन तथा विभिन्न खाद्य घटकों का खिलाने के प्रयोग आदि कार्य प्रगति पर है।
- टाइगर झींगा नमूनों को एकत्रित किया गया तथा अंडमान के पानी में सफेद धब्बेदार रोग की उपस्थिति या अन्य घटनाओं का अध्ययन तथा निरीक्षण किया गया। PCR अध्ययनों में 36 प्रतिशत झींगा मछलियों के नमूने WSSV के लिए सकारात्मक पाए गए।
- अंडमान में मूंगों की प्रचुरता तथा वितरण के अध्ययन के लिए स्थूलाकृति विज्ञान उपग्रह मानचित्रों का उपयोग करते हुए रेखीय अनुप्रस्थ सर्वेक्षण किया गया। अंडमान निकोबार में 15 कुलों की 57 जेनेरा के अंतर्गत मूंगों की 157 प्रजातियों पाई गई ।
- डामसेल मछलियों जैसे एम्फीपरिआन परक्यूला की कुछ प्रजातियों का संग्रहण किया गया तथा समुद्रीय अनुसंधान प्रयोगशाला में इनका प्रबंधन किया गया। इन मछलियों के भोजन के रूप में जीवित खाद्य जैसे रोटिफर्स का उपयोग किया गया।
- केन्द्रीय कृषि अनुसंधान संस्थान में मैकरोब्रकियम रोसेन बर्गाई की बैकयार्ड हैचरी का विकास किया गया। हैचरी में बीज उत्पादन किया गया तथा दक्षिणी अंडमान के किसानों में निरंतर वितरण किया गया।

सामाजिक विज्ञान विभाग

- दक्षिणी अंडमान में दुधारू पशुओं का वितरण, क्षेत्र आकार श्रेणियां, गृह के प्रकार तथा दुग्ध उत्पादन की प्रेरणा देने वाले स्त्रोतों की तहसील वार तुलना करने के लिए एक अध्ययन किया गया।

- इस अध्ययन से यह ज्ञात हुआ कि पोर्ट ब्लेयर तहसील में विभिन्न क्षेत्र आकार श्रेणियों जैसे- मध्यम तथा बड़े डेरी पालन करने वाले कृषकों का प्रतिशत् क्रमश: 74.77, 15. 89 और 9.35 था जबकि फरारगंज तहसील में कृषकों का वितरण क्रमश: 84.81, 10. 13 और 5.06 प्रतिशत् था। एक सम्पूर्ण नमूने के रूप में विभिन्न श्रेणियों जैसे छोटे, मझोले तथा बड़े किसानों में यह वितरण क्रमश: 79.03,13.44 और 7.53 प्रतिशत् था।
- दोबारा दुधारू पशुओं को जैसे-स्थानीय गाय, संकर गायों तथा भैसों का विभिन्न प्रजातियों के रूप में विभेद करने पर यह पाया गया कि एक लघु कृषक के पास क्रमश: 0. 75, 0.48 तथा 0.05 स्थानीय गाय, संकर गाय तथा भैंसे थी। मझोले किसानों के पास इन नस्लों का औसत 1.40,1.88 तथा 0.12 पशु था। बड़े कृषकों के पास औसतन 2. 00, 4.29 तथा 3.07 दुधारू पशु थे।
- तहसीलवार सापेक्षिक अध्ययन से विदित हुआ कि पोर्ट ब्लेयर तहसील में स्थानीय गायों की औसत संख्या अधिक थी जबकि फरारगंज तहसील में संकर गाय अधिक थी। यह देखा गया कि अध्ययन क्षेत्र में पक्के, कच्चे-पक्के तथा कच्चे घरों मे रहने वाले डेरी कृषकों का प्रतिशत क्रमश: 66.67, 11.29 तथा 22.04 था।
- यह भी देखा गया कि अधिकतर कृषकों को {81.18 प्रतिशत} डेरी पालन के लिए प्रेरित करने का काम उनके रिश्तेदारों ने किया। जबकि 11.83 प्रतिशत कृषक पशुपालन तथा पशुचिकित्सा विभाग, 3.76 प्रतिशत केन्द्रीय कृषि अनुसंधान संस्थान तथा 3.23 प्रतिशत कृषक अपने मित्रों द्वारा प्रेरित किये गये ।
- अध्ययन से पता चला कि अध्ययन क्षेत्र में पशु पालन खंड के विकास के लिए सबसे अधिक निर्णायक तथा मुख्य आर्थिक नियामकों में विपणन व्यवस्था की कमी, दुग्ध के अनुचित मूल्य, कम दुग्ध सहकारी समितियाँ, श्रमिकों की अनुपलब्धता, वित्त तथा कर्ज की कमी, पशुओं के लिए भूमि का अभाव तथा शहरी और क्षेत्रों में खाद्य पदार्थो तथा दानों की अनुपलब्धता आदि थे।
- प्रतिवादियों द्वारा बताये गये प्रौद्योगिकीय नियामकों में विशेषकर गर्मी के मौसम में चारे की कमी, प्रौद्योगिकीय ज्ञान की कमी, बीमारियों का प्रकोप तथा कम संसाधन आदि थे।

- अंडमान में सुनामी प्रभावित कृषि पशुपालन तथा मत्स्य पालन पर सामाजिक आर्थिक प्रभाव के मूल्यांकन से पता चला कि भूभाग के ऊपर की ओर उठ जाने के कारण कुछ धान उत्पादन क्षेत्र सूख गये। मेढ बनाने जैसे हस्तक्षेपों के कारण वर्षा जल का समुद्र में जाना रूक गया तथा दक्षिणी अंडमान के स्टूवर्टगंज, मीठा खाड़ी तथा वन्डूर के अधिकतर क्षेत्रों में खेत, वर्षा जल तथा नमकीन जल के सम्मिश्रण से भर गये।

- सर्वेक्षण किये गये पांच गांवों में से स्टूवर्टगंज, मीठाखाड़ी तथा वन्डूर अभी भी बुरी तरह प्रभावित है जबकि छोलदारी तथा गुप्तापाड़ा गांवों को प्रादेशिक सरकार, के.कृ.अ.सं, गैर सरकारी संगठनों तथा स्थानीय नागरिकों के प्रयासों से नई प्रौद्योगिकियों के हस्तक्षेप द्वारा विकास किया जा रहा है।

- इन द्वीपों में पहली बार दक्षिणी अंडमान के मंजरी गांव में किसानों को उनके गांव में सिंचाई सुविधा का प्रबंध एवं सृजन के साथ साथ संस्थान द्वारा सहभागिता पद्धति के माध्यम से अन्य प्रौद्योगिकी हस्तक्षेप मुहैया करायी गई ।

कृषि विज्ञान केन्द्र

- मानव संसाधन विकास के लिए कुल 37 कार्यक्रमों का आयोजन किया गया। इन कार्यक्रमों में व्यवसायी किसान, ग्रामीण महिलाओं, ग्रामीण युवकों और प्रसार कार्यकर्ताओं ने भाग लिया जिनमें 474 पुरूष और 641 महिलाएँ थी।

- प्रथम पंक्ति प्रदर्शन के अंतर्गत किसानों के खेत में धान की अधिकतम उपज वाली किस्मों, सब्जियों और पशुओं पर प्रदर्शन किए गए। साथ ही समस्यात्मक एवं सामान्य मिट्टी में धान एवं सब्जियों पर खेत परीक्षण भी किया गया।

- चुनी गई प्रौद्योगिकियों के प्रचार-प्रसार के लिए कृषि एवं अन्य क्रियाकलापों जैसे खेत दिवस, प्रदर्शनी, बैठक, प्रचार रेडियो वार्ता, आलेख एवं बुलेटिनों के माध्यम से कई प्रसार कार्यक्रम किए गए ।

EXECUTIVE SUMMARY

NATURAL RESOURCE MANAGEMENT

- Small ponds, an integral part of farmer's household to provide water supply during post monsoon season, can be developed in to a full fledged production system to produce vegetables, fruits, spices, fish, egg and meat.
- On the basis of pH, EC, cation exchange capacity, exchangeable bases, soil acidity, base saturation percent, available nutrient contents and fertility constraints for crop production, fertility capability classification were made for rice growing areas of South Andaman.
- Assessment of tsunami affected soils revealed that the temporal and spatial variability in soil pH, electrical conductivity and microbial loads are approaching towards normal pre tsunami condition due to the leaching of excess soluble salts by monsoon rainfall.
- Study on anthropogenic disturbances on the soils of mangrove ecosystem revealed minimum variation in physico-chemical characteristics.
- Integrated farming systems tested for different micro-farming situations revealed better socio-economic prospect in terms of high net returns and employment generation. In case of integration of fish-cum-poultry-cum-duckery in the farming system, pond water should not be used for house hold purposes as microbial load increases substantially during summer season.
- Adoption of Broad Bed and Furrow (BBF) system provides opportunity for crop diversification in lowlying paddy lands. Higher net return can be realized by growing radish-chillies on the beds and rice-ratoon (azolla + fish: singhi + magur)-groundnut in the furrows. Cropping intensity of rice areas can be increased from 100 % to 300-500 % on the beds and up to 300 % on the furrows through BBF system.
- SRI method led to significantly higher yield (2613 kg ha^{-1}) than conventional method (2400 kg ha^{-1}) apart from saving of seed and planting time. SRI method of planting was found to be economical in terms of energy compared to line and mechanical transplanting as energy ratio was more (3.9).
- Groundnut can be grown as profitable crop in rice fallow areas. Bold seeded varieties *viz.*, SG 99, ICGS 76, TG 37A and GPBD 4 recorded net returns to the tune of Rs. 19540 to 22980 ha^{-1} with B:C ratio of > 1.

- Application of agroboom (organic liquid manure) through seed treatment + soil application + foliar spray with FYM had significantly increased the yield of ladies finger over control and 100% recommended dose of N.
- Supplemental irrigation at knee high, tassel initiation and grain filling stages of maize, flowering, pod setting stages of green gram, 4-5 leaf stage, flowering, pod setting stages of sesamum, early vegetative, flowering, fruit formation stages of ladies finger and chilli were identified to achieve higher yield and profitability during post-monsoon season.
- Kalmegh should be grown during summer season under irrigated condition with 45 x 30 cm spacing along with basal application of FYM @12.5 t ha^{-1} to achieve higher biomass yield and net returns under Island conditions.
- A modified greenhouse was developed with 60% reduced cost towards two-exhaust fans, shading nets, cooling system and humidity control system that maintained inside temperature (1^{o}C higher) and relative humidity (23% lower) than existing greenhouse resulting in saving of energy and water.
- The capacity of CARI pedal operated, KAU hand operated coconut dehuskers and local tool *sabbal* was 119, 68 and 170 nuts/hr, respectively. Even farm women found CARI pedal operated dehusker comfortable and safe in operation.
- Solar dryer saved 33% time in comparison to open sun drying of coconut, black pepper, mushroom, green chillies, jack fruit pulp and fish. It also improved the quality of dried products as there were no attack of maggot and insect pest.
- Higher productivity, profitability and energetic can be achieved through power tiller driven rotavator and angle iron type cage wheel to meet the energy requirement for tillage that consume 26% of energy required for puddling.

HORTICULTURE & FORESTRY

- Influence of seawater inundation on vegetative growth of *Morinda citrifolia* showed that irrigation with 75% seawater favoured its luxuriant growth. With regard to root parameters plants irrigated with 100 % seawater showed longer roots.
- Application of 2.5 kg of vermicompost resulted in earlier fruit bud initiation. Mulching with glyricidia and banana leaves in Morinda plantation was found efficient in increasing the morphological and yield parameters.

- In terms of fruit weight among the different accessions of the *Morinda citrifolia*, maximum weight was obtained in the accession HD-6. Sowing and germination studies of *Morinda citrifolia* in monthly intervals collected from different location revealed the seedlings planted during September germinated earlier than other months of planting.
- Genetic diversity of the wild *Mangifera sp* was performed using 50 RAPD markers which separated all the wild species and showed the involvement of *M griffithi* in the *indica* types.
- The difference in peroxidase, polyphenoloxidase and phenylalaninelyase between the varieties of banana collected from different locations showed the influence of environment in changing the enzymatic activity of the varieties. Molecular characterization of the same were also done using 50 RAPD markers.
- Early and differentially flowering mango clones were collected from different locations of the South Andaman and analysed for variability using biochemical and RAPD markers. The higher PPO content in the cultivated species showed their involvement in inducing regular bearing while the lower content of PO and PPO in the wild species established the fact that they were occasional and shy bearers.
- GL-1, GL-2 and GL-3 accessions of papaya were selected based on higher yield, qualitative characters and stability among the germplasm collections.
- Varietal evaluation of vegetables revealed that the variety Sweta in cowpea, Arka Lohit in chillies, PB-6 in brinjal and Contender in french beans performed well with higher yield under the island conditions.
- Morphological and yield parameters recorded on arecanut varieties (20 year old) revealed that the variety Samrudhi recorded the highest number of nuts per tree followed by Mangala.
- Soil N mineralization under high rainfall regime of Andaman were studied which showed the influence of heavy rainfall on net nitrification, net ammonification and microbial biomass C in soils under different land use systems.
- Phosphorus availability under different soil water regimes in humid tropical climate of Andaman showed that litter turnover in the humid tropical climate of Andaman is annual. Population of termites grows quickly during dry spells between high rainfalls and decomposes the litters quickly and releases phosphorus. Available P and microbial

biomass P were estimated in native soils and termite soils under evergreen forest, semi evergreen forest and homegarden.

- High rainfall makes soil anaerobic which reduces redox potential of the soil and thus makes the phosphorus mobile. Greater availability of phosphorus during the higher WFPS could also be due to increase in permanent charge and cation retention which led to less sorption of phosphate and increased mobility.

FIELD CROPS

- Performance of five fungal antagonists selected by *in vitro* screening were evaluated in field trial, in that *T. harzianum*1 and *T. hamatum* 1 were found effective in controlling major diseases of chilli and brinjal.
- In A & N Islands about 56.5 percent of the wilt diseases of solanaceous vegetable crops were identified to be caused by complex of bacteria (*Ralstonia solanacearum*) and root knot nematode.
- *In vitro* screened 8 effective isolates of PGPRs were evaluated in field trial, in that two *viz., Pseudomonas* spp & *Bacillus* spp were found effective in controlling major diseases of chilli.
- Surveys of major vegetable growing areas of South Andaman revealed presence of 26 diseases in 13 vegetable crops belonging to four families. Highest disease severity and incidence were leaf spot of snake gourd/little gourd, wilt of brinjal, frog eye spot of chilli and leaf curl of tomato during rainy season.
- A total of 273 agriculturally important micro organisms were isolated from the hot humid coastal agro-eco system of A & N Islands. Among the total isolates 194 antagonistic rhizobacteria, 22 mycoparasitic fungi, 20 fungal pathogens and 25 bacterial pathogens were found to be associated with vegetable and spice crops.
- Isolated and partially characterized 25 *Ralstonia* sp associated with wilt of tomato, brinjal and chilli crops and their pathogenicity was assessed in the glass house condition.
- Extreme environments were surveyed, naturally growing wild legumes were collected and a total of 12 *Rhizobium* spp associated were isolated and partially characterised.
- A total of 197 published references with the description of 280 plant species i.e. 22 herbs, 62 shrubs, 137 trees, 29 climber, 17 liana, 11 epiphyte and 1 lithophyte were compiled for digitization of plant resources of A & N Islands.

- A compilation of medicinal plants of A & N Islands were done, which amounts to 120 medicinal plants utilized by tribes & local people.

ANIMAL SCIENCE

- Characterization of exon 2 & 3 of LHβ gene in goat breeds of A&N islands *viz.* Teressa, Local Andaman and Malabari revealed two different variants through SSCP study.
- Significant differences in body weight and physical parameters among the goat breeds alongwith sexual dimorphism in Local Andaman and Malabari goat were observed.
- Turkey and Guinea fowl were found to yield better dressing percentage at the age of marketing.
- Supplementation of *M. citrofolia* extract enhanced the immuno response of poultry.
- Azolla supplementation (2-3%) by replacing commercial feed in growing quails up to the age of marketing saved the feed cost of 16 paise per quail and yielded better carcass percentage. It was also found to have an immunoenhancer effect in chicken.
- Parameters of productive and reproductive performance of cross bred cows were studied and no significant relationship between milk yield and climatic parameters were observed.
- Breeding calendar for better reproductive management of both heifers and postpartum cattle has been developed.
- Population status and phenotypic characteristic of Nicobari and Desi pigs has been recorded from different Islands.
- Micro and macro mineral status of water, soil, fodder and sera samples from different village of South Andaman has been studied.

FISHERIES SCIENCE

- Post tsunami survey to assess potential cultivable area revealed that approximately 4000 ha areas of agricultural farmlands were submerged, out of which 630.12 ha of area were suitable for coastal aquaculture purpose.
- Because of high potentiality of the cage culture in Andaman different grouper species were collected and reared in the Marine Research Laboratory (MRL). For

assessing growth in terms of weight gain, feeding experiment with different feed ingredients is in progress.

- Tiger shrimp samples were collected and monitored to study the incidence or prevalence of white spot disease in Andaman waters. Through PCR studies 36 percent of shrimp samples were found to be positive for WSSV.
- Line transect survey was employed using topographic satellite maps to study the distribution and abundance of corals of Andaman. A total of 192 species of corals under 57 genera in 15 families were recorded from Andaman and Nicobar during the period.
- Few species of damsel fishes like *Amphiprion percula* were collected and maintained in the MRL. Live feed like rotifers were used for feeding the fishes.
- Backyard hatchery for *Macrobrachium rosenbergii* were developed at CARI. Seeds were produced and distributed to the farmers of South Andaman.

SOCIAL SCIENCE

- The study on milch animals revealed that in Port Blair tehsil 74.77, 15.89 and 9.35% of farmers were in farm size category of small, medium and large dairy farm households whereas in Ferrargunj tehsil the respective distribution of farmers were found to be 84.81, 10.13 and 5.06%. As a whole the distribution were found to be 79.03, 13.44 and 7.53% in small, medium and large category, respectively.
- It was observed that on an average small farmer had 0.75, 0.48 and 0.05 local cows, crossbred cows and buffalos. Medium farmers had 1.40, 1.88 and 0.12 animals and large dairy farmers had 2.00, 4.29 and 3.07 of milch animal respectively.
- The tehsil wise comparative study indicated that the average number of local cow were more in Port Blair tehsil, whereas crossbred cows were more in Ferrargunj tehsil. It was found that, 66.67, 11.29 and 22.04% of dairy farm households lived in pucca, Semi-pucca and katcha type of houses, respectively.
- Majority of the farmers were found to be motivated by their relatives (81.18%) to start dairy farming followed by Dept. of AH & VS. (11.83%), CARI (3.76%) and friends (3.23%). The extension activities of Dept. of AH & VS and CARI were more in Ferrargunj tehsil than Port Blair.
- Lack of marketing infrastructure, inadequate pricing of milk followed by poor milk co-operative societies, non-availability of labour, lack of finance and loan,

insufficient land space for animal and non-availability of feed and concentrates both in the city as well as in rural areas were identified as the economic constraints.

- Technological constraints as expressed were shortage of fodder especially during summer season, lack of technological knowledge, incidence of diseases and poor infrastructure.
- Socio-economic impact assessment on Agriculture, Animal Husbandry and Aquaculture in the Tsunami-hit Andaman revealed that some of the paddy field were dried off due to upward rise of land mass. The intervention like bund construction checked the rain water from draining into the sea, as a result, the fields are flooded by a mixture of saline and rain water mostly in Stewartgunj, Mithakari and Wandoor areas of South Andaman.
- Out of the five villages surveyed, Stewartgunj, Mithakari and Wandoor are severely affected till date, whereas Chouldari and Guptapara villages are being developed through intervention of new technologies by the effort of State Govt., CARI, Non-Govt. agencies and local people.
- Water Users Association at Manjeri village of South Andaman was formed for the first time in the Islands with the objective of empowering the farmers in creation and management of their irrigation facilities. Technological intervention in agriculture and allied fields is also undertaken by the institute in then villages through participatory mode.

KRISHI VIGYAN KENDRA

- A total of 37 training programmes were conducted for the practicing farmers, farmwomen, rural youth and extension functionaries covering 1115 of which 474 were men and 641 women.
- Front line demonstrations, on HYV of rice, vegetables and livestock followed by on farm trial on rice and vegetables were taken up in farmer's field.
- Extension activities like field days, video shows, radio talks, mela and farm school were conducted to popularize the technologies in agricultural and allied fields.

INTRODUCTION

HISTORICAL PERSPECTIVE

Apart from its strategic importance the Andaman and Nicobar islands also represent unique example of eco-system where agriculture, forestry and coastal activities are intimately integrated among themselves. Thus, the agricultural development in these islands can not be viewed in isolation.

Further there has been significant shift in island economy which has moved to tourism based forest and subsistence agriculture has changed the paradigm of the requirement of different agricultural products, where agriculture has to be a feeder for tourism.

Indian Agriculture is at cross roads. National Sample Survey envisage that about 40 percent of the farmers are ready to leave agriculture if an alternate livelihood option is available. Similarly 60 percent of practicing farmers are above 50 years, which means that the youth are not viewing farming as an occupation. The situation in the islands is even more peculiar wherein the first generations of settlers who were either freedom fighters/convicts or displaced persons from Bangladesh/Burma/Sri Lanka took up farming as it was the only source of livelihood. However with globalization and information explosion, the aspiration level of today's youth has risen. This young population does not find quality of employment available in traditional agriculture compatible to their aspirations to lure them towards farming. Thus our agricultural production system has to be reoriented by appropriate intervention for reducing drudgery, value addition, increased productivity and improved profits to match his aspiration.

Central Agricultural Research Institute (CARI) with amalgamation of the regional research centres of Indian Agricultural Research Institute, New Delhi, Indian Veterinary Research Institute, Izatnagar, Central Marine Fisheries Research Institute, Cochin and Central Plantation Crops Research Institute, Kasaragod came into existence on 23 June, 1978 with its headquarter at Port Blair. Situated in the rural background it has been instrumental in supporting the island agriculture through technological intervention leading to livelihood opportunities for the people both during pre and post tsunami situation. Besides research and development, dissemination of the technologies could be achieved by keeping close coordination and functional linkages with the line departments, NGO's, nationalised banks, PRI members and other related organization, working for the upliftment of the target groups practicing agriculture, horticulture, livestock, fisheries, and other allied activities without compromising on the sustainability of the Island. Heading towards the completion of third decade of it's existence in the islands innumerable technologies has been transmitted through the change agents of KVK, CARI for its adoption in

length and breath of the cluster of villages of South, Middle, Little and Great Nicobar part of the Island. The change in scenario after tsunami has reoriented our research work to meet up these challenges as per the felt needs of the target groups. Plethora of technological intervention like System of Rice Intensification (SRI) & MAT nursery in paddy, crop diversification through Integrated Farming System (IFS) and Broad Bed Furrow System (BBFS) for both hilly and low lying areas, Quail farming, Indian Major Carps (IMC) with Scampi in fresh water pond, *Morinda citrofolia* for Tsunami areas, Black pepper on *Gliricidia*, Oyster mushroom cultivation, Goat farming and IPM for solanaceous vegetables have made favourable dent in its acceptance by the target group(s) in cluster of villages adopted for restoration of livelihood tsunami affected people in South Andaman.

Much emphasis has been laid on diagnosis of the problems of farmers, developing their skills in sustainable technologies to mitigate identified problems, develop insight into the farming system and harness the natural resource ultimately leading to sustainable agriculture in the islands.

MANDATE

- To provide a research base to improve the productivity of important agri-horticulture, livestock and fisheries of A& N islands through adaptive and basic research for attaining economic self-sufficiency.
- To develop appropriate plans for conservation of natural resources and their sustainable use.
- To standardize technologies for animal health coverage and livestock production.
- To standardize techniques for capture and culture fisheries including coastal aquaculture.
- First line transfer of technology and training to the relevant State Departments.

ORGANISATIONAL SET UP

Administration of the institute rests with the Director, who receives support from both research divisions and administration. The Research Advisory Committee (RAC), Staff Research Council (SRC) and Institute Management Committee (IMC) reviews and monitor the research programmes and facilitates to identify new research thrust areas for the Institute. To accomplish the mandate, the research activities are organized under five divisions namely, Natural Resource Management, Horticulture & Forestry, Field Crops, Fisheries Science, Animal Science and one section namely Social Science.

ORGANOGRAM

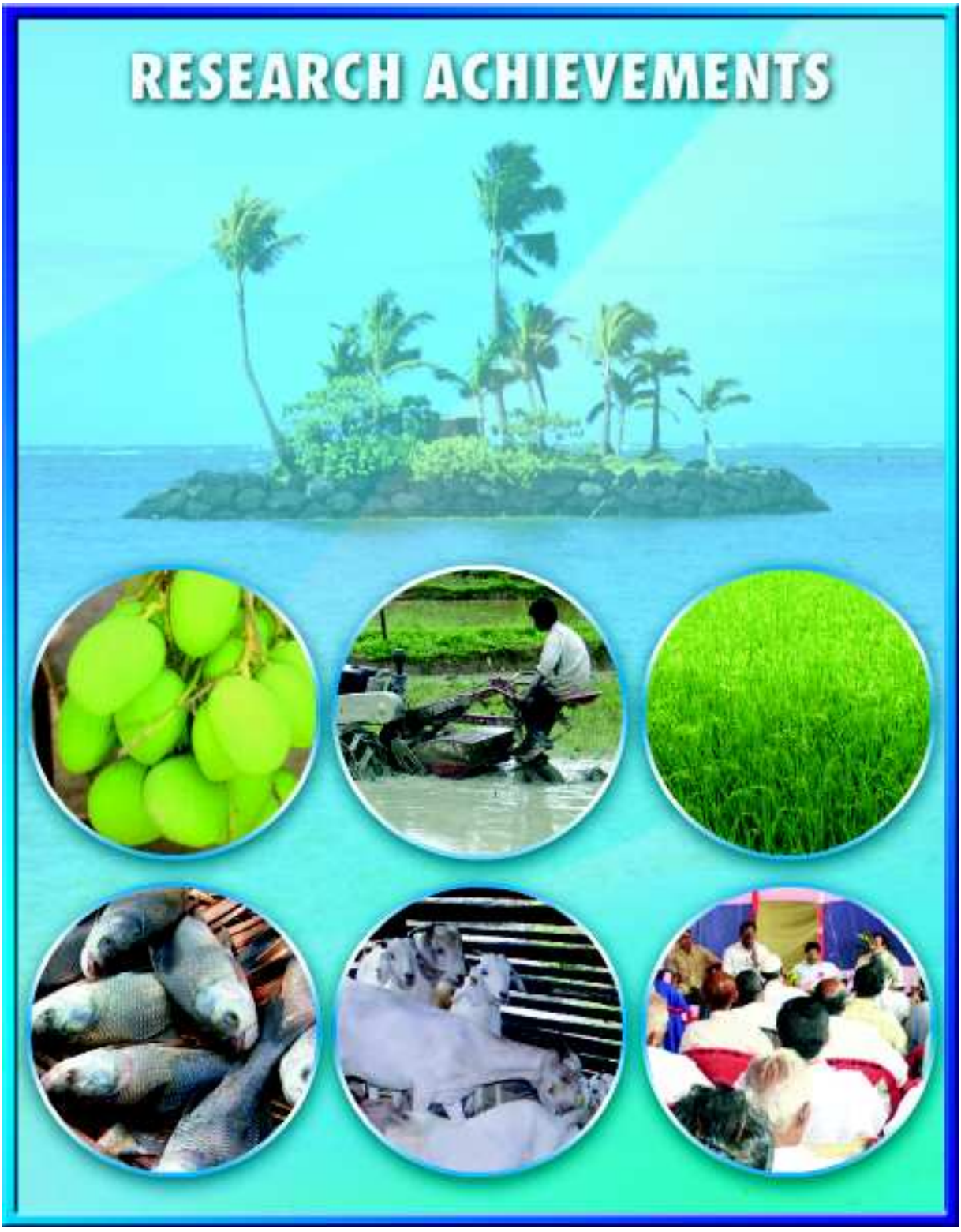

Research Advisory Committee
DIRECTOR
Institute Management Committee
Administrative Officer
Finance & Accounts Officer
Research Divisions/Section
Central Facility / Other Sections
Extension
Horticulture & Forestry
Field Crops
Natural Resource Management
Animal Science
Fisheries Science
Social Science
Library
Computer Cell
Central Instrumentation Facility
Planning, Monitoring & Coordination Cell
Official Language Cell
Museum
Estate, Workshop & Engineering
Art & Photography
Security
Krishi Vigyan Kendra
ATIC

STAFF POSITION

Sl. No.	Category	Sanctioned	Filled
1.	Scientific	56	33
2.	Technical	43	38
3.	Administrative	30	26
4.	Supporting	84	79
	Total	213	176

BUDGET UTILIZATION DURING 2006-2007

Head of Account	Plan(In Lakhs)		Non-Plan (In Lakhs)	
Particulars	RE 2006-07	Expt. 2006-07	RE 2006-07	Expt. 2006-07
Establishment Charges	—	—	383.25	383.07
Travelling Allowances	12.00	12.00	15.60	15.55
Other charges including equipment	110.00	109.90	77.15	77.11
Maintenance of office building	—	—	90.00	92.08
Maintenance of residential building	—	—	5.00	3.07
Petty work	—	—	4.00	3.84
Major works	102.00	102.00	—	—
H.R.D.	6.00	5.98	—	—
Total	**230.00**	**229.88**	**575.00**	**574.72**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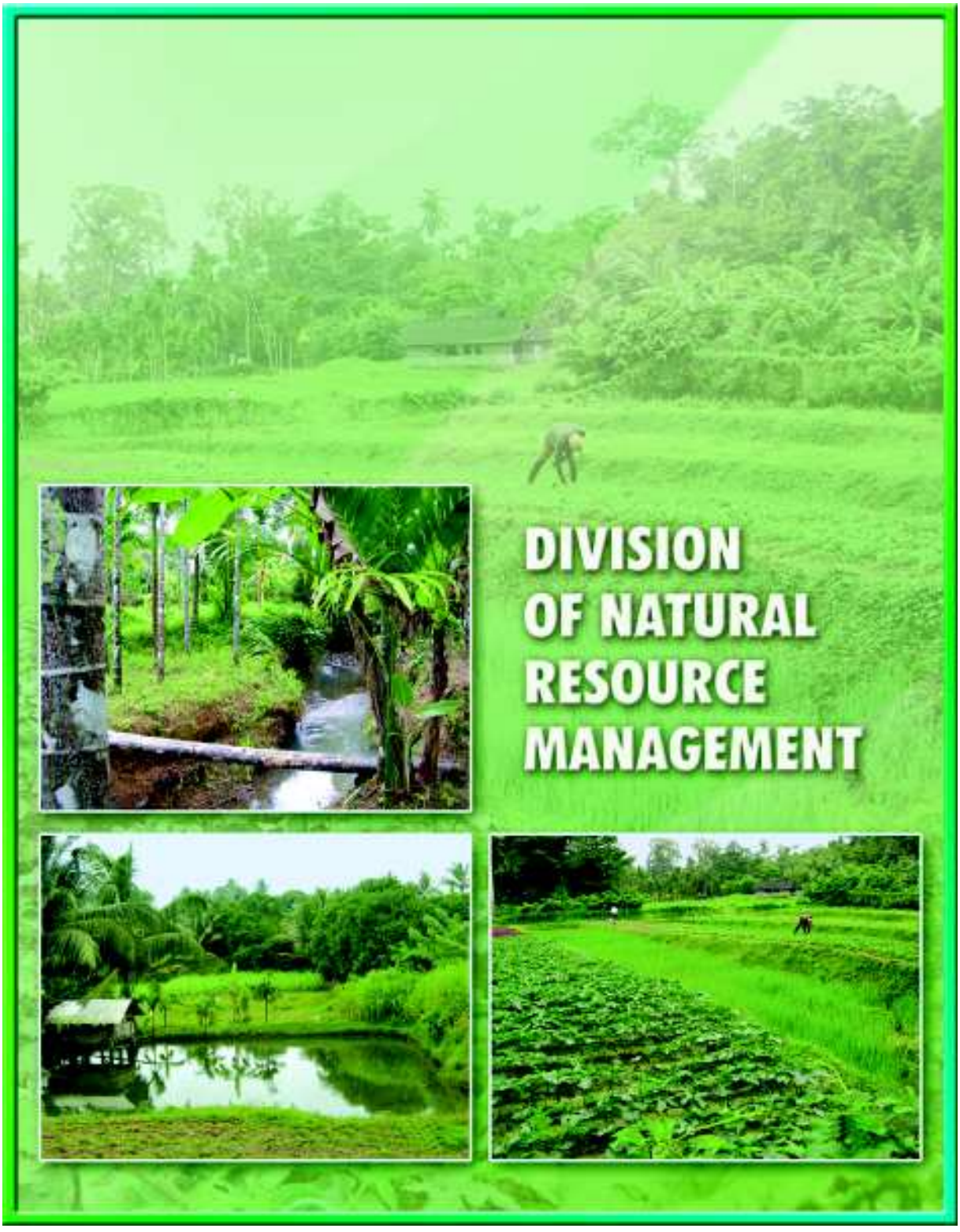

DIVISION
OF NATURAL
RESOURCE
MANAGEMENT

DEVELOPMENT OF FRESH AND BRACKISH WATER BASED INTEGRATED FARMING SYSTEM (IFS) IN BAY ISLANDS

R.C. Srivastava, N. Ravisankar, S. Ghoshal Chaudhuri, T. Damodaran, Simmi Tomar, Subhash Chand, S.N. Sethi and Grinson George

Experiments on fresh and brackish water based integrated farming system has been initiated with an objective to identify, characterize and optimize the crop, animal, poultry and fish components for fresh and brackish water based farming. Project was initiated in the backdrop of increased number of ponds after tsunami and multiple use of water. Fresh and brackish water ponds at Garacharma and Guptapara, respectively were identified for the development of pond based system (Table 1).

Plate 1. Fresh water pond at Garacharma

Small ponds are an integral part of farmer's household, which provide them water supply during post monsoon season as well as rearing freshwater fishes. Preliminary studies have shown that these ponds can be converted in to full fledged production system producing fish, eggs, vegetables and fruits.

Plate 2. Brackish water pond at Guptapara

Table 1. Size and components of the ponds

Characters / pond	Fresh water	Brackish water
Location	Garacharma	Guptapara
Pond area (including embankment)	0.15 ha(0.03 ha)	0.22 ha(0.06 ha)
Crop component	Arecanut + blackpepper + crossandra + gourds (vegetable), Bhendi, cowpea, chillies, banana, colacasia, paragrass (fodder)	*Morinda citrifolia*, fodder, vegetables in raised bed
Livestock component	poultry + duckery	poultry + duckery
Fish component	Indian major carps (catla, rohu, mirgal)	Brackish water prawn

ASSESSMENT OF SPATIAL AND TEMPORAL VARIABILITY IN SOIL PHYSICO-CHEMICAL AND BIOLOGICAL PROPERTIES OF TSUNAMI AFFECTED AGRICULTURAL LANDS OF ANDAMANS

S. Ghoshal Chaudhuri, R. C. Srivastava, R. Raja, N.Ravisankar, T. P. Swarnam, V. Jayakumar, Babu Lal Meena and M. Balakrishnan

Rehabilitation and management of salt-affected soils require a combination of agronomic and management practices. Unlike texture or bulk density, which is static property of soils, salinity is a dynamic property. It varies temporally and spatially with depth and across the landscape. Hence to keep the track of changes in soil salinity of tsunami affected agricultural lands, an extensive survey cum soil sample collection was undertaken at periodical intervals in the *Tsunami* affected areas of South Andaman *viz.*, Lalpahar, Craikabad, Chouldhari (Dhanikhari series) Guptapara (School line series), Mitha Khari, Loha Barrack and New Manglutan (Tushnabad series).

Samples were collected from surface (0-15 cm) and subsurface layer (15-30 cm) using Edelmann corer (7cm Ø, 60 cm length) from ten selected spots by making a transect walk across the slope under Situation I (Sea water intruded to the cultivated land during Tsunami and receded completely) and Situation II (Sea water intrudes during high tide and recedes during low tide) during March 2006, September 2006, November 2006, January, March 2007.

The Soil pH of the surface soil layer of Dhanikari series under situation I varied between 5.6-5.9, 5.9.-6.3 and 6.0 - 6.4 in Lalpahar, Craikabad and Chouldhari over the period (Table 2). The same trend was observed in situation II also as the pH varied between 5.5-5.9, 5.9- 6.3and 6.6- 6.7 in the same locations. In case of Tushnabad series of soil, the trend of soil pH were 5.5-5.9, 6.1-6.5 and 5.3 -5.7 for Mitha Khari, Loha Barrack and New Manglutan respectively. Similar trend was noticed under Situation II for the same locations as the pH of these locations varied between 5.9-6.1, 6.0-6.5 and 5.2-5.8, respectively. For school line series of soil in Guptapara under situation I and II, the soil pH varied between 4.2 -5.1and 4.9-5.1, respectively. The reason for such variation in hydrogen ion concentration may be attributed to the high rainfall received after tsunami (during 2005 and 2006), which might have leached out excess soluble salts from the soil through surface and internal drainage and in turn the soil pH gradually came back to the original, pre tsunami level.

In case of soil salinity, most of the salts remained in the root zone raising soil salinity to a level as high as ECe 2.3-14.1 dSm^{-1} under Situation I & II, irrespective of locations. High ECe values prevailed after the flooding even after receiving one seasonal rainfall. Results revealed that under Dhanikari series at

Table 2. Temporal and spatial variability of Soil pH and salinity of tsunami affected soils of South Andaman

Situation	Location	pH (± SE of mean)					ECe, dSm^{-1} (± SE of mean)				
		Mar' 06	Sept' 06	Nov' 06	Jan' 07	Mar' 07	Mar' 06	Sept' 06	Nov' 06	Jan' 07	Mar' 07
Surface soil (0-15 cm)											
I	Lalpahar	5.9 ± 0.13	5.5 ± 0.15	5.5 ± 0.12	5.6 ± 0.05	5.6 ± 0.13	9.9 ± 0.22	6.2 ± 0.14	5.1 ± 0.08	4.8 ±0.10	5.6 ± 0.32
	Crikadabad	6.3 ± 0.21	6.2 ± 0.13	6.0 ± 0.20	6.0 ±0.13	5.9 ± 0.19	9.5 ± 0.32	5.8 ± 0.19	4.8 ± 0.12	4.2 ±0.14	5.9 ± 0.28
	Guptapara	5.1 ± 0.25	5.0 ± 0.12	4.8 ± 0.18	5.0 ±0.14	4.2 ± 0.16	3.9 ± 0.15	1.13 ± 0.04	0.68 ± 0.09	0.43 ±0.01	0.62 ± 0.02
	Mithakhari	5.9 ± 0.23	5.6 ± 0.13	5.5 ± 0.17	5.5 ±0.12	5.6 ± 0.17	11.9 ± 0.36	7 ± 0.21	5.8 ± 0.12	4.4 ±0.13	5.2 ± 0.16
	Loha Barrack	6.5 ± 0.28	6.3 ± 0.14	6.2 ± 0.27	6.1 ±0.19	6.5 ± 0.29	7.2 ± 0.31	5.3 ± 0.23	2.3 ± 0.08	3.4 ±0.14	4.8 ± 0.21
	New Mangl	5.7 ± 0.19	5.4 ± 0.11	5.3 ± 0.17	5.3 ±0.03	5.6 ± 0.18	4.1 ± 0.13	2.7 ± 0.08	1.8 ± 0.05	0.5 ±0.01	0.85 ± 0.03
	Chouldhari	6.4 ± 0.31	6.4 ± 0.21	6.3 ± 0.31	6.2 ±0.17	6.0 ± 0.29	8.3 ± 0.40	6.0 ± 0.29	4.5 ± 0.15	3.7 ±0.18	4.31 ± 0.21
II	Lalpahar	5.9 ± 0.19	5.3 ± 0.12	5.5 ± 0.15	5.5 ±0.12	5.5 ± 0.12	10.8 ± 0.24	7.7 ± 0.17	6.1 ± 0.13	5.4 ±0.11	7.1 ±0.16
	Crikadabad	6.3 ± 0.27	6.1 ± 0.20	6.0 ± 0.11	6.0 ±0.20	5.9 ± 0.18	11.3 ± 0.37	7.4 ± 0.24	5.8 ± 0.19	5.1 ±0.07	7.5 ±0.25
	Guptapara	5.1 ± 0.13	4.7 ± 0.18	4.9 ± 0.28	5.0 ±0.19	4.9 ± 0.19	6.8 ± 0.26	5.2 ± 0.20	4.1 ± 0.15	3.3 ±0.07	4.7 ±0.18
	Mithakhari	6.1 ± 0.18	6.0 ± 0.18	6.0 ± 0.15	5.9 ±0.18	6.0 ± 0.21	14.1 ± 0.43	8.8 ± 0.27	6.2 ± 0.19	6.6 ±0.20	8.3 ±0.26
	Loha Barrack	6.5 ± 0.20	6.3 ± 0.27	6.2 ± 0.42	6.0 ±0.26	6.6 ± 0.29	9.4 ± 0.41	7.2 ± 0.31	4.8 ± 0.21	4.4 ±0.19	5.9 ±0.25
	New Mangl	5.4 ± 0.17	5.4 ± 0.17	5.2 ± 0.37	5.5 ±0.18	5.8 ± 0.19	4.5 ± 0.14	3.6 ± 0.11	2.2 ± 0.17	2.8 ±0.09	3.9 ±0.13
	Chouldhari	6.6 ± 0.22	6.6 ± 0.32	6.5 ± 0.39	6.4 ±0.31	6.7 ± 0.33	9.7 ± 0.47	7.1 ± 0.34	4.6 ± 0.22	4.9 ±0.24	5.7 ±0.28
Subsurface soil (15-30 cm)											
I	Lalpahar	6.2 ± 0.14	5.9 ± 0.13	5.2 ± 0.08	5 ±0.07	5.4 ± 0.123	7.4 ± 0.17	5.8 ± 0.13	3.6 ± 0.08	3.9 ±0.08	4.2 ± 0.10
	Crikadabad	6.0 ± 0.20	5.7 ± 0.19	5 ± 0.06	4.9 ±0.13	6 ± 0.201	7.1 ± 0.24	5.5 ± 0.18	4.7 ± 0.05	5 ±0.16	5.3 ± 0.18
	Guptapara	5.4 ± 0.21	5.2 ± 0.20	4.9 ± 0.11	4.9 ±0.12	4.9 ± 0.189	2.3 ± 0.09	2 ± 0.07	0.9 ± 0.07	0.6 ±0.02	0.4 ± 0.02
	Mithakhari	6.1 ± 0.27	5.9 ± 0.18	5.4 ± 0.12	5.1 ±0.05	5.8 ± 0.179	8.4 ± 0.26	5.2 ± 0.16	4 ± 0.12	4.1 ±0.12	4.4 ± 0.14
	Loha Barrack	6.6 ± 0.19	6.1 ± 0.26	5.7 ± 0.19	5.5 ±0.14	6.3 ± 0.277	5.6 ± 0.24	4.7 ± 0.20	4.2 ± 0.18	3.8 ±0.16	4.1 ± 0.18
	New Mangl	5.5 ± 0.23	5.3 ± 0.17	5.2 ± 0.11	5 ±0.06	5.5 ± 0.180	3.7 ± 0.12	2 ± 0.06	0.6 ± 0.02	0.4 ±0.04	0.63 ± 0.02
	Chouldhari	6.1 ± 0.30	5.6 ± 0.27	5.3 ± 0.16	5.1 ±0.19	5.8 ± 0.285	6.9 ± 0.34	3.8 ± 0.18	1.9 ± 0.09	1.6 ±0.07	4.1 ± 0.20
II	Lalpahar	5.2 ± 0.12	5.2 ± 0.11	5.1 ± 0.11	5 ±0.11	5.4 ± 0.123	9.2 ± 0.21	6.2 ± 0.14	5.5 ± 0.12	5.2 ±0.11	6.2 ± 0.14
	Crikadabad	6.1 ± 0.26	6 ± 0.14	5.8 ± 0.19	5.6 ±0.18	5.7 ± 0.191	10.7 ± 0.36	7.3 ± 0.24	4.6 ± 0.15	3.9 ±0.13	6.6 ± 0.22
	Guptapara	4.8 ± 0.18	4.4 ± 0.12	4.3 ± 0.16	4.4 ±0.17	4.4 ± 0.170	6.6 ± 0.25	6 ± 0.23	4.1 ± 0.15	3.7 ±0.14	4.4 ± 0.17
	Mithakhari	6.4 ± 0.20	6.2 ± 0.06	6 ± 0.18	5.8 ±0.17	5.8 ± 0.179	11.3 ± 0.34	8.1 ± 0.25	7.6 ± 0.23	6.4 ±0.19	7.6 ± 0.23
	Loha Barrack	6.4 ± 0.28	6.2 ± 0.17	5.8 ± 0.25	5.7 ±0.25	6.8 ± 0.30	8.7 ± 0.38	5.5 ± 0.24	3.2 ± 0.14	4.8 ±0.21	5.3 ± 0.23
	New Mangl	5.6 ± 0.18	5.9 ± 0.09	5.6 ± 0.18	5.6 ±0.18	5.5 ± 0.18	6.2 ± 0.20	5.1 ± 0.16	3.8 ± 0.12	3.2 ±0.10	3.7 ± 0.12
	Chouldhari	6.3 ± 0.34	6.1 ± 0.21	6 ± 0.29	6.2 ±0.30	6.6 ± 0.32	8.4 ± 0.41	4.9 ± 0.24	3.4 ± 0.16	3.7 ±0.18	5.2 ± 0.26

different locations viz., Lalpahar, Craikabad, Chouldhari, the salinity level varied between 5.6 to 9.9, 5.9-9.5 and 4.3-8.3, respectively in the surface soil of situation I with a decreasing trend upto January 2007 and slight increase then after during March 2007 and similar trend was observed in subsurface soil also. The pattern of changes in salinity level in case of Tushnabad and School line soil series have also showed the similar pattern of decreasing salinity level during rainy season and slight increase during the dry season under situation I and II. The decreasing trend in soil salinity from March 2006 to January 2007 may be attributed to the amount of rainfall received during the year and its distribution. The variation with in the year can be explained by the timing of the soil sampling. During dry season (March 2007), the higher evaporation rate induced the capillary rise of soluble salts from lower layer to surface layer and in turn increased the salinity level. Analysis of bacterial and fungal load revealed that the microbial load increased to normal pre *Tsunami* level during January 2007 (Table 3). Between situation I and II, the soils of situation I have showed enhanced microbial load over situation II which may be due to the continuous changes in soil pH and EC.

Table 3. Status of microbes in tsunami affected soils during January 2007(two years after *Tsunami*)

Situation	Location	Surface soil (0-15 cm)		Sub surface soil (15-30 cm)	
		Bacterial population (x 10^8 cells/ g of soil)	Fungal population (x 10^4 cfu/ g of soil)	Bacterial population (x 10^8 cells/ g of soil)	Fungal population (x 10^4 cfu/ g of soil)
I	Lalpahar	6.18	4.3	2.31	2.3
	Crikadabad	9.32	8.3	3	2.8
	Guptapara	5.33	6.4	1.83	1.7
	Mithakhari	3.94	2.3	1.22	0.9
	Loha Barrack	8.14	4.1	2.16	2.2
	New Mangl	7.29	7.3	1.62	1.9
	Chouldhari	7.36	5.5	1.63	1.4
II	Lalpahar	1.32	1.3	0.12	0.6
	Crikadabad	1.84	2.4	0.07	0.9
	Guptapara	1.41	0.9	0.05	0.3
	Mithakhari	1.37	0.3	0.01	0.1
	Loha Barrack	1.86	1.1	0.38	0.8
	New Mangl	1.62	0.9	0.26	0.2
	Chouldhari	1.44	0.7	0.07	0.6

OPTIMISING LAND USE BASED ON FERTILITY CAPABILITY CLASSIFICATION (FCC) IN COASTAL PADDY SOILS OF SOUTH ANDAMAN

T.P. Swarnam, S. Ghoshal Chaudhuri, R. Raja and N. Ravisankar

Rice growing areas of south Andaman was identified and delineated using IRS-P6 and INSAT-1D imageries along with Survey of India toposheets at 1:50,000 scale. Soil series map was used to identify the major soil series found in rice growing areas of South Andaman. Dhanikari was the major soil series followed by Wandoor, School line, Garacharma and Tusnabad. Soil samples were collected from each soil series found in rice growing areas of South Andaman at 0-20 and 20-50 cm depth. Soil samples were analysed for texture, pH, cation exchange capacity (CEC), exchangeable cations, base saturation percentage (BSP), electrical conductivity (ECe), soluble salts, total acidity, organic carbon and available nutrients. The soil fertility constraints for rice crop production were identified and soils were grouped into various fertility capability classes (FCC) developed by Sanchez *et al* (1982).

The soils of rice growing areas are acidic to neutral. Dhanikari series is acid sulphate having black encrustations on the surface. In general, the average ECe is low with values ranging between 0.14-4.97 dS m^{-1}. However, the salt concentration was found much higher (> 10 dS m^{-1}) in Chouldari and Mithakhari areas of dhanikari series and Guptapara and Manjeri areas of Wandoor series mainly because of seawater intrusion and accumulation of salts due to saline water intrusion during tsunami. CEC ranged from 3.1 to 24.2 c.mol (+) kg^{-1}. The low CEC values of most of the soil series are due to light texture (sandy clay, sandy clay loam) and nature of clay minerals. The low CEC indicates poor nutrient adsorption and retention capacity of the soils. The mean values of BSP in these soils are only 73 to 77 % indicating poor base saturation. It is mainly because of the nature of clay minerals and light soil texture. The acidic nature of the soils further indicates the poor base saturation percent. The low base saturation has direct relation with soil reaction, low nutrient reserve and potential leaching losses. Soil acidity is also an important parameter in assessing the soils into different fertility capability unit. The mean value of exchange acidity of different soil series ranged from 1.7 to 3.6 c.mol (+) kg^{-1} soil due to H^+ and Al^{3+} ion saturation of the base complex indicating poor soil nutrient reserve and nutrient exchange properties.

Available nutrients

The available nutrient status of the soil has direct bearing on crop growth and soil productivity. The soils are good in organic carbon (OC), medium in available N and poor in P and K. The OC of the soil is medium to high with mean value for

different soil series ranging from 0.44-1.65 % (Table 4). The N content varied from 199 to 243 kg ha^{-1}. However, the available P is low (10 to 13 kg ha^{-1}). The lower availability of P is due to acidic nature of the soils, where it is fixed into insoluble forms. The available K content is low in Wandoor, Garacharma and School line series, mainly because of low CEC, erosion and OC as compared to other soil series. However, the soils of Dhanikari and Tushnabad series recorded more than 240 kg ha^{-1} N which might be due to higher CEC, clay and organic carbon content.

Table 4 . Area, textural class and available nutrients of different rice areas of South Andaman

Soil series	Area (ha)	Textural class*	OC(%)	Available nutrients (kg ha^{-1})		
				N	P	K
Wandoor	1648.6 (30.0 %)	SL	0.82	199	11	78
Garacharma	1374.5 (25.0 %)	SCL	0.44	223	10	64
Tushnabad	1082.6 (19.7 %)	SC	1.65	243	11	248
Dhanikari	687.6 (12.5 %)	CL	1.25	241	13	256
School Line	594.0 (10.8 %)	SCL	0.72	221	11	97

* SL: Sandy loam, SCL: Sandy clay loam, SC: Sandy clay, CL: Clay loam

Soil fertility constraints for rice crop

As per FCC classification system, poor drainage during monsoon, dry condition and Al toxicity are the major constraints for crop production in the soils of the South Andaman. Spatial variability of soil is high within the soil series for salinity, alkalinity and water logging. Impeded drainage and water logging during monsoon period restrict the cultivation of rice alone in the low lying valley areas. Similarly, post monsoon dryness during December to May restricts crop cultivation. Besides these climatic and edaphic factors, Al toxicity induced by soil acidity is another major constraint for crop production. The vertic "v" i.e. formation of deep cracks during dry period is another major constraint observed in Dhanikari soils which hinders crop germination and establishment.

Suggested management options include (i) land configuration into broad bed and furrows (BBF) for growing other crops with rice in lowlands (where water logging during monsoon period prevents cultivation of other crops); (ii) providing supplemental irrigation during dry season months for vegetables, maize and groundnut; (iii) mulching, organic matter addition with frequent light irrigation (formation of cracks can be prevented) and and (iv) the nutrient loss through leaching and erosion can be managed by addition of organic matter.

IMPACT OF INTEGRATED NUTRIENT MANAGEMENT ON SOIL QUALITY UNDER RICE-MAIZE CROPPING SYSTEM IN ANDAMAN

Babu Lal Meena, S. Ghoshal Chaudhuri, N. Ravisankar, R. Raja and M. Din

Soil is bound to be mined of its nutrient reserve, when addition through fertilizer and native source lag behind those removed by crop. More over, the crop rotation is not being practiced properly, leaving the resources underutilized in Islands. Maize can be a better substitute on residual soil moisture in post-monsoon season. Organic manures that may supply a part of the P and K along with the secondary and micronutrients required by crops can help to offset the negative nutrient balance and slow down nutrient depletion processes. Even the better quality soils are unable to remain productive over a long period without adequate care of their health. The judicious balance between organic and inorganic source of nutrient should be maintained for improving productivity, stability and environment in these islands.

The main objective of the project is to identify a suitable integrated nutrient management practice in order to maintain the soil health for rice - maize cropping system in Bay Islands. Soil samples were collected from 0-15 and 15-30 cm from experimental site at Bloomsdale farm and analysed for different soil properties (Table 5). Preliminary physico-chemical properties of soil were estimated and found that soils were acidic in nature having the low to medium organic carbon and low in potassium.

Table 5. Preliminary chemical properties of soil

Parameter	Depth (cm)	
	0-15	15-30
pH	5.3	5.7
EC (dS m^{-1})	0.1	0.1
Organic carbon (%)	0.7	0.4
Available K (kg ha^{-1})	80.0	70.0

ALLEY CROPPING SYSTEM: EFFECT OF PRUNINGS ON PHYSICO-CHEMICAL PROPERTIES OF SOIL AND PRODUCTIVITY OF INTERCROPS IN ANDAMAN

Babu Lal Meena and C.B. Pandey

The project aims to maintain soil health through pruning biomass application and selection of suitable crop sequence in the *Gliricidia* based alley-cropping system for the Andaman Islands. The alley cropping system is considered to be a viable and sustainable land use system in Andaman Islands because

of benefits of the Nitrogen Fixing Trees (NFT) shrub hedge rows and recycling of nutrients through pruning. *Gliricidia* prunings application will protect soils from erosion, improve their physical condition through aggregate formation which in turn improve soil texture and enhance microbial activity. Samples were collected up to 30 cm depth from the alleys and processed in order to find out the physico-chemical properties of the soil under the alley cropping system at Sippighat farm (Table 6).

Table 6. Physico chemical properties of soil in alley cropping

Parameter	Value±SE
Texture	Sandy loam
Gravel (%)	23.8 ± 1.8
Fine sand (%)	73.0 ± 1.8
Silt (%)	2.2 ± 0.1
Clay (%)	1.0 ± 0.1
Bulk density (g cm^{-3})	1.1 ± 0.1
pH	5.9 ± 0.2
Total N (kg ha^{-1})	1232.0 ± 67.2
Total P (kg ha^{-1})	44.8 ± 4.5

BIO-CHEMICAL AND MOLECULAR CHARACTERIZATION OF SOILS OF THE MANGROVE FORESTS OF ANDAMANS

S. Ghoshal Chaudhuri, R. Raja and V. Jayakumar

Impact of anthropogenic disturbances on the mangrove soils were assessed by collecting surface (0-30 cm) and subsurface (30-60 cm) soil samples from both disturbed and undisturbed areas of Andamans using an Edelmann corer and GPS. The sampling sites for soil sample collection (Manjery, Burmanalha, Kodiyaghat, Sippighat, Wandoor, Shole Bay, Kalataung, Yerata, Barataung and Potataung) have been selected in such a way that the site encompasses both disturbed and undisturbed mangrove areas. The collected soil samples were analyzed for various physico-chemical and biochemical parameters using standard procedures. All values reported are mean of twenty determinations. Results indicated that undisturbed mangrove soils are having higher enzymatic activity than that of disturbed mangrove soils (Table 7) irrespective of places especially in the surface soils which may due to the higher organic matter presence through litter fall under undisturbed mangroves.

The average content of microbial biomass carbon at the undisturbed mangrove sites was 426 ± 50.46 µg g^{-1} (Mean ± SD) in the surface soils and in the subsurface soil, it was 397 ± 53.4 µg g^{-1} and at disturbed mangrove sites, the average content of microbial biomass carbon was 285 ± 35.81 µg g^{-1} and 257.6 ± 35.91 µg g^{-1} in surface

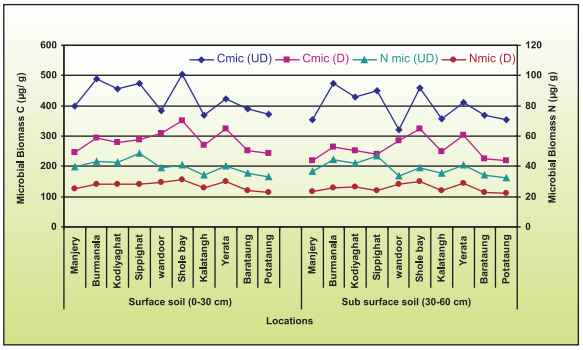


Fig 1. Microbial Biomass Carbon (C mic) and Nitrogen (N mic) content of undisturbed and disturbed mangrove soils of South Andaman

and subsurface soils respectively (Fig. 1) indicating that 33.1 % and 35.3 % decline in the disturbed mangrove sites vis-à-vis undisturbed mangrove sites in surface and subsurface soils, respectively. This may be due to the fact that the disturbed mangrove sites yielded lesser litter fall which resulted in lesser microbial activity and in turn resulted in lower microbial biomass carbon level at the disturbed mangrove sites. In

Table 7. Soil enzymes content of undisturbed and disturbed mangrove soils of South Andaman

Location	Urease (µmol NH_3 N g^{-1} h^{-1})		Phosphomonoesterase (µmol pnp g^{-1} h^{-1})		Phosphodiesterase (µmol pnp g^{-1} h^{-1})	
	Undisturbed	Disturbed	Undisturbed	Disturbed	Undisturbed	Disturbed
Surface soil (0-30 cm)						
Manjery	15.1 (0.88)	13.1 (0.76)	11.6 (0.70)	6.3 (0.38)	3.6 (0.68)	3.2 (0.61)
Burmanala	10.5 (0.61)	8.4 (0.49)	15.2 (0.91)	7.1 (0.43)	4.2 (0.80)	3.6 (0.68)
Kodiyaghat	10.8 (0.63)	9.6 (0.56)	14.2 (0.85)	9.1 (0.55)	4.5 (0.86)	4.1 (0.77)
Sippighat	17.0 (0.98)	13.1 (0.76)	13.6 (0.82)	5.5 (0.31)	3.5 (0.67)	3.1 (0.59)
wandoor	13.8 (0.81)	11.4 (0.66)	11.5 (0.69)	5.2 (0.36)	5.1 (0.97)	4.9 (0.93)
Shole bay	12.7 (0.74)	11.1 (0.65)	20.4 (1.23)	9.4 (0.57)	6.2 (0.98)	5.4 (1.01)
Kalatangh	6.0 (0.35)	3.8 (0.22)	18.6 (1.12)	8.6 (0.52)	5.9 (0.92)	5.5 (1.03)
Yerata	13.9 (0.81)	11.4 (0.66)	17.5 (1.05)	7.7 (0.46)	6.1 (0.96)	5.3 (0.98)
Barataung	14.4 (0.84)	12.3 (0.72)	16.8 (1.01)	6.9 (0.41)	5.4 (0.83)	5.1 (0.94)
Potataung	13.4 (13.4)	9.6 (0.56)	15.4 (0.93)	7.6 (0.46)	5.8 (0.86)	5.2 (0.92)
Mean ± SD	*12.77 ± 3.05*	*10.37 ± 2.77*	*15.48 ± 2.90*	*7.34 ± 1.43*	*5.03 ± 1.02*	*4.54 ± 0.95*
Sub surface soil (30-60 cm)						
Manjery	12.0 (0.70)	9.6 (0.56)	10.7 (0.64)	5.8 (0.35)	3.5 (0.67)	3.0 (0.57)
Burmanala	9.6 (0.56)	7.0 (0.41)	13.2 (0.79)	6.5 (0.39)	4.0 (0.76)	3.2 (0.61)
Kodiyaghat	10.1 (0.59)	7.4 (0.43)	11.6 (0.70)	8.4 (0.50)	4.6 (0.87)	4.1 (0.78)
Sippighat	14.4 (0.84)	11.9 (0.69)	10.9 (0.66)	5.1 (0.31)	3.0 (0.57)	2.8 (0.53)
wandoor	12.3 (0.72)	10.9 (0.64)	11.0 (0.63)	5.4 (0.33)	4.2 (0.80)	3.1 (0.59)
Shole bay	13.9 (0.81)	10.7 (0.63)	17.5 (1.05)	8.7 (0.52)	5.8 (0.94)	4.5 (0.86)

Kalatangh	5.5 (0.32)	4.2 (0.25)	16.2 (0.97)	8.2 (0.49)	5.5 (0.88)	5.1 (0.97)
Yerata	13.3 (0.78)	10.9 (0.64)	15.9 (0.91)	7.9 (0.44)	6.0 (0.97)	5.8 (0.91)
Barataung	14.7 (0.85)	10.0 (0.58)	14.1 (0.85)	6.8 (0.41)	5.4 (0.86)	5.1 (0.97)
Potataung	12.9 (0.75)	11.7 (0.68)	12.7 (0.76)	7.0 (0.51)	5.6 (0.89)	5.4 (0.93)
Mean ± SD	*11.87 ± 2.81*	*9.44 ± 2.46*	*13.38 ± 2.46*	*6.98 ± 1.29*	*4.76 ± 1.05*	*4.21 ± 1.12*

Plate 3. Soil sample collection from (a) undisturbed and (b) disturbed mangrove sites

contrast, greater microbial biomass carbon at the undisturbed site reflects greater accumulation of plant residues and organic carbon which are substrates for soil microbes. Soils at the undisturbed mangrove sites exhibited markedly greater level of microbial biomass nitrogen than the disturbed mangrove sites in surface soils (33.2 to 48.8 as against 23.0 to 31.2) and subsurface soils (32.3 to 46.8 as against 22.0 to 30.2) indicating an average reduction of 32 % and 33 % with respect to surface and subsurface soils of disturbed mangrove sites. The higher microbial biomass carbon in undisturbed mangrove sites in turn resulted in higher microbial biomass carbon to microbial biomass nitrogen ratio in surface and subsurface soils compared to disturbed mangrove sites.

DEVELOPMENT OF INTEGRATED FARMING SYSTEM (IFS) MODELS UNDER DIFFERENT RESOURCE CONDITIONS IN HUMID TROPICS OF BAY ISLANDS

N. Ravisankar, B. Ganeshkumar, S. Ghoshal Chaudhuri, R. Raja, R. C. Srivastava, D. R. Singh, A. Kundu and R. P. Medhi

Agro-ecosystem analysis of the island farming system revealed four distinct micro farming situations (MFS) viz., Hilly (MFS I), Slopping hilly upland (MFS II), Medium upland valley (MFS III) and Low lying valley (MFS IV). The enterprise combination study indicated the suitability of plantation based cropping sequences + backyard poultry and livestock in

Plate 4. Banana plantation in MFS I

hilly areas, Short & medium duration paddy, vegetables, floriculture, plantations, fodder + backyard poultry + goat, fish cum poultry cum duck and cattle in slopping hilly uplands, vegetables, plantations + backyard poultry, fish cum poultry cum duck in medium upland valley and long and short duration paddy,

Plate 5. Floriculture in MFS II (Model 1)

vegetables + backyard poultry, fish cum poultry and cattle in low lying valley micro farming situations (Table 8). Productivity and profitability analysis of different farming systems under various micro farming situations revealed that net return obtained from cropping was Rs 3,26,408, livestock and poultry was Rs 64,300 in MFS I where as under MFS II, it is Rs. 1,53,989 from cropping, Rs. 77,176 from livestock and backyard poultry and Rs. 12,465 from poultry + duck + fish. In MFS III, net return obtained from cropping was Rs. 9,297 livestock was Rs. 72,306 and poultry was Rs. 2,630 and poultry + duck + fish was Rs. 24,957. Similarly, in MFS IV, net return obtained from cropping was Rs. 57,760

Plate 6. Vegetables in MFS II (Model 2)

whereas Rs 90,893 was obtained from livestock, Rs 11,000 from backyard poultry and Rs 14,872 from poultry + duck + fish. Energy analysis of various systems infers that effective conversion of input energy in to out put energy. For

Plate 7. QRT team visit to IFS model (MFS II)

Plate 8. Bhendi on the embankment (MFS III)

example in MFS II, the total input and output energy from field crops, vegetables, plantation and spices was 40,149 and 1,35,092 MJ where as in cattle component, it is 200190 and 22465 MJ respectively. Component analysis of

Plate 9. Goat, poultry, duck & Guinea fowl (MFS II)

Integrated Farming system under various farming situations indicated that cropping contributed more to net returns (69 to 83 %) in hilly and slopping hilly uplands where as livestock components (Cattle, poultry and fish) contributed more to net returns (49 to 66 %) in medium upland valley and low lying valley areas.

Plate 10. Milch cow (MFS IV)

Microbial load of fish + poultry + duck system

Study on bacterial load in different samples in different seasons of fish + poultry + duck system revealed low bacterial load before monsoon due to various management practices in the pond like removing of excess silt and application of lime just before rain. During the monsoon season, bacterial load especially Salmonella sp in the pond gets increased due to the factors like poultry drop gets accumulated

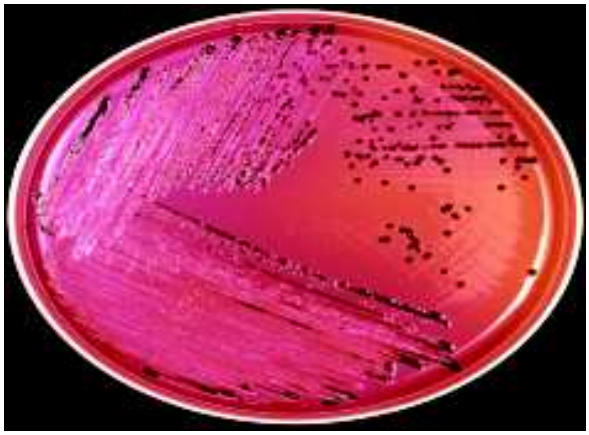


Plate 11. *Salmonella sp* in Fish+poultry+duck pond water

uniformly in the pond water. Bacterial load sharply increased during dry season (Table 9) mainly due to low level of water, higher droppings and increase in temperature which favours the growth of bacteria. Hence, the pond water of fish cum poultry cum duck should not be used for house hold purposes.

Table 9. Bacterial colonies in different micro farming situations

Samples	No. of colonies before monsoon (CFU/0.1ml)	No. of colonies in monsoon	No. of colonies in dry season
MFS II (Model 1)	32×10^4	45×10^5	78×10^5
MFS II (Model 2)	32×10^4	38×10^5	94×10^5
MFS III	36×10^4	44×10^5	30×10^5
FS IV	36×10^4	48×10^5	67×10^5

Expenditure Pattern

Critical analysis of expenditure pattern of different farm families engaged in IFS under different micro farming situations illustrates that higher expenditure was incurred on purchase of household items (10-32 %) followed by expenditure on agriculture (5-39 %). In the medium upland valley (MFS III), where cultivated land is limited only around the pond, expenditure on agriculture was lowest (only 5%), whereas expenditure

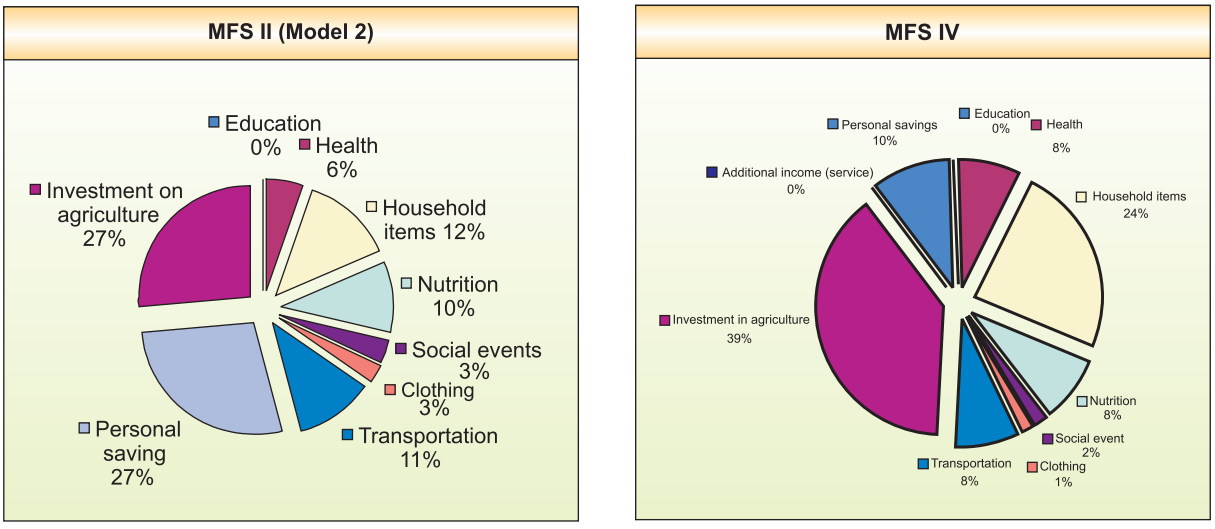


Fig 2. Expenditure pattern of different micro farming situations

Table 8. Net returns and employment generation in integrated farming system (IFS) under different micro farming situations

System	MFS I		MFS II				MFS III		MFS IV	
			Model 1		Model 2					
	Net returns (Rs ha^{-1}	Employ-ment generation (mandays)	Net returns (Rs ha^{-1})	Employ-ment generation (mandays)	Net returns (Rs ha^{-1})	Employ-ment generation (mandays)	Net returns (Rs ha^{-1})	Employ-ment generation (mandays)	Net returns (Rs ha^{-1})	Employ-ment generation (mandays)
Integrated system (IFS)	3,90,708	528	2,20,959	370	3,94,167	438	1,09,190	290	1,64,960	259
Crops alone	3,26,408	365	1,53,989	180	2,94,349	240	9,297	20	57,760	58
Additional benefits	64,300	163	66,970	190	99818	198	99,893	270	1,07,200	201
System components	Crops: coconut, arecanut + black pepper, sapota, banana Cattle: 2 buffalo +3 calves Backyard poultry: 50 birds		Crops: paddy, sugarcane, coconut, arecanut + black pepper, ginger, marigold, crossandra, leafy vegetables, ladies finger, brinjal, fodder Cattle: 3 cows +2 bullocks Fish + poultry + duck rearing: 200 fingerlings, 25 poultry, 5 ducks Backyard poultry : 23 birds Goat: 9 + 18 kids		Crops: paddy, sugarcane, coconut, arecanut + black pepper, ginger, sesamu, crossandra, leafy vegetables, all gourds, ladies finger, brinjal, fodder Cattle: 3 cows + 2 bullocks Fish + poultry + duck rearing: 200 fingerlings, 25 poultry, 5 ducks Backyard poultry: 31 birds Goat: 4 + 9 kids		Crops: Okra, Cowpea, bottle-gourd, fodder sorghum Cattle: 3 cows + 2 calves Fish + poultry + duck rearing: 200 fingerlings, 25 poultry, 5 ducks Backyard poultry: 31 birds		CropS: paddy, vegetables, coconut + orange + fodder, arecanut + black pepper, vegetables on the pond dykes Cattle: 3 cows + 2 calves Fish + poultry + duck rearing: 200 fingerlings, 13 poultry, 7 ducks Backyard poultry: 21 birds	

MFS I - Hills; MFS II - Slopping hilly upland; MFS III - Medium upland valley; MFS IV - Lowlying valley

on business was 29% that gives 36% of the earnings. The expenditure on agriculture includes creation of ponds/well, construction of animal's shed and purchase of seeds. The expenditure on health services was nil as it is available free of cost through primary health centers (except in MFS II-Model 2 and MFS IV). Other expenditures include education, nutrition, clothing, social events and transportation. The personal saving (ranges from 2 to 27 %) was highest in MFS II - Model 2 (Fig. 2), where plantation and commercial crops like sugarcane, ginger, floriculture and other components were present. In MFS III, only 2% savings stated by the business people appears to be incorrect. In general, study suggests that IFS, if adopted properly with investment on agriculture, has improved the personal savings and wealth of farmers.

CROP DIVERSIFICATION THROUGH BROAD BED AND FURROW (BBF) BASED FARMING SYSTEM IN VALLEY AREAS OF BAY ISLANDS

N. Ravisankar, R. Raja, M. Din, R.C. Srivastava, P. Krishnan S. Ghoshal Chaudhuri, T. Damodaran and S.N. Sethi

Information on paddy varieties, their yield and economics were collected from three villages namely Chouldari, Port Mout and Indiranagar. Cropping systems for beds and furrows of BBF system were evaluated in the research farm.

Plate 12. General view of BBF

Yield, cropping intensity and economics of paddy in farmers field

C 14-8, Jaya and Krishna Hamsa are the paddy varieties cultivated by the farmers (Table 10).

Plate 13. Cowpea (bed) + Rice (furrow)

Among these varieties, Jaya recorded highest yield followed by Krishna Hamsa. C14-8 recorded the lowest yield of 1999 kg. The cropping intensity in the lowlying areas where paddy is grown is only 100%. The net returns

was highest for Jaya (Rs.12890 ha^{-1}) followed by Krishna Hamsa. C 14-8 recorded the lowest returns and B:C ratio.

Evaluation of cropping systems for beds and furrows

Eight cropping systems viz., ladies finger-amaranthus-coriander-amaranthus-amaranthus; amaranthus-cowpea - groundnut-amaranthus; radish-chillies; crossandra; bittergourd-cauliflower-ladies finger; pumpkin/ bottlegourd-cabbage-cowpea; cowpea-brinjal and cucumber-

Plate 14. Chillies (bed) + Groundnut (furrow)

spinach-coriander were evaluated in the beds of BBF system (Table 11). All crops performed well except gourds. Chilli recorded an extremely good yield of 9156 kg from 4000 m^2 area. Cropping intensity was the highest in ladiesfinger-amaranthus-coriander-amaranthus-amaranthus (500%). The cultivated land utilization index (CLUI) was highest for crossandra (1.0) due to its presence in the land throughout the year. Bittergourd-cauliflower-ladies finger and radish-chillies recorded higher CLUI of 0.73 and 0.72, respectively. In terms of economics, radish-chillies recorded the highest net return of Rs 189486 ha^{-1} (B:C ratio: 6.9) followed by ladies finger-amaranthus-coriander-amaranthus-amaranthus of Rs 92480 ha^{-1} (B:C ratio: 2.5) under BBF system. Crossandra also recorded high B:C ratio of 2.9.

In the furrows, four cropping systems i.e., rice-ratoon + azolla + fish; maize; black gram and table purpose groundnut were evaluated (Table 12). Rice-ratoon (azolla + fish: singhi and magur) and groundnut recorded higher production. The cropping intensity was 300% in all the systems. CLUI was higher for sequence involving maize. Maximum net return of Rs. 8595 with B:C ratio of 1.6 has been obtained from the above sequence.

Plate 15. Crossandra flowers

The economic analysis of BBF system suggests that a net return of Rs. 198081 ha^{-1}

can be obtained from radish-chillies on the beds and rice-ratoon(azolla + fish: singhi and magur)-groundnut in the furrows. The B:C ratio of lowlying paddy land can be enhanced from <1 to 3.8 through crop diversification by adopting BBF. Further, BBF increases cropping intensity from 100% to 300-500 % on the beds and 300 % in the furrows.

Fish culture

In the furrows of BBF system, the maximum weight attained by catla, rohu and mirgal was 263, 134 and 56 g, respectively during the 6 months culture period whereas singhi and magur attained the average weight of 65 and 80 g, respectively without any supplementary feeding. The total production of catla, rohu and mirgal from 10 furrows of BBF (1 ha) was 73 and 78 kg. Similarly, singhi and magur recorded a production of 25 to 45 kg respectively from 10 furrows, which clearly indicates the compatibility of these fishes with rice+azolla+fish system in the furrows.

Plate 16. Harvested Cat fish

Table 10 . Paddy variety, yield and economics in the farmers field

Farmer (Location)	Variety and duration (days)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Net returns (Rs ha^{-1})	B:C ratio
Sh. Sri Singh (Chouldari)	C 14-8 (201)	2451	3063	1155	0.1
	Jaya (123)	4798	6813	12890	1.2
	Krishna Hamsa (120)	4114	5842	9472	0.9
Sh. Kashinath Saha (Port Mout)	C14-8 (177)	3535	4419	6577	0.6
	Jaya (150)	4167	3917	9733	0.9
Shri Muthaiah (Indiranagar)	C14-8 (150)	1999	2838	1994	0.2

Table 11. Cropping sequence, intensity, yield and economics of 10 beds (4000 m²)

Sequence (Intensity,%)	Season	Yield (kg)	CLUI	Gross returns (Rs)	Net returns (Rs)	B:C ratio
CS 1 (500)						
Ladies finger	July - Oct	1823	0.67	130092	92480	2.5
Amaranthus	Oct - Nov	1748				
Coriander	Dec - Feb	333				
Amaranthus	Feb - Mar	1852				
Amaranthus	May - Jun	2643				
CS 2 (400)						
Amaranthus	July - Sept	1666	0.70	82794	53842	2.0
Cowpea	Oct - Dec	1298				
Groundnut	Jan - April	1551				
Amaranthus	May - Jun	2643				
CS 3 (200)						
Radish	July - Sept	323	0.72	209886	189486	6.9
Chillies	Oct - June	9156				
CS 4 (100)						
Crossandra	July - June	371	1.00	27825	20625	2.9
CS 5 (300)						
Bittergourd	July - Oct	10	0.73	50496	20954	1.5
Cauliflower	Nov - Feb	2366				
Ladies finger	Feb - June	1832				
CS 6 (300)						
Pumpkin	July – Oct	173	0.59	87288	51694	0.9
Bottlegourd	July – Oct	348				
Cabbage	Dec – Feb	5128				
Cowpea	Feb – May	1625				
CS 7 (200)						
Cowpea	July - Oct	978	0.66	41892	21500	1.0
Brinjal	Oct - May	2513				
CS 8 (200)						
Cucumber	July - Oct	2028	0.27	44388	30128	2.1
Spinach	Dec - Feb	1671				
Coriander	Feb	-				

Table 12. Yield and cropping intensity in furrows (6000 m²)

Cropping Sequence (intensity %)	Season	Yield (kg/ 6000m²)	CLUI *	Gross returns (Rs)	Net returns (Rs)	B:C ratio
CS 1 (300)						
Rice + Azolla	June-Oct	1333	0.71	21580	7180	1.50
Rice ratoon +Azolla	Oct-Dec	25				
Groundnut	Jan-Apr	652				
Fish: Singhi + Magur	Jul-Mar	25				
CS 2 (300)						
Rice + Azolla	June-Oct	1000	0.71	22995	8595	1.60
Rice ratoon + Azolla	Oct-Dec	25				
Groundnut	Jan-Apr	736				
Fish: Singhi + Magur	Jul-Mar	45				
CS 3 (300)						
Rice + Azolla	June-Oct	667	0.93	13288	2688	1.25
Rice ratoon + Azolla	Oct-Dec	12.50				
Maize	Dec-Apr	443				
Fish: Catla, Rohu, Mrigal	Jul-Mar	78				
CS 4 (300)						
Paddy + Azolla	June-Oct	700	0.71	14820	20	1.03
Ratoon + Azolla	Oct-Dec	18				
Groundnut	Jan-Apr	306				
Fish: Catla, Rohu, Mrigal	Jul- Mar	73				

*CLUI - Cultivated land utilization index

PERFORMANCE EVALUATION OF TABLE PURPOSE GROUNDNUT VARIETIES IN A&N ISLANDS

N. Ravisankar, S. Ghoshal Chaudhuri, R. Raja and R. C. Srivastava

Eleven table purpose varieties (TAG 24 (Bombay), SG 99, ICGS 76, TG 26, TG 37 A, GPBD 4, TAG 24 (Junagadh), ICGV 86015, ICGV00350, ICGS44 and ICGV9114) of Groundnut from NRCG, Junagadh, BARC, Trombay & ICRISAT, Hyderabad were tested for its yield potential in rice fallow. The experiment was conducted in randomized

Plate 17. General view of plot

block design with three replications. Groundnut was raised as rice fallow crop with four irrigations and mulching with paddy straw from 30 DAS.

Yield parameters

The results revealed that number pods / plant were not significantly influenced by the different varieties. However, maximum number of pods were recorded from TG 26 (28.9) followed by GPBD 4 (28.3). The weight of the pods and nuts are the important characters of table purpose groundnut varieties. SG 99 registered significantly higher 100 pod weight (246.4 g) and nut weight /plant (62.2 g) followed by TG 37A and ICGS 76. TAG 24 (Junagadh) registered the least 100 pod weight. The shelling per cent was maximum with ICGV91114 (99 %) which is comparable to that of ICGS 76 and SG 99.

Plate 18. Nuts of SG 99

Yield

Pod and haulm yield was significantly influenced by the varieties of groundnut. ICGV 86015 had registered significantly higher dry pod yield of 2788 kg /ha followed by GPBD 4 (Table 13). Bold varieties suitable for table purpose viz., SG 99, TG 37A & ICGS 76 also registered higher yield of 1733, 1627 & 1627 kg /ha respectively. Similar trend was observed for haulm yield also. Around 1.6 t of dry pods can be harvested from the rice fallow residual groundnut.

Plate 19. Nuts of TG 37 A

Economics

Cost of cultivation of groundnut was estimated to Rs. 13000 ha^{-1}. Owing to

higher yield registered by ICGV 86015, the same variety recorded higher net return of Rs. 42760 ha^{-1}. Bold seeded varieties *viz.*, SG 99, ICGS 76, TG 37A and GPBD 4 also recorded net returns to the tune of Rs. 19540 to 22980 ha^{-1}. On an average, Rs. 19245 ha^{-1} can be obtained from groundnut with a B:C ratio of 1.48. Thus, it can be concluded that, groundnut can be grown as a profitable crop in rice fallow with minimum number of irrigations and mulching practices.

Table 13. Performance evaluation of groundnut varieties

Varieties	No of pods Plant^{-1}	100 pod weight (g)	Nut weight (g plant^{-1})	Pod yield (kg ha^{-1})	Shelling (%)	Net returns (Rs.)	B:C ratio
TAG 24 (Bombay)	18.9	155.6	29.5	1310	86.1	13200	1.0
SG99	25.7	246.4	62.2	1733	87.2	21660	1.7
ICGS 76	19.7	202.2	48.3	1627	93.7	19540	1.5
TG26	28.9	139.7	35.2	952	77.1	6040	0.5
TG37A	27.0	186.6	55.8	1627	82.0	19540	1.5
GPBD 4	28.3	168.6	28.5	1799	89.4	22980	1.8
TAG 24 (Juna)	21.5	58.4	34.3	1521	84.4	17420	1.3
ICGV 86015	16.4	170.2	23.2	2788	84.0	42760	3.3
ICGV00350	13.0	191.2	26.8	1797	88.0	22940	1.8
ICGS44	13.8	185.4	32.6	1475	78.0	16500	1.3
ICGV91114	18.0	194.6	24.8	1106	99.0	9120	0.7
Mean	21.0	172.6	36.5	1612	86.3	19245	1.5
SEd	4.7	24.1	7.4	317	4.0	-	-
CD (*P=0.05*)	9.8	50.3	15.4	662	8.4	-	-
CV (%)	27.4	17.1	24.8	24.10	5.7	-	-

EVALUATION OF AGROBOOM (ORGANIC LIQUID MANURE) FOR VEGETABLES

N. Ravisankar and Babu Lal Meena

Two experiments in randomized block design with six treatments and four replications in each involving liquid manure (Krishi Sanjeevani) as seed, soil and foliar application along with organics and without organics have been conducted to study on the growth and yield of vegetables (ladies finger, cv. Arka Anamika; chillies, cv. Arka Lohit and tomato, cv. Khusi) (Table 14). Ladies finger and tomato reached up to

maturity. The results revealed that liquid manure with farm yard manure lead to increase in growth and yield of Bhendi compared to without farmyard manure where in increase in yield was not significant. Combined effect of seed treatment + soil application + foliar spray with farmyard manure (FYM) had significantly increased the yield per plant over control and 100% recommended dose (29 and 24 % respectively). Seed treatment of liquid manure with FYM led to higher yield of 122 g plant^{-1}. Effect of liquid manure on ladies finger was more tangible than chillies and tomato.

Plate 20. Seed + Soil + Foliar treated Bhendi

Table 14. Effect of liquid manure on growth parameters and yield of ladies finger

Treatments	Plant height (cm)		No. of fruits		Yield (g plant^{-1})	
	With OM	Without OM	With OM	Without OM	With OM	Without OM
Control (T_1)	41.1	40.4	6	7	69.7	85.7
Seed treatment with LM (T_2)	46.6	31.2	9	7	122.0	90.1
Soil application with LM (T_3)	46.7	34.1	6	7	72.5	73.1
Foliar spray with LM (T_4)	45.0	31.4	-	6	-	75.2
$T_2 + T_3 + T_4$	56.1	33.6	6	7	90.0	101.9
100 % RD of N (T_5)	47.2	33.6	5	6	72.3	74.4
SEd	1.5	1.3	1	1	3.2	3.3
CD (*P=0.05*)	3.3	2.7	3	NS	6.8	6.9
CV (%)	16.2	18.4	12.6	18.7	19.3	20.4

OM: Organic manure (FYM), LM: Liquid manure, RD: Recommended dose.

EFFECT OF SUPPLEMENTAL IRRIGATION ON CROP YIELD AND WATER USE EFFICIENCY IN RICE BASED CROPPING SYSTEM OF A&N ISLANDS

R. Raja, S. Ghoshal Chaudhuri, Babu Lal Meena, M. Din and Subhash Chand

In order to increase the cropping intensity and productivity of rainfed lowland rice ecosystem, an attempt was made to optimize the supplemental irrigation (SI) schedule at critical growth stages for different crops during post monsoon

season. Field trials for different SI schedules (I_0: No irrigation, I_1: One, I_2: Two, I_3: Three, I_4: Four irrigations and I_5: Farmers practice of irrigating as and when required) in the main plots and crops (maize (*Zea mays*), green gram (*Vigna radiata*), sesamum (*Sesamum indicum*), ladies finger (*Abelmoschus esculentus*) and chillies (*Capsicum annuum*)) in the sub plots with three replications were conducted in the rice fallows at Field Crop Research Farm. Crops were sown in the first fortnight of December 2006 after the harvest of rice crop. Supplemental irrigation of 5 cm depth was provided at critical crop growth stages (Table 15).

Table 15. Supplemental irrigation schedule at different growth stages of crop

Crop	Supplemental Irrigation levels				
	I_1	I_2	I_3	I_4	I_5
Maize	TI	TI, GF	KHS, TI, GF	KHS, TI, Early GF, M	Eight irrigations
Green gram	F	F, PS	Pre-F (25 DAS), F, PS	Pre-F, F, Early PS, Early M	Six irrigations
Sesamum	F	F, PS	4-5 leaf stage (25 DAS), F, PS	4-5 leaf stage, F, Early PS, Early M	Six irrigations
Ladies finger	F	F, FF	EVS, F, FF	EVS, F, FF-1, FF-2	Twelve irrigations
Chillies	F	F, FF	EVS, F, FF	EVS, F, FF-1, FF-2	Twelve irrigations

TI- Tassel initiation; F- Flowering; GF: Grain filling; PS- Pod setting; FF- Fruit formation; KHS- Knee high stage; EVS- Early vegetative stage; M- Maturity

SI had significant effect on the yield and economics of post monsoon crops (Table 16). In maize, though SI has not achieved on par yield with that of I_5 (3472 kg ha^{-1}), I_4 has resulted in acceptable yield (3151 kg ha^{-1}) with 4 SI. The percent yield increase over I_0 due to supplemental irrigation was 65, 99, 152, 161 and 188 in I_1, I_2, I_3, I_4 and I_5, respectively. In case of green gram, SI at flowering and pod setting has resulted in on par yield (720 kg ha^{-1}) with that of I_5 (824 kg ha^{-1}), I_4 (811 kg ha^{-1}) and I_3 (787 kg ha^{-1}), and significantly higher yield and economic returns than that of I_0 (488 kg ha^{-1}). This indicates that green gram can be raised as a dry season crop with two supplemental irrigations there by 48% yield increase over I_0 can be achieved. In case of sesamum, SI at 4-5 leaf stage, flowering and pod setting (I_3) has registered on par yield (829 kg ha^{-1}) with that of I_5 (895 kg ha^{-1}) and significantly higher yield than I_2, I_1 and I_0. Treatments I_1 and I_2 has also produced

significantly higher yield over I_0. In case of vegetables, the yield increase by applying 4 irrigations (I_4) at critical growth stages was comparable (5751 kg ha^{-1} for ladies finger and 2083 kg ha^{-1} for chilli), though not on par, with that of farmers practice (I_5) of applying 12 irrigations (6433 kg ha^{-1}for ladies finger and 2415 kg ha^{-1} for chilli).

Table 16. Effect of supplemental irrigation on crop yield

Irrigation level	Yield (kg ha^{-1})*				
	Maize	Green gram	Sesamum	Ladies finger	Chillies
I_0	1207	488	516	1639	497
I_1	1988	615	678	2241	964
I_2	2406	720	724	3355	1431
I_3	3039	787	829	4024	1752
I_4	3151	811	873	5751	2083
I_5	3472	824	895	6433	2415
SEd	142.3	54.5	63.7	253.5	128.4
CD *(P=0.05)*	317.6	121.4	142.9	565.7	286.1

* Average yield of maize, green gram and sesamum are reported at 0% moisture level while the yield of ladies finger and chillies are reported as weight of the fresh harvested produce

The results revealed that SI could increase the crop yield with lesser irrigation water usage and in turn increase the profitability (Table 17) and water productivity (Table 17a).

Table 17. Economics of supplemental irrigation for different crops

Crops	Net returns (Rs ha^{-1})					
	I_0	I_1	I_2	I_3	I_4	I_5
Maize	7,557 (2.05)	13,818 (2.44)	18,201 (2.82)	24,808 (3.38)	25,916 (3.41)	29,968 (3.60)
Green gram	6,798 (2.26)	8,702 (2.30)	11,113 (2.61)	12,467 (2.73)	12,853 (2.73)	12,750 (2.62)
Sesamum	8,035 (2.65)	11,237 (2.97)	12,173 (3.05)	14,370 (3.26)	15,149 (3.27)	15,164 (3.10)
Ladies finger	20,841 (2.04)	21,502 (1.62)	48,603 (2.38)	64,686 (2.80)	1,07,433 (3.96)	1,23,199 (4.27)
Chillies	4,660 (1.23)	13,458 (1.39)	35,738 (2.00)	51,467 (2.42)	67,589 (2.85)	82,798 (3.18)

The data in the parenthesis indicates output : input ratio

Table 17a. Water productivity (kg/m³) of crops for different SI levels

Irrigation level	Maize		Green gram		Sesame		Ladies finger		Chillies	
	TWP*	GIWP**	TWP	GIWP	TWP	GIWP	TWP	GIWP	TWP	GIWP
I_1	2.36	1.56	0.73	0.25	0.80	0.32	2.66	1.20	1.14	0.93
I_2	1.79	1.20	0.54	0.23	0.54	0.21	2.50	1.72	1.06	0.93
I_3	1.65	1.22	0.43	0.20	0.45	0.21	2.18	1.59	0.95	0.84
I_4	1.34	0.97	0.35	0.16	0.37	0.18	2.45	2.06	0.89	0.79
I_5	0.80	0.57	0.25	0.10	0.27	0.13	1.01	0.80	0.38	0.32

* TWP is taken as the ratio of irrigated yield to total water supply (rainfall: 34.4 mm + SI)
** GIWP is taken as the ratio of increase in yield (over control) to the gross depth of SI

Plate 21. a) I_3 Maize b) I_2 Green gram c) I_3 Sesamum d) I_4 Ladies finger

AGRO TECHNIQUES FOR KALMEGH UNDER ISLAND CONDITIONS

R. Raja, N. Ravisankar, T. P. Swarnam, S. Ghoshal Chaudhuri and R. P. Medhi

Kalmegh (*Andrographis paniculata*), a wonder drug of traditional Siddha and Ayurvedic medicine system with high demand in both national and international markets, has high potential for cultivation in Bay Islands. Confirmatory trials were carried out during 2006-07. *Kalmegh* grows luxuriantly during dry season under irrigated condition and produced higher dry biomass yield (which is the economic yield as well) than wet season. This was mainly due to the more availability of bright sunshine to the crop during dry season and more cloudiness during wet season. The dry season crop requires 4-5 irrigations to produce good yield whereas fairly distributed rainfall is sufficient during wet season. Closer planting of 45 x 30 cm yielded more biomass (3562 kg ha^{-1} in dry season and 1555 kg ha^{-1} in wet season) (Table 18) than wider spacing of 60 x 45 cm (2868 kg ha^{-1} in dry season and 1438 kg ha^{-1} in wet season) which may be due to the optimum planting density.

Table 18. Growth and yield attributes of kalmegh at harvest and net returns during wet and dry season

Treatments	Plant height (cm)		Leaf area (cm^2)		DMP (kg ha^{-1})		Net returns (Rs. ha^{-1})	
	W '06	D '07	W'06	D '07	W'06	D '07	W'06	D '07
Cropping situation								
C_1: Cropping under open space	55.7	-	1371	-	1655	-	16,683	-
C_2: Cropping under shade	57.1	-	982	-	1339	-	10,363	-
SEd	1.2	-	21.4	-	41.5	-	-	-
CD (P=0.05)	NS	-	52.3	-	101.4	-	-	-
Spacing								
S_1: 60 x 45 cm	54.6	63.2	1126	2698	1438	2868	12,343	37,507
S_2: 45 x 30 cm	57.8	69.9	1227	2884	1555	3562	14,683	51,387
SEd	1.2	2.76	21.4	10.8	41.5	163.5	-	-
CD (P=0.05)	2.9	5.85	52.3	46.4	101.4	584.5	-	-

Treatments	Plant height (cm)		Leaf area (cm^2)		DMP (kg ha^{-1})		Net returns (Rs. ha^{-1})	
	W '06	D '07	W'06	D '07	W'06	D '07	W'06	D '07
Nutrient level (Through organic source only)								
M_1:Control (No FYM)	51.4	57.7	1056	2314	1250	2296	20,013	38,567
M_2:FYM @12.5 t ha^{-1}	56.9	71.5	1198	2902	1574	3480	15,063	49,747
M_3:FYM @25 t ha^{-1}	60.2	72.1	1276	3157	1667	3665	4,423	40,947
SEd	1.8	2.90	17.9	25.6	32.3	128.1	-	-
CD (P=0.05)	3.9	6.69	38.1	58.9	68.6	295.2	-	-

W: wet season, D: Dry season * Due to lack of irrigation facility, kalmegh crop was not raised under shade during dry season

Application of farm yard manure (FYM @25 t ha^{-1}) has produced higher dry matter yield (1667 kg ha^{-1}) than FYM application @12.5 t ha^{-1} (1574 kg ha^{-1}) and no FYM (1250 kg ha^{-1}) during wet season. In dry season, application of FYM @12.5 t ha^{-1} has produced yield (3480 kg ha^{-1}) on par with that of FYM application @25 t ha^{-1} (3665 kg ha^{-1}). During wet season, FYM application @25 t ha^{-1} has resulted in taller plant with more leaf area and dry matter production. This may be due to the higher incessant rainfall received during the wet season, which let to the soil compaction under control conditions (no FYM application) which in turn resulted in poor soil condition compared to FYM applied plots. In addition during wet season, FYM application also overcomes the phosphorus deficiency, which were observed during the early vegetative growth stage in plots where FYM was not applied. Hence, in order to get higher biomass yield and net returns under Island conditions, *kalmegh* should be grown during dry season under irrigated condition with 45 x 30 cm spacing along with basal application of FYM @ 12.5 t ha^{-1}.

Plate 22 (a) Dry season and (b) Wet season crop of *Kalmegh*

PERFORMANCE EVALUATION OF DIFFERENT STRUCTURES OF PROTECTED CULTIVATION IN THE HUMID TROPICS OF BAY ISLANDS

M. Din, P.S. Deshmukh, R.C. Srivastava, N. Ravisankar, D.R. Singh, Krishna Kumar and Subhash Chand

Vegetable production in open field is constrained due to heavy rains in eight months and water shortage in four months. The greenhouses are ineffective due to high temperature. Keeping the problems in view, survey of existing greenhouses constructed at CARI and farmer's field was undertaken. Besides, observation on solar radiation, ambient temperature, relative humidity and greenhouse room air temperature were also recorded.

A type (even span type greenhouse)

This type is suitable for composite climate. The cooling system includes forced convection, evaporative cooling, shading nets and misting in the greenhouse to maintain the required temperature for higher production. At no load, inside and outside temperatures of greenhouse ranged from 30-52 ^{o}C and 22^{o}C to 35^{o}C, respectively during February and March as high solar radiation of 1173 W m^{-2} at 11 AM during February 2006 and 1100 W m^{-2} at 12 noon in March 2007 was observed (Fig 3 & 4). Because of high inside temperature (> 35^{o}C), greenhouse are unsuitable for plant growth, flowering and fruiting. It also leads to occurrence of fungal diseases inside the greenhouse mainly due to the poor air exchange rate between outside and inside greenhouse and high humidity. Due to recurrent rainfall, algae growth was also observed over the FRP sheet in existing greenhouse that reduces the transmittance of solar radiation.

"B type" greenhouse covered with nets

Two greenhouses constructed by a progressive farmer were surveyed. These greenhouses were covered with a plastic film on the top and insect proof nets on the sidewalls. High value crops like broccoli, capsicum and leafy vegetables were grown using sprinkler irrigation system. In these greenhouses, the temperature varied from 29-39 ^{o}C and relative humidity was > 65%. In case of high temperature (>35 ^{o}C) inside the greenhouse, misting method was used for cooling and reducing the temperature inside the greenhouse. Broccoli and capsicum registered higher yield.

Modified low cost greenhouse

In this type, north and south roof was covered with FRP plain sheet or double layered UV stabilized 250m transparent polyethylene sheets and there is no provision of cooling arrangement like forced convection, evaporative cooling and misting. The roof provided in the greenhouse is protected from soil erosion. Heat and mass transfer will be

through natural convection only. All four sides of greenhouse were covered with plastic coated GI wire mesh to avoid the damage from giant snails, birds, dogs and animals. In this modified low cost greenhouse, air temperature varied from 27-35°C (1 °C higher than existing) and humidity ranged from 40-60 % (23 % lower than existing) (Fig 5). The modified system does not require the cost of two-exhaust fan, shading nets, cooling system and humidity control system reducing cost up to 60 %. It is suitable for both wet and dry seasons.

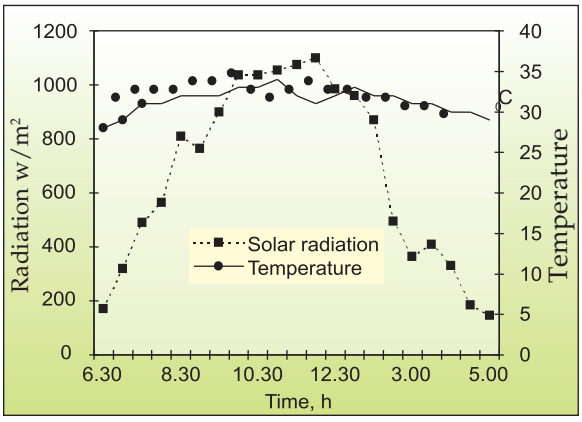


Fig 4. Solar radiation and temperature during March 2007

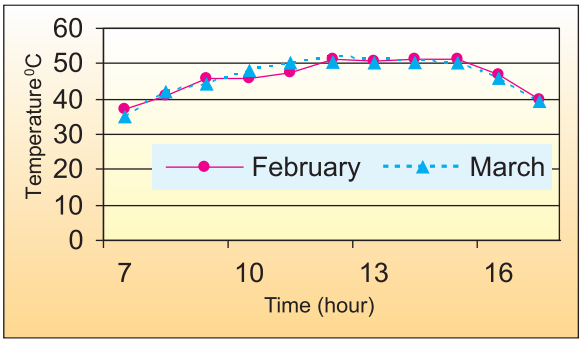


Fig 3. Hourly variation of air temperature (°C) inside 'A' type green house with cooling and misting

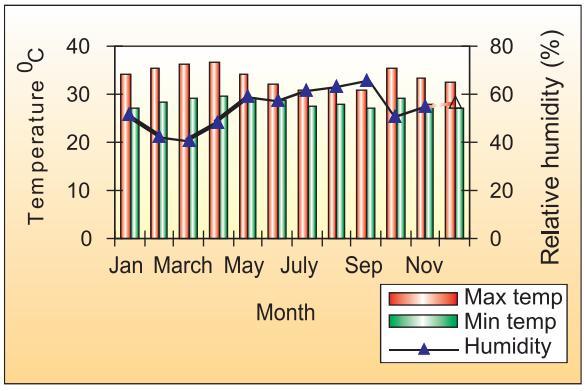


Fig 5. Temperature and RH variation in low cost modified green house with out cooling and misting

VALUE ADDITION TO HORTICULTURAL CROPS AND FISHERIES PRODUCTS THROUGH APPLICATION OF RENEWABLE AND NON-RENEWABLE ENERGY SOURCES

M. Din, P.S. Deshmukh, R.C. Srivastava, N. Ravisankar, Grinson George and M. Balakrishnan

Under this project, solar dryer and biomass dryer have been designed and developed for efficient utilization of renewable sources like solar and biomass energy.

Design of solar dryer

A roof type even span greenhouse solar dryer with mild steel frame having floor area

of 2.4 x 1.2 m^2 was designed and constructed for drying of farm commodities. It was covered with transparent FRP sheet. The orientation of the dryer was in East-West direction and top cover was inclined at 28^0 in order to get maximum penetration of solar radiation. Nine drying trays, each tray having the size 0.72 x .086 m^2 were provided. Three doors have been provided for loading and unloading the materials. The moist air from the drying chamber exits through two air vents (0.3 x 0.3 m^2) located at the north and south roof of the drying chamber for natural convection. Wire mesh having the height of 0.1 m at the drying floor has been provided along the length and width. The total aperture area was 0.53 m^2. Blackened aluminum corrugated sheets were kept at bottom to absorb maximum solar radiation. Arrangement for opening the sheet was made from north side for easy loading and unloading of the materials. For hygienic and ergonomic reasons, the dryer stands on a 0.7 m angle iron plinth.

Performance of solar dryer

Coconut, black pepper, mushroom, green chillies, jack fruit pulp and fish were dried in the dryer. The performance of the solar dryer was compared with traditional open air sun drying during January to April when solar radiation availability is good. The solar radiation varied between 20-1200 W m^{-2}. Drying characteristic for different products under solar and open sun drying are shown in Fig 6 & 7. It is clear that moisture content decreases with increasing drying time. The drying rate was higher in case of solar dryer than that in open sun drying for each product. It is evident from figures that different products have different drying characteristic curves. The critical moisture content in drying rate curves at specific drying times of all dried products is given in Table 19. It is clear that solar drier saved considerable time for drying of all the farm products.

Table 19. Critical moisture content in drying rate curves at specific drying times

Product	Critical moisture content (dry wet basis)	Time (h) (New model) type solar dryer	Time (h) (Open sun drying)	Time (h) Mechanical dryer
Coconut	5.7	32	40	16
Black paper	4.8	24	28	-
Green chilli	5	22	28	-
Jack fruit	7	26	34	-
Mushroom	2.9	16	22	-
Fish	8.6	24	32	14

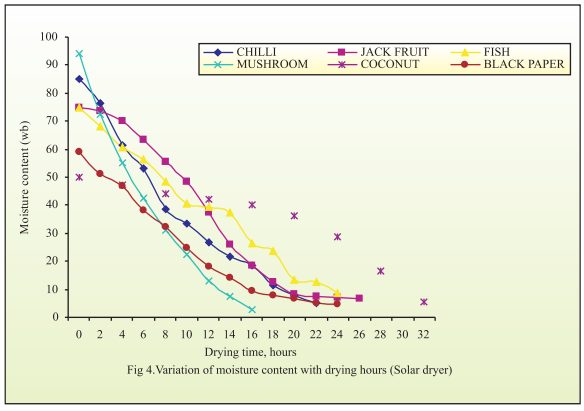


Fig 6. Influence of solar dryer drying on moisture content and drying hours

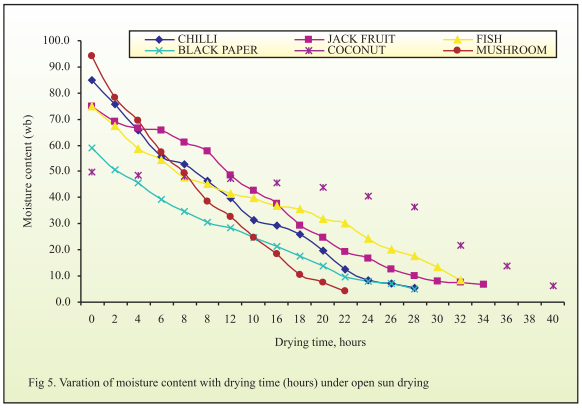


Fig 7. Influence of open sun drying on moisture content and drying hours

Prototype design and development of biomass fired dryer

A mechanical dryer with capacity of 1000 coconuts per batch was designed and fabricated using MS frame (2.4 m x 1.2 m x 1.7 m). The drying bed made of M.S bar grill at a height of 1.20 m above the ground level. The combustion chamber (2.5 m diameter) is made of 2 mm thick M.S. sheet. Two heat exchangers (10 cm diameter) made of galvanized pipes have been connected at

Plate 23. Biomass fired dryer

upper and lower side with combustion and drying chambers. A door is provided for loading and unloading of fuel. Four wheels have been provided at the base for mobility.

Drying (moisture content from 50% to 5.7%) of 1000 coconuts took 16 hrs with 50 kg of coconut shell. Split coconut halves are kept upwards to facilitate easy removal of moisture and to prevent discolouration. The kernel cups were separated from the shells after 8-10 hrs of heating. The drying of fish required about 14 hrs to reduce moisture from 75 % to 8.6% (wb) as compared to 32 hrs under open sun.

Development and evaluation of a pedal operated coconut dehusker

Traditionally, dehusking is done with a tool called *sabbal* that can be operated only by skilled persons as risk involved is more. In order to reduce the drudgery and risk involved in dehusking, a pedal operated coconut dehusker was developed. It has a

flat bracket made of 30 x 50 cm MS angle for fixing at the ground. The main assembly of dehusker comprised of fixed cutting blade (passive) and turning cutting blade (active). Passive blade (8 x 3 x 0.5 cm) is welded at the top of inner side pipe having 31.75 mm diameter whereas active blade is connected to pedal operated mechanism. When force is exerted on the pedal, the active blade will turn in front side and dehusk coconut. Active cutting blade reaches at original position due to spring fixed pedal part to base frame, when foot is lifted from the pedal part. The weight of the dehsuker is 10 kg.

Plate 24. Pedal operated coconut dehusker

The performance of pedal operated dehusker, KAU dehusker and local tool was evaluated with different size of nuts at 10.5% moisture content. A total of 500 nuts were tested per tool. The dehusking of coconut was done by unskilled persons with pedal operated coconut dehusker, KAU hand operated dehusker and local tool. Observations on time requirement for dehusking, qualitative assessment of comfort and safety of the operator were taken on ten persons. The dehusking capacity of dehusker was 119, 68 and 170 nuts/hr respectively for CARI pedal operated, KAU hand operated dehusker and local tool 'sabbal'. In case of KAU dehusker, number of operation required for dehusking a nut was more as compared to pedal operated coconut dehusker. Also short height of dehusker made the operator to feel stress in his/her abdominal portion. The bending stress was more in local tool 'sabbal' followed by KAU and pedal operated dehusker as KAU dehusker's height is shorter than CARI deshusker. In case of CARI deshusker the height can be adjusted as per operator's requirement. Hence in a straight standing posture, the operator was dehusking the nuts. It was observed that the bending cycle stress / pain was experienced after dehusking of 80-90 nuts by 'sabbal', 110-120 nuts by KAU and 140-150 nuts by pedal operated due to picking up of nuts at ground. The traditional local tool 'sabbal' can only be operated by the skilled person. The over all performance of pedal operated dehusker was found to be satisfactory as compared to KAU dehusker and traditional method of dehusking tool. Ergonomically designed pedal operated coconut dehusker, its easiness and safety in operation was preferred by both farmers and farm women.

ADOPTION OF IMPROVED IMPLEMENTS FOR RICE BASED FARMING IN ANDAMAN AND NICOBAR ISLANDS

M. Din, P. S. Deshmukh and N. Ravisankar

Field experiments were conducted during the wet season of 2006 at Field Crops Research Farm, Bloomsdale. Four tillage methods (i) tractor with cage wheel without cultivator twice puddling; (ii) tractor with cage wheel and peg type puddler twice puddling;(iii) tractor with cage wheel and cultivator twice puddling and (iv) power tiller rotavator with angle iron type cage wheel twice puddling; and three planting methods (transplanting by CIAE design manual transplanter, Line transplanting (20 x 20 cm) and transplanting by SRI method (25 x 25 cm) were tested in split plot design with three replications.

Labour and time

Labour required for paddy cultivation and time required for transplanting was significantly influenced by tillage and planting methods (Table 20). Tractor with cage wheel and peg type puddler registered less number of labour (95 mandays/ha), which is at par with tractor with cage wheel (98 man days/ha). Similarly mechanical transplanter required significantly less labour (94 man days/ha) compared to line sowing transplanting (120 mandays/ha) and SRI method (118 mandays/ha).

Tractor with cage wheel had consumed significantly lower time for planting (21 mandays/ha) compared to other tillage methods. CIAE mechanical transplanter required only 13 man-days/ha followed by SRI method (26 mandays/ha). Mechanical transplanter plants the seedlings in a row thus reducing time consumption for planting, line making which might be the cause for lower time under mechanical methods.

Growth and yield parameters

Power tiller rotavator with lugged type cage wheel registered significantly taller plants (114 cm) compared to other tillage methods. Similarly number of tiller/m^2 also higher with tractor with cage wheel, which is at par with power tiller rotavator. No. of hills/m^2 was not influenced method of tillage. SRI method recorded significantly taller plants (111.75 cm) compared to manual and mechanical transplanting. The number of hills remained almost same with all the planting methods as the spacing adopted was same. Ability of younger seedlings in SRI to absorb nutrients and growth might have helped for better growth and yield parameters under SRI method compared to line sowing and mechanical transplanting.

Yield

Among the tillage methods, power tiller rotavator with angle iron type cage wheel recoded significantly higher grain yield of 4694 kg/ha (Table 20) followed by tractor with cage wheel and cultivator. Other two

Table 20. Labour requirement for transplanting, yield, net returns and energetic of paddy influenced by tillage and planting methods

Treatment	Transplanting (man days ha^{-1})	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Net return, (Rs ha^{-1})	Energy ratio	Specific energy (MJ ha^{-1})
Tractor with cage wheel	21	1854	1428	1610	1.94	13.76
Tractor with cage wheel and peg type puddler	25	2092	1606	3174	2.49	9.94
Tractor with cage wheel and cultivator	24	3341	2619	9887	3.58	6.96
Power tiller with angle iron type cage wheel	26	4694	2314	16055	5.17	4.93
SEd	2	243	165	1265	0.25	0.51
CD (P = 0.05)	4	595	403	3094	0.62	1.25
CIAE manual transplanter	13	2542	1757	5263	2.86	10.08
Line transplanting	32	2938	1924	6891	3.16	9.56
Transplanting by SRI method	26	3505	2294	10890	3.87	7.05
SEd	3	209	172	1107	0.24	0.636
CD (P = 0.05)	5	209	365	2345	0.51	1.35

tillage operations done with tractor cage wheel and peg type puddler recorded significantly lower yield. Among the planting methods, SRI method of planting led to significantly higher yield of 3505 kg/ha followed by line transplanting and mechanical planting. Higher yield under SRI method is attributed to planting of young single seedlings, square planting (25 ´ 25cm), cono-weeding once in 10 days from 20 to 50 days after planting, which in turn led to more number of productive tillers per unit area. Similar trend was observed for straw yield and harvest index.

Economics

Owing to higher grain yield, power tiller rotavator with angle iron type cage wheel recorded significantly higher gross return (Rs. 24858/ha), net return (Rs. 16055/ha) and B:C ratio (1.83). Tractor with cage wheel and cultivator also recorded better returns and B:C ratio compared to tractor with cage wheel and peg type puddler. Significantly higher gross returns (Rs. 18901/ha) net returns (Rs. 10890/ha) and B:C ratio (1.34) was recorded under SRI method of planting compared to line and mechanical transplanting.

Energetic

Input energy was lesser with tractor with cage wheel and peg type puddler compared to other method of tillage operations. However output energy and energy ratio was significantly higher with power tiller rotavator with angle iron type cage wheel followed by tractor with cage wheel and cultivator. Higher energy ratio was due to the higher output energy resulting from higher grain yield and straw yield. Energy required to produce one kg of grain is low with power tiller rotavator with angle iron type cage wheel which is positive factor in energy saving. Similarly mechanical and SRI planting method had lower input energy and higher output energy resulting in efficient conversion of energy. Owing to high grain and straw yield in SRI method, energy ratio (3.87) was also higher in comparison to line planting and mechanical planting. Specific energy (7.05 MJ/kg) was also significantly lesser with SRI method than line sowing (9.56 MJ/kg)) and mechanical planting (10.08 MJ/kg). It may be attributed to higher output energy with respect to unit quantity of input energy.

Plate 25. Puddling tractor with cage wheel

Plate 26, Puddling with power rotary tiller

Energy intensive operation was seedbed preparation (Table 21) and its share was found to be maximum in all treatments. Labour required for seedbed preparation was less in Tractor with cage wheel and peg type puddler. Transplanting of paddy and threshing required lower energy when

tillage was done with tractor with cage wheel. Effect of tillage on energy requirement of different operations in paddy is clearly established.

Table 21. Operation wise energy requirements for paddy as influenced by tillage operations

Operations	Tractor with cage wheel (MJ ha^{-1})	Tractor with cage wheel and peg type puddler (MJ ha^{-1})	Tractor with cage wheel and cultivator (MJ ha^{-1})	Power tiller with lugged type wheel (MJ ha^{-1})
Seed bed preparation	6986 (77.4)	4043 (66.5)	6379 (74.1)	5148 (65.3)
Transplanting of paddy	326 (3.6)	392 (6.5)	380 (4.4)	414 (5.3)
Fertilizer application	37 (0.4)	37 (0.6)	37 (0.4)	37 (0.5)
Intercultural operation and plant protection	953 (10.6)	946 (15.6)	953 (11.1)	1506 (19.1)
Harvesting	387 (4.3)	302 (5.0)	463 (5.4)	329 (4.2)
Threshing	216 (2.4)	241 (4.0)	280 (3.3)	330 (4.2)
Post harvest activities	120 (1.3)	120 (2.0)	120 (1.4)	120 (1.5)
Total	9025	6081	8612	7884

Figure in parenthesis indicates % of total value

Testing of animal drawn puddlers at farmers field

Among animal drawn puddlers, rectangular blade puddler required less time (0.11 ha hr^{-1}). To reduce drudgery seating arrangement was also made on this puddler. The Deshi plough required maximum time for puddling operation (0.018 ha hr^{-1}) among all tested puddlers. Drudgery in puddling operation was reduced due to seat arrangement at puddler and worked for longer duration. It has increased the efficiency of human and animal by 10-15%.

Plate 27. Demonstration on thresher at farmer's field

Design, development and testing of Conoweeder

One prototype of paddy conoweeder was designed, and was tested at Bloomsdale farm. The average field capacity of the new weeder was 0.06 ha hr^{-1}. Its field capacity was ten

times higher as compared to traditional method of hand weeding. The weeding index was 90.2% for newly developed weeder. Thus, conoweeder saves labour, time, energy and reduces drudgery in operation.

Demonstration on thresher

Farmers are doing threshing operation by animal treading or beating the paddy on stone/wooden plank. Demonstration of electric operated thresher was arranged at farmer's field in Calicut village. Farmers used paddy thresher for the first time and showed their keen interest for purchasing the same as it saved the time, labour and energy. The output capacity of thresher ranged from 157-183 kg hr^{-1}.

STUDIES ON EFFECTIVE STORAGE OF WATER IN PONDS

P. S. Deshmukh, R.C. Srivastava and M. Din

In order to ensure the effective storage in dug out ponds by applying different lining treatments, study on effective storage of water in ponds was started in the backdrop of water scarcity during post monsoon period in the Islands. Eight treatments *viz.*, IIT-Delhi developed lining material with and without cement concrete (CC) tiles, LDPE sheet (250 m) with and without CC tiles, Silpaulin, pre-casted cement concrete, mud block and unlined as control. The layout of the experimental set up at Sippighat is depicted in Fig. 8. The storage capacity of each pond is 73.19 m^3.

The area of each pond is 8m x 8 m with dimensions at the top 6.7 m x 6.7 m, bottom 2 m x 2 m, depth 2.35 m, bund width 0.6 m with slope of 1:1.

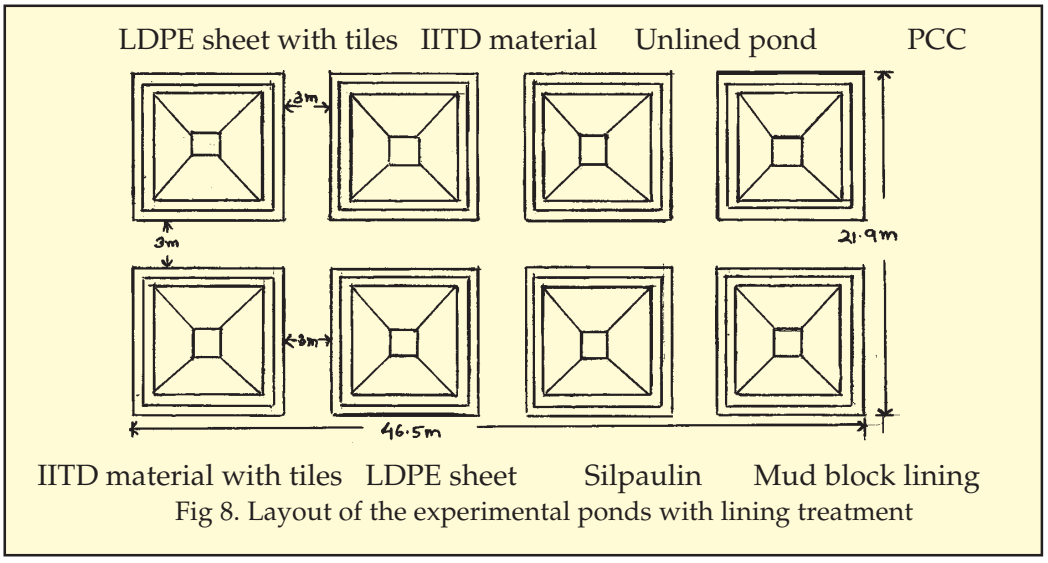


Fig 8. Layout of the experimental ponds with lining treatment

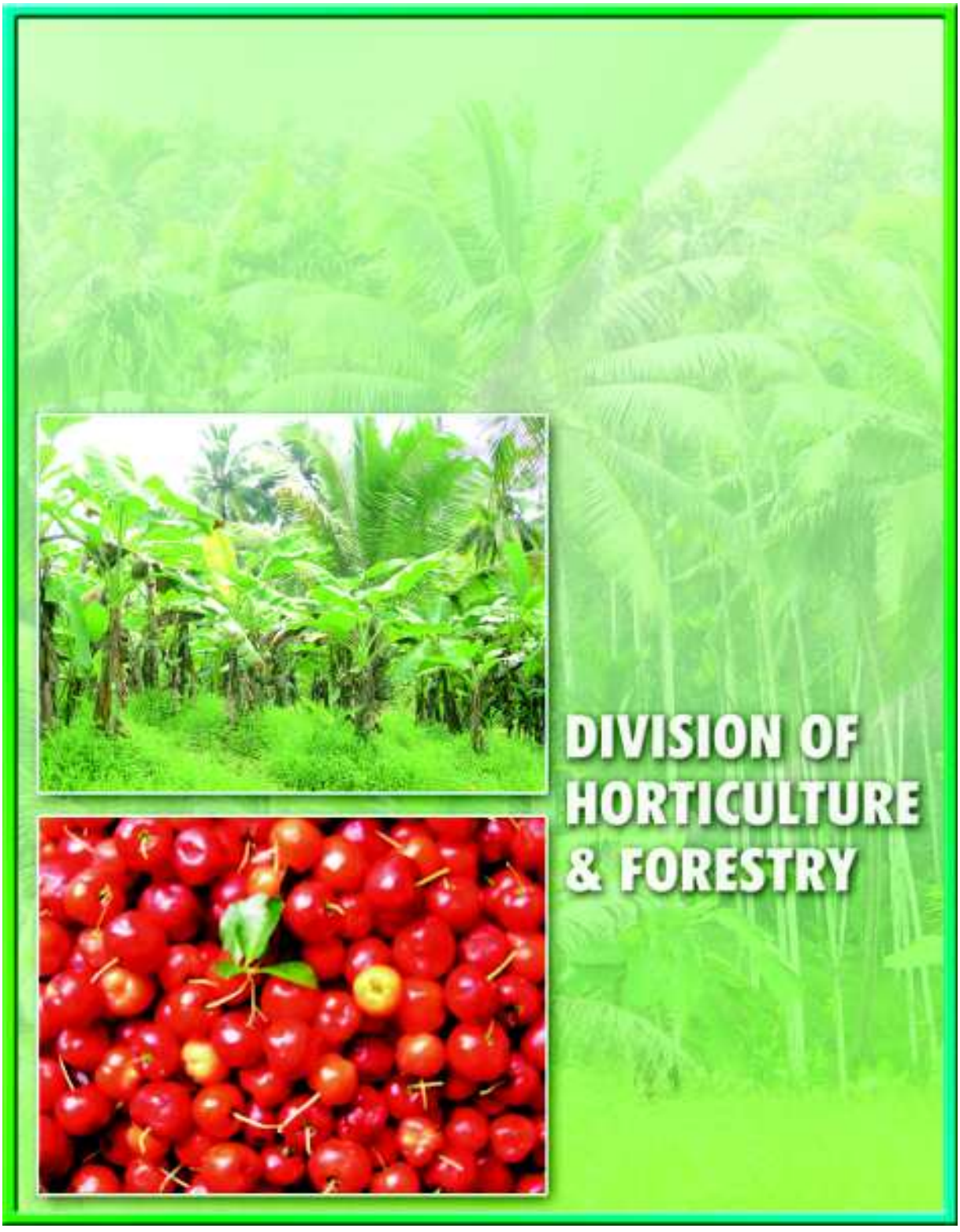
IMPACT OF POST TSUNAMI AGRICULTURE MECHANISATION INPUTS ON PROFITABILITY OF FARMERS IN SOUTH ANDAMAN

P.S. Deshmukh, M. Din, R.C. Srivastava and Subhash Chand

In the post tsunami period, mechanization inputs like power tiller, diesel engine pumpsets, small hand tools and sprayers were distributed to the affected farmers under agricultural rehabilitation programme. In order to study the impact of mechanization inputs on farm profitability, a survey was initiated. The survey has been conducted in the Tsunami affected villages of Mithakhari, Chouldhari, Guptapara and Manjeri. The selection of the villages and farmers was done on the basis of inputs on availability of mechanization. The farmers had been given a power tiller or pumpset and a set of hand tools and sprayer. The data showed that the farmers were very much in need of the farm machineries. In general, power tillers helped in restoring the rice production in the available cultivated area by accelerating the tillage operations. All the farmers stressed for proper training of the versatile use of power tiller. The pump sets were used for irrigation of the vegetables along with other uses like propelling boats, hullers and electricity generator.

Post tsunami, as a part of the agricultural rehabilitation programme, mechanisation inputs like power tiller, diesel engine pump sets, small hand tools and sprayers were distributed to the affected farmers. It was felt that the impact of these inputs on the farmers should be quantified. Hence this survey-based project is taken up. Questionnaires for survey of farmers have been prepared for primary collection of data on mechanisation inputs from the farmers from the identified villages of South Andaman. The survey work using the questionnaires has been started by visiting the villages of Mithakhari, Chouldhari, Guptapara and Manjeri. The selection of the villages and farmers was done on the basis of mechanisation inputs availability. The farmers were given 1 no of power tiller or pumpset, one set of hand tools and one sprayer. The partially collected data showed that the farmers were very much in need of the mechanisation inputs. Particularly power tillers helped in restoring the rice production from the available cultivable area by accelerating the tillage operations. Out of the 20 farmers, 70% farmers are puddling paddy fields twice for cultivation and 55% farmers saved time in the range of 20-30 h per ha with

power tiller. More than 16 farmers did not know driving of power tiller, were not satisfied with quality of power tiller and have no easy availability of spare parts and repair. More than 50% are not making versatile use of power tiller. All the farmers stressed for the proper training of the versatile use of power tiller. The pump sets were used for irrigation of the vegetables, along with other uses like propelling boats, hullers and electricity generator. 50% farmers were satisfied with pumpset, but more than 13 farmers were not having easy availability of spare parts and repair service and not making the versatile use. 75 % were satisfied with the quality of hand tools, but says it could be given in more numbers.


DIVISION OF
HORTICULTURE
& FORESTRY

VARIETAL EVALUATION AND STANDARDIZATION OF AGROTECHNIQUES IN TROPICAL FRUITS

T.Damodaran, D.R.Singh and V.Jayakumar

Banana

Biochemical and molecular characterization of *Musa* sp. in Bay Islands

The cultivated bananas are collected from two different locations (CARI germplasm block and villages of South Andaman) for assessing their genetic diversity and relatedness. The peroxidase, polyphenoloxidase and phenylalanineamnonvalyase content were observed in the two different locations of cultivated banana species. The PO and PPO content showed distinct differentiation between the varieties collected from two different locations. This shows the influence of environment in changing the enzymatic activity of the varieties (Fig 1).

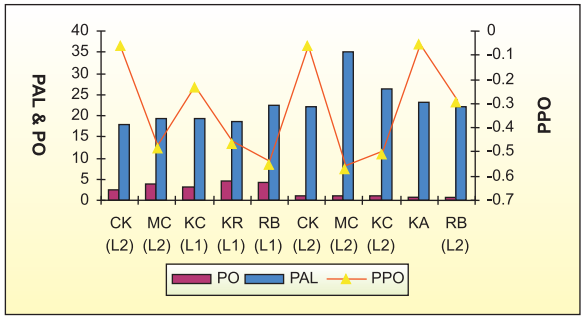


Fig 1. Assay of enzymes in characterization

Molecular characterization of banana using RAPD markers

Of the 50 RAPD primers screened, only 25 were amplified and among them 5 primers did not show sufficient variability to distinguish the banana varieties used in the initial screening. The dendrogram (Fig 2.) of the banana varieties constructed using 50 RAPD markers revealed wide diversity among the varieties ranging from 5% to 32% similarity among themselves. The similar varieties collected from location 1 and location 2 were separated distinctly based on the locations. All the varieties showed similarity between the same location rather than the genome. This shows that under the Island ecosystem the influence of environment is more than the genotype. This could be attributed to a slow genetic drift facilitated by the entirely different weather conditions prevailing in the Andaman and Nicobar Islands, their isolated nature and the inter and intra-breeding of local wild *M. balbisiana* types.

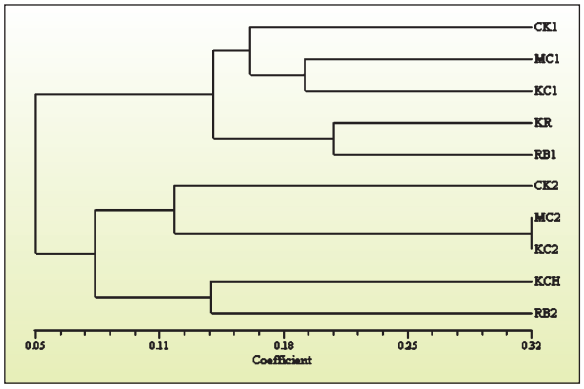


Fig 2. Dendrogram illustrating the characterization of Banana

CK-Cheena kela; MC-Meeta champa; KC- Katta champa; KR- Korangi; RB-Red banana

Mango

Identification of Open Pollinated Mango Clones of Andaman & Nicobar Islands and Analysis of Genetic Variations Using RAPD Markers

Early and differentially flowering mango clones were collected from different locations of the South Andaman Islands and analysed for variability using RAPD markers. Eighteen mango clones (*Mangifera indica* Linn.) including fourteen from Andaman and four from Tamil Nadu were examined for genetic diversity using 60 RAPD primers. Of the 60 primers screened, 15 primers gave polymorphic DNA amplification patterns. The number of bands generated ranged from 8 - 5 per primer (Fig 3 & 4). Similarity coefficients were calculated based on 57 selected bands and UPGMA clustering (Fig 5) analysis was performed. Six local clones were found to be related closely with four clones from South India.

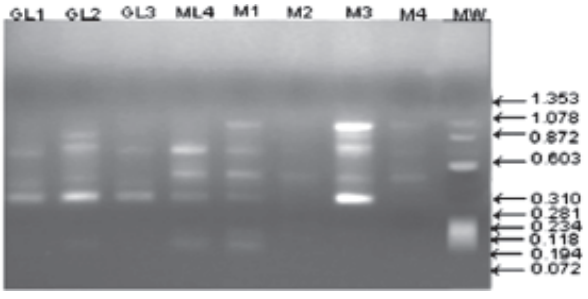


Fig 3. PCR-amplified genomic DNA of mango clones using OPF 3 random primer, Lanes MW – 500 bp DNA ladder

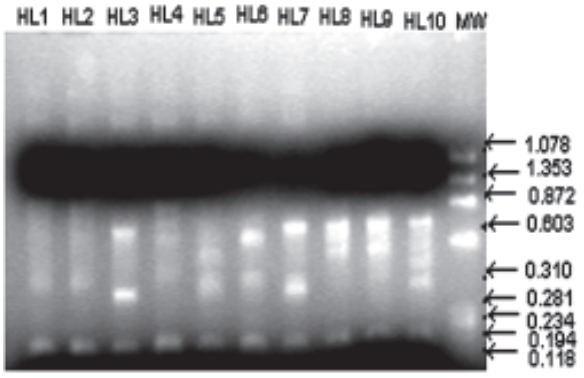


Fig 4. PCR-amplified genomic DNA of mango clones in Havelock Islands using OPF 3 random primer, Lanes MW - 500 bp DNA ladder

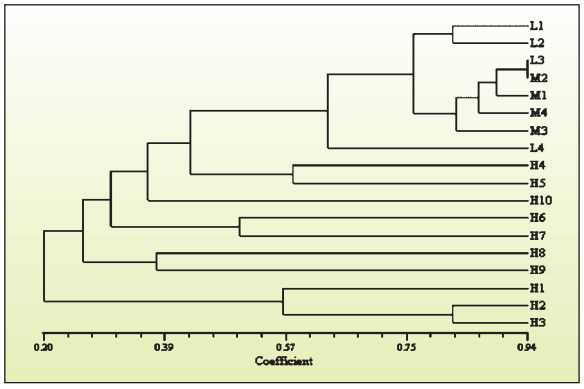


Fig 5. UPGMA dendrogram showing genetic relationships with in 18 varieties of *Mangifera spp,.* (L1 – GL1; L2 – GL2; L3- GL3; L4- ML4; H1- HL1; H2- HL2; H3- HL3, H4- HL4, H5- HL5; H6-HL6; H7-HL7; H8- HL8; H9-HL9; H10-HL10)

The remaining eight clones were classified into four groups based on the dendrogram. Our analysis also separated the differentially flowering polyembryonic local clones with single flowering monoembryonic ones. Thus if these are selected using marker aided selection and mass multiplied they can result

in export of mango early in the January to the Indian market to have a unchallenged price.

Biochemical characterization on flowering behaviour of wild mangoes of Bay Islands

The peroxidase, polyphenoloxidase and phenylalanineannonialyase content were observed in the three wild *Mangifera* species and two cultivated genotypes. The PO and PPO content was lower in wild *Mangifera* species when compared to cultivated types while the PAL content was higher in the wild than the cultivated ones. The higher PPO content in the cultivated species showed the involment in inducing regular bearing while the lower content of PO and PPO in the wild species established the fact that they are occasional and shy bearers. The role of PAL in incorporating resistance to biotic and abiotic stress in the wild genotypes is found (Fig 6).

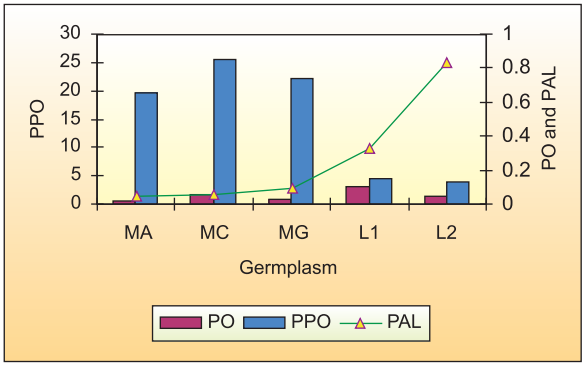


Fig 6. Assay of enzymes in characterization

Collection and evaluation of papaya

Four local accessions of papaya were collected for their yield and were evaluated with the controls i.e. Solo and Co-5. The local accessions GL-1 and GL-2 exhibited higher yield and quality characters (Table 1) when compared with the mainland collections. The homozygous seeds are further being subjected to stability analysis.

Table 1. Performance of papaya varieties based on their qualitative characters

Var. /Acc.	Length(cm)	Girth (cm)	TSS%	Total sugars%	Weight (kg)
GL-1	28.66[a]	49.33[a]	11.13	12.33	2.26[a]
GL-2	24.66[a]	41.00[a]	11.66	11.83	2.31[a]
Solo	10.00[b]	16.33[b]	12.33	12.50	0.25[b]
CO-5	25.66[c]	32.00[c]	12.00	11.00	1.40[c]
GL-3	10.33[b]	22.00[b]	12.50	12.33	0.27[b]
GL-4	26.33[c]	42.66[d]	11.66	11.00	1.53[c]
CD (0.05)	4.33	5.99	1.60	1.57	0.29
SEd	1.94	2.70	0.72	0.70	0.13

IMPROVEMENT AND STANDARDIZATION OF AGRO TECHNIQUES OF VEGETABLE CROPS

T. Damodaran, D.R. Singh and V. Damodaran

Cowpea

Thirteen varieties of cowpea were evaluated. Among the varieties, Sweta (pole type) recorded the highest yield of 112.6 q/ha followed by Indira Hari (bush type), which recorded the yield of 107.5 q/ha (Table 2).

French beans

Eleven varieties of French beans were evaluated. Among the varieties Contender, IIHR-909 and Arka Anoop were found to be promising one for Island conditions, which recorded the yield of 116, 112.5 and 96 Q/ha, respectively.

Chilli

Twenty eight varieties were evaluated and among the varieties the most susceptible lines for bacterial wilt was discarded from the trial at initial stage. Only eight varieties were retained for the study. The result revealed that the varieties *viz* F_1 hybrid, Arka Lohit, LCA-353, Indira Chilli-1and HDC-75 registered the

Table 2. Performance of cowpea varieties

Variety	Plant height (cm)	Days to 50% flowering	Colour of pods	Length of pod (cm)	Crop duration (days)	Yield (q/ha)
Indra Lal	282.0	50	Red	26.60	80	91.97
Swarna Harita	264.5	48	Green	54.26	73	95.98
Sweta	272.2	50	White	34.00	84	112.65
Vanita	146.6	51	White	71.66	80	83.33
VR-5	79.8	45	Green	26.43	67	55.55
Arya Vaibha Laxmi	131.0	48	Green	26.27	73	77.58
HACP-3	264.5	53	White	36.76	84	67.16
Indira Hari	106.9	47	Green	12.80	73	107.50
IVRCP-3	100.8	42	Light green	27.75	67	75.10
IVRCP-4	68.2	42	Green	27.70	63	52.47
Lola	280.0	63	Light green	47.96	84	24.30
Vayjanthi	286.6	67	Red	47.00	102	32.40
Arka Garima (Control)	254.3	60	Light white	24.46	89	41.00
CD (0.05)	9.00	NS		2.18	NS	10.04

cent per cent survival against the bacterial wilt. With regard to yield, the variety LCA-353 was found to be promising with a yield of 298 Q/ha followed by the variety Arka Lohit, which recorded the yield of 257.5 Q/ha (Table 3).

Brinjal

Twenty five varieties were evaluated for yield and resistance to bacterial wilt. Recommended cultural practices were followed in time pest and diseases were monitored. Among the varieties evaluated, most of the varieties were found highly susceptible to bacterial wilt disease. However the varieties, viz. PB-61 and HABR-5, hybrid runako, Kasi Ganesh, HABL-1 and PB-60 exhibited cent percent survival against bacterial wilt. Regarding the yield, the variety PB-69 recorded the highest yield of 132 Q/ha followed by PB-60 (124 Q/ha).

Table 3. Performance of Chilli varieties

Varieties	Plant height (cm)	Survival % against bacterial wilt	Days to 50 % flowering	No. of fruits/ plant	Single plant yield (g)	Yield (q/ha)
F_1 hybrid	97.1	91.7	85	53.3	901.6	190.0
Arkha Lohit	126.2	100.0	88	214.6	618.3	257.5
LCA-353	105.6	100.0	90	253.6	760.0	298.0
Indira chilli-1	94.8	100.0	95	122.6	331.6	138.0
PC-7	95.8	87.5	90	124.0	618.3	214.0
HDC-75	127.2	87.5	82	123.0	641.6	211.0
HSHP-154	73.7	83.3	78	74.0	315.0	66.2
LCA-206 (C)	95.5	87.5	91	136.0	460.0	78.5

IMPROVEMENT AND MANAGEMENT OF COCONUT AND ARECANUT

T. Damodaran and V. Damodaran

Morphological and yield parameters recorded on arecanut varieties (20 year old) revealed that the variety Samrudhi (Table 4) recorded the highest number of nuts (815 no) per tree followed by Mangala (614). Similarly the dry weight of challi /nut was also the highest in Samrudhi (3.50g) whereas the variety Cal-31 recorded the least weight of challi (2.3g).

Table 4. Performance of arecanut varieties (2006-07)

Variety	Plant height	Grith of stems	No. of inter-nodes	No. of leaves	No. of bunch-es	Total No. of nuts	Bunch wt (kg)7	Dry wt. / fruit (g)	Wt. of husk / fruit (g)	Wt. of challi (g)
Mangala	841.66	44.66	9.66	9.66	3.33	614.00	14.86	20.56	11.60	2.53
Samrudhi	715.00	46.00	7.33	9.33	3.33	815.00	16.80	23.23	12.80	3.50
Calicut 31	786.66	46.00	7.00	8.66	2.66	430.00	11.80	14.30	8.46	2.30
Calicut 35	826.66	38.33	7.00	8.66	2.33	319.33	9.03	15.23	9.86	3.10
CD (0.05%)	39.85	2.28	1.10	1.29	1.15	27.77	0.83	3.19	4.66	0.55
SEd	16.29	0.93	0.45	0.53	0.47	11.35	0.34	1.30	1.90	0.23

TREE-SOIL-CROP INTERACTIONS IN AGROFORESTRY PRACTICES IN THE ANDAMAN AND NICOBAR ISLANDS

C.B. Pandey

Soil N mineralization under high rainfall regime of Andaman

The present study was designed to examine the effect of high rainfall on net nitrification, net ammonification, and microbial biomass C in soils under different land use systems (moist evergreen forest, semi evergreen forest and homegarden). Treatment included 12 incessant rainfall and 9 dry spells between rainfalls. Soils in all the land use systems

Table 5. Physico - chemical characters of the soils under different land use systems at South Andaman Island of India.

Land use systems	*Soil texture				Bulk density (g cc^{-3})	Organic C mg g^{-1}	Total N mg g^{-1}	C/N ratio	Total P mg g^{-1}	pH
	Gravel (%)	Sand (%)	Silt (%)	Clay (%)						
Most evergreen forests	6.54^{a}	90.23^{b}	2.22^{a}	1.01^{a}	0.98^{a}	23.57^{a}	1.12^{a}	21.04^{a}	0.012^{a}	5.67^{a}
Semi evergreen	8.25	88.54^{ab}	2.21^{a}	1.00^{a}	0.93^{a}	20.10^{b}	1.24^{ca}	16.26^{b}	0.013^{a}	6.54^{b}
Home garden	10.05^{c}	86.73^{ac}	2.20^{a}	1.02^{a}	0.96^{a}	21.20^{b}	1.30^{b}	20.67^{a}	0.014^{b}	6.01^{ab}

* Gravel (>4mm), sand (0.2-0.02mm), silt (0.02-0.002mm), clay (<0.002mm)

were gravely-sandy-loamy in texture and slightly acidic in reaction (Table 5). Bulk density did not differ among the land use systems. C/ N ratio, ranging from 16 to 21, was the lowest in the semi-evergreen forest and the highest in the moist evergreen forest ecosystem. It indicates that evergreen forests are conservative in nature.

Water filled pore space (WFPS) in the soils varied significantly due to the rainfall conditions (incessant and dry spell) ($P<0.0001$) in all the land use systems. However, it did not differ due to the land use systems. Across the land use systems, it ranged from 68 to 84 % during the incessant rainfall and 25 to 47 % during the dry spells (Fig 7a). The WFPS was always more than 1.5 times higher during the incessant rainfall compared to that during the dry spell in all the land use systems.

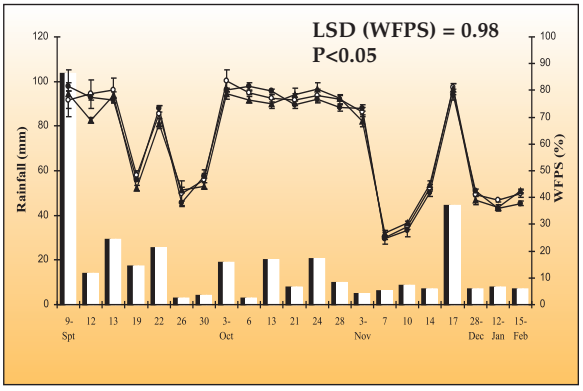


Fig 7a.

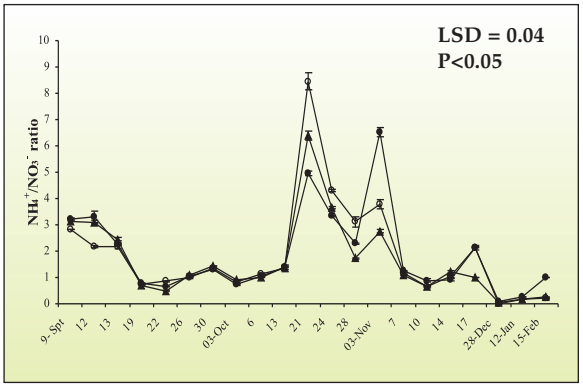


Fig 7b.

Ammonium N pool in the soils was affected due to the land use systems ($P< 0.0001$) and rainfall conditions ($P< 0.0001$). It ranged from 2 to 14 µg g^{-1} in the moist evergreen forest, 2 to 17 µg g^{-1} in semi-evergreen forest and 4 to 14 µg g^{-1} in homegarden. Ammonium N pool, averaged across the sampling dates, was nearly equal between the forest types, but it was 13 % higher in the homegarden compared to that in the forests. It was 1.4 to 1.8 times higher during the incessant rainfall compared to that during the dry spell ($P<0.05$) in all the land use systems. The ammonium N pool was positively correlated with the WFPS in the moist evergreen forest ($r = 0.453$, $P< 0.05$), semi-evergreen forest ($r = 0.498$, $P<0.02$) and homegarden ($r = 0.486$, $P<0.02$). The NH_4^+-N, pooled across the land use systems, was also positively correlated with the WFPS (Fig. 8). Nitrate N pool, ranging from 2 to 86 µg g^{-1} in the moist evergreen forest, 2 to 86 µg g^{-1} in semi-evergreen forest and 3 to 74 µg g^{-1} in homegarden, was influenced significantly due to the rainfall conditions ($P<0.0001$). The NO_3^--N, pooled across the land use systems, was inversely related with the WFPS ($r = -0.324$, $P < 0.005$). It was 2 to 3 times higher during the dry spell compared to that during the incessant rainfall. Moreover, the difference was the highest in the semi-evergreen forest and the lowest in

the moist evergreen forest. Across the land use systems, NH_4^+ / NO_3^- ratio during the incessant rainfall was found more than 3 times higher compared to that during the dry spells (Fig 7b.).

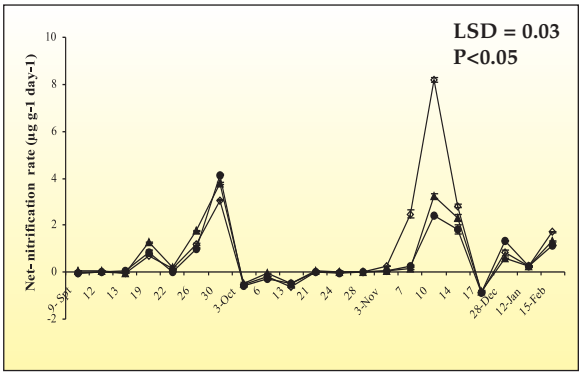


Fig 7c.

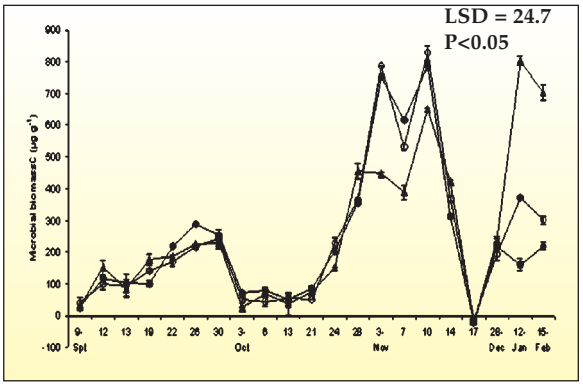


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Fig 7d.

Fig 7(a). Variation in water filled pore space (WFPS), (b) NH4+ / NO3- ratio, (c), net-nitrification rate and (d), microbial biomass C in soils under homegarden (— •—), moist evergreen forest (— ▲—) and semi evergreen forest (— o—) during incessant rainfall (Sept. 9, 12, 13, 22; Oct. 3,6, 13, 21, 24, 28; Nov. 3, 17) and dry spell events (Sept. 19, 26, 30; Nov. 7, 10, 14; Dec. 28; Jan 12; Feb. 15) at South Andaman island of India. Bars represent ±1SE.

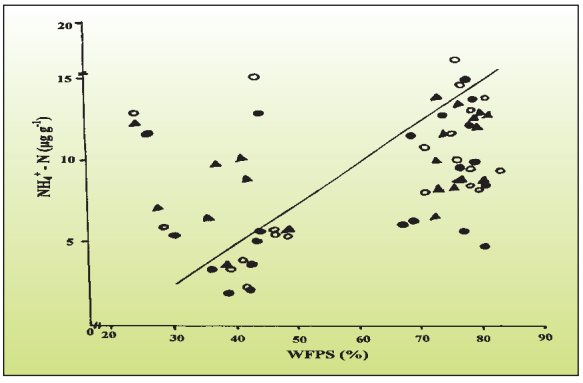


Fig 8. Relationship between NH_4^+-N (Y, µg g^{-1}) and water filled pore space (WFPS) (X, %): Y = -82.1299 + 1.5038 X), (r^2 = 0.2187, P<0.001, N= 63), across homegarden, moist evergreen forest and semi evergreen forest at South Andaman. Symbols are same as in Fig 9.

Net nitrification rate was influenced by the rainfall conditions (P<0.0001), land use systems (P <0.001) and their interactions (P< 0.05). Across the rainfall conditions, the nitrification rate ranged from -0.8 to 8.2 µg $g^{-1}d^{-1}$ in the moist evergreen forest, -0.9 to 8.2 µg g^{-1} d^{-1} in semi-evergreen forest and -0.6 to 4.1 µg g^{-1} d^{-1} in homegarden (Fig 7c.). The net nitrification rate, across the land use systems, was 8-15 times lower during the incessant rainfall compared to that during in the dry spell. However, during the incessant rainfall, it declined to the level that did not differ among the land use systems (P <0.05). During the dry spell it was the highest in the semi-evergreen forest and the lowest in homegarden. The net nitrification rate was inversely correlated with the WFPS in the moist evergreen forest (r = -0.668, P < 0.001), semi-evergreen forest (r = -0.717, P < 0.0001) and homegarden (r = -0.641, P < 0.002). Net nitrification rate, pooled across the land use

systems, was also inversely related with the WFPS (r = -0.654, P < 0.0001). Net ammonification rate, like the net nitrification, was also affected due to the rainfall conditions (P<0.0001) and the land use systems (P<0.0001). However, unlike the latter, it tended to increase with the WFPS in the semi-evergreen forest and homegarden, but the increase was insignificant. Across the land use systems also the ammonification rate was positively correlated with the WFPS, but the relation was weak (r = 0.11, P<0.30, N = 61). Net nitrification rate contributed maximum (68- 94 %) to net N mineralization rate, therefore, the former is used for further discussion.

Microbial biomass C, ranging from -18 to 803 µg g^{-1} in the moist evergreen forest, -11 to 786 µg g^{-1} in semi-evergreen forest and -22 to 786 µg g^{-1} in homegarden, differed significantly due to the rainfall conditions (P<0.0001) (Fig 7d.). The microbial biomass C in all the land use systems declined simultaneously with decline in the rate of net nitrification during the incessant rainfall, and increased simultaneous with the increase in the latter during the dry spells (Figs 9 c., d.). During the dry spells it was the highest in the evergreen forest and the lowest in the homegarden. The microbial biomass C (Y, µg g^{-1}) was positively correlated with the net nitrification rate (X, µg g^{-1} d^{-1}) in the moist evergreen ($Y = 212 + 242 X - 56 X^2$, r = 0.422, P< 0.05) and semi- evergreen forests ($Y = 169.2 + 93.5 X - 1.9 X^2$, r = 0.690, P< 0.001). However, this relation was weak in the homegarden.

Pooled across the land use systems, the microbial biomass C showed a quadratic relation with the net nitrification rate (Fig 9.)

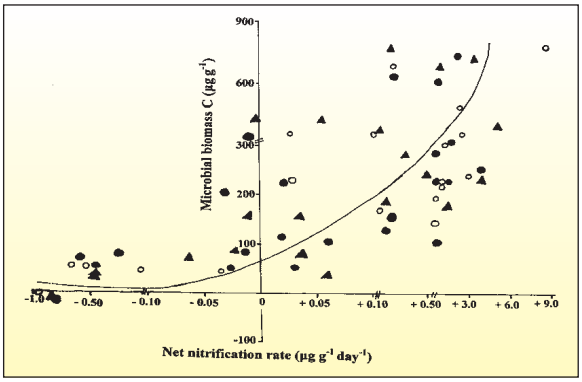


Fig 9. Relationship between microbial biomass C (Y, µg g^{-1}) and net nitrification rate (X, µg g^{-1} day^{-1}): $Y = 191.3 + 102.5 x - 4.76 x^2$, ($r^2 = 0.259$, P <0.001, N = 63), across home garden, moist evergreen forest and semi evergreen forest at South Andaman. Symbols are same as in Fig 8.

Phosphorus availability under different soil water regimes in humid tropical climate of Andaman

Phosphorus is derived mostly from the weathering of parent rock material, but plant litter plays an important role in its cycling. It is observed that litter turnover in the humid tropical climate of Andaman is annual. It is mainly because of the termite activity. Population of termites grows quickly during dry spells between high rainfalls and decomposes the litters quickly and releases phosphorus. Available P and microbial biomass P were estimated in native soils and termite soils under evergreen forest, semi evergreen forest and homegarden (Table 6). Both available

phosphorus as well as microbial biomass P varied due to the land use systems. Available P was 19 to 20 % higher in the termite soil compared to that in the native soils. However, this difference was the highest in the semi evergreen forest and lowest in the homegarden. Like the available P, microbial biomass P was also 24 to 32 % higher in the termite soils compared to that in the native soils. Moreover, the difference was the highest in the evergreen forest and the lowest in the homegarden.

Table 6. Available phosphorus and microbial biomass P in native and termite soil under different land use systems

Land use	Available phosphorus(μg g^{-1})		Microbial biomass P(μg g^{-1})	
	Native soil	Termite soil	Native soil	Termite soil
Evergreen Forest	^{a} 0.971 ^{a}	^{b} 1.157 ^{a}	^{a} 25.87 ^{a}	^{b} 34.21 ^{a}
Semi evergreen Forest	^{a} 0.679 ^{b}	^{b} 0.813 ^{b}	^{a} 22.65 ^{b}	^{b} 29.75 ^{b}
Homegarden	^{a} 1.068 ^{c}	^{b} 1.267 ^{c}	^{a} 25.01 ^{a}	^{b} 30.89 ^{c}

- Superscript prefixed with different letters in a row is significant at $P < 0.05$
- Superscript suffixed with different letters in a column is significant at $P < 0.05$

To know the role of rainfall in phosphorus availability in the humid tropics, available P was estimated in the soils sampled from evergreen forest, semi evergreen forest and homegarden under different water saturated soil regimes, which is estimated as a function of water filled pore space. Water filled pore space ranged from 25 to 81 % in the evergreen forest 24 to 84 % in semi-evergreen forest and 25 to 81 % in homegarden. Available phosphorus was found positively correlated with WFPS in all the land use systems (r = 0.86 to 091, P<001) (Fig 10). This indicates that high rainfall perhaps makes soil anaerobic which reduces redox potential of the soil and thus makes the phosphorus mobile. Greater availability of phosphorus during the higher WFPS could also be due to increase in permanent charge and cation retention which led to less sorption of phosphate and increased mobility.

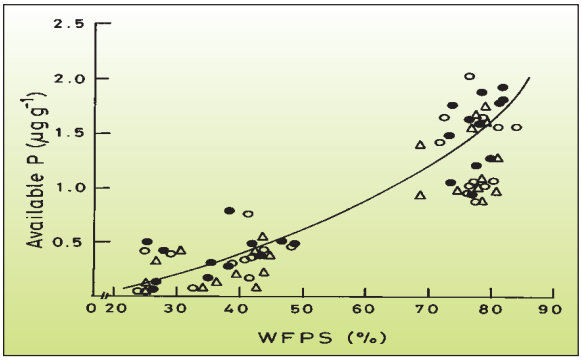


Fig 10. Relationship between water filled pore space (WFPS %) and available P (μgg^{-1}) in soils under moist evergreen forest, semi evergreen forest and homegarden. Symbols are same as started in fig 9.

INTRODUCTION AND EVALUATION OF EXOTIC AND LESS KNOWN INDIGENOUS FRUIT CROPS

D.R. Singh and T. Damodaran

Seed sowing and germination studies (monthly intervals), assessment of specific gravity and physiological loss weight studies of *Morinda citrifolia* collected form different accessions

The studies revealed that during the month of September 06, the seedlings germinated within 5 days from the samples collected from MEM-3 and GAH-1 followed by 6 days from SPG –2 and JGH-5 accessions whereas the time taken for germination was 19-20 days from the samples collected from HD-6 and PBAY-7accessions.During the month of October 06, the seedlings germinated within 8 days from the samples collected from SPG-2 and JGH-5 and seedlings germinated after 25 days from the samples collected from PBAY-7 with similar trend in November 06 and further studies are in progress.

Specific gravity was found to be higher in mature fruits and lowest in ripe fruits. The results were found to be similar in all fruits collected from various accessions. Maximum specific gravity (1.42) from HD-6 accession and minimum (1.12) from SPG-2 accession was recorded in mature fruits. In case of ripe fruits there was no variation in specific gravity (0.93 – 0.96) of fruits collected from various accessions.

Maximum shelf life of mature fruits(with & without stalk) lasted for 9 days in case of fruits collected from GAH-1, SPG-2, MEM-3 and PBAY-7accessions followed by 7 days in fruits collected from WAND-4, JGH-5, and HD-6 accessions. The shelf life lasted for 9 days in case of ripe fruits with stalk collected from SPG-2 and MEM-3 accessions. Maximum percentage reduction of mature fruits (with stalk) of 13.64% on 9th day was observed in WAND-4 accession and minimum of 3.76% reduction from fruits of HD-6 accessions and about 10.07% reduction was observed in mature fruits(without stalk) of MEM-3 accessions. In case of ripe fruits (with and without stalk), percentage reduction was maximum (10.58 and 9.18%) on 9th day in fruits of SPG-2 accession whereas minimum (3.64 and 2.32%) reduction was observed in fruits of JGH-5 accessions on 7th day .

In another experiment conducted in small scale, more juice was extracted from fully ripe pulp of the fruit rather than from the whole ripe fruit. The percentage of juice extracted increased (67.09 and 63.56 %) as age of raw material increased before extraction of juice for a period of 3 days and further the trend decreased (63.22 and 62.73 %) when the days stored for extraction was increased to 42 days in case of fruit pulp as well as from whole fruit.

Chemical analysis in Sapida varieties and comparison of ascorbic acid in West Indian Cherry

Physicochemical analysis of Sapida varieties revealed that fruit weight (14.23g), juice (80.12%) and ascorbic acid content (39.00mg/100g) was comparatively higher in case of variety S-I whereas, TSS (4.50Ú Brix) and acidity (0.80%) was higher in case of variety S-11.

Sapida varieties were processed into powder form and about 12.5% powder was obtained from variety S-II with 87.50 % moisture and 12.0% in case of variety S-I with 88% moisture.

Comparison of ascorbic acid content in West Indian Cherry revealed that during dry season (Nov.-Dec.) the ascorbic acid content was higher i.e., 4514mg/100g while compared to about 2980.92mg/100g during wet season (July – August).

DIVISION OF FIELD CROPS

UTILISATION OF NATIVE BIOAGENTS FOR THE MANAGEMENT OF MAJOR DISEASES OF VEGETABLES AND CATALOGUING OF CROP DISEASES OF ANDAMAN & NICOBAR ISLANDS

V. Jayakumar and T.V. R. S. Sharma

Field Screening of *Trichoderma* spp

The promising five fungal antagonists selected by *in vitro* screening *viz*., Thr1, Thr5, Tv3, Tv5 and Thm1 were mass multiplied for field trials to screen against diseases of chilli and brinjal. The commercial formulations of *Trichoderma* spp were prepared as per the standard procedure using talc powder as a carrier. The treatment schedule followed was as given below. The treatments were compared with similar treatments of commercial formulation of *T. viride* available in market, chemical treatment and a control.

The chilli and brinjal crops were observed for disease incidence and yield was recorded treatment wise. The results on field efficacy of each treatment are presented in (Table 1 & 2).

Table 1. Field evaluation of *Trichoderma* spp against diseases of Chilli

Treatment	Disease incidence							Yield t/ha
	Damping off (%)	Root rot (%)	Anthracnose incidence on leaf (PDI*)	Anthracnose incidence on fruit (%)	Leaf spot (PDI)	Wilt (*R. solanacearum*) (%)	Leaf curl (%)	
T_1	21.0^{a} (27.27)	3.0^{a} (9.97)	15.0^{a} (22.78)	56.3^{c} (48.62)	7.6^{c} (16.0)	14^{ab} (21.97)	32.0^{b} (34.45)	10.45^{a}
T_2	61.0^{f} (51.35)	7.0^{c} (15.34)	19.0^{c} (25.84)	82.5^{f} (65.27)	8.3^{cd} (16.74)	12.3^{ab} (20.53)	44.0^{d} (41.55)	5.23^{cd}
T_3	56.0^{e} (48.44)	9.0^{d} (17.45)	21.0^{d} (27.27)	97.6^{g} (73.14)	9.6^{d} (18.05)	5.7^{a} (13.81)	49.0^{e} (44.42)	6.02^{bcd}
T_4	54.0^{d} (47.29)	7.0^{c} (15.34)	22.0^{d} (27.97)	76.0^{d} (60.66)	16.4^{e} (23.88)	21.7^{b} (27.76)	44.0^{d} (41.55)	7.92^{abc}
T_5	27.0^{b} (31.30)	3.0^{a} (9.97)	17.0^{b} (24.35)	42.1^{a} (40.45)	4.1^{a} (11.68)	12.7^{ab} (20.87)	38.0^{c} (38.05)	11.4^{a}

T_6	51.0^{c} (45.57)	4.0^{b} (11.53)	19.0^{c} (25.84)	78.3^{e} (62.23)	8.4^{cd} (16.84)	20.0^{b} (26.56)	58.0^{f} (49.60)	8.13^{abc}
T_7	56.0^{e} (48.44)	5.0^{b} (12.92)	18.0^{bc} (25.10)	51.4^{b} (45.80)	5.6^{b} (13.68)	43.7^{c} (41.38)	24.0^{a} (29.33)	9.57^{ab}
T_8	66.0^{g} (54.33)	14.0^{e} (21.97)	29.0^{e} (32.58)	91.2^{g} (72.74)	18.9^{f} (25.76)	44.3^{c} (41.72)	44.0^{d} (41.55)	3.43^{d}
CD (0.05)	0.421	1.33	1.33	0.74	1.6	9.12	1.45	3.61

* *PDI- Per cent disease index*

Values in parenthesis is arc-sine transformed values for per cent data. Means followed by the same letter are not significantly different (p = 0.05) by DMRT on arcsine-transformed values

Treatment : T_1- Seed treatment with Thr1@10g/kg of seed + Root dipping with Thr1@0.1% for 30 min + Soil application of Thr1@2.5kg/ha at 0, 45 & 90 Days After Planting (DAP); T_2- Seed treatment with Thr5@10g/kg of seed + Root dipping with Thr5@0.1% for 30 min + Soil application of Thr5@2.5kg/ha at 0, 45 & 90 DAP; T_3- Seed treatment with Tv3@10g/kg of seed + Root dipping with Tv3@0.1% for 30 min + Soil application of Tv3@2.5kg/ha at 0, 45 & 90 DAP; T_4- Seed treatment with Tv5@10g/kg of seed + Root dipping with Tv5@0.1% for 30 min + Soil application of Tv5@2.5kg/ha at 0, 45 & 90 DAP; T_5- Seed treatment with Thm1@10g/kg of seed + Root dipping with Thm1@0.1% for 30 min + Soil application of Thm1@2.5kg/ha at 0, 45 & 90 DAP;T_6- Seed treatment with Tv (M)@10g/kg of seed + Root dipping with Tv (M)@0.1% for 30 min + Soil application of Tv (M)@2.5kg/ha at 0, 45 & 90 DAP; T_7- Seed treatment with Thiram@2.5g/kg of seed + Spray of Fytolan (CoC) @ 2.5g/lt of water at 0, 45 & 90 DAP; T_8- Control

Table 2. Field evaluation of *Trichoderma* spp against diseases of brinjal

Treat-ment	Disease incidence				Plants died (%)	Yield t/ha
	Damping off	Root rot	Wilt (*R. solana-cearum*)	*Nematode*		
T_1	10.3c (18.72)	0a (0.41)	26.3a (30.85)	39.7b (39.06)	27.1b (31.37)	13.8a
T_2	18.1e (25.18)	1.3b (6.55)	43.1e (41.04)	63.8e (53.01)	45.3f (42.30)	5.2c
T_3	19.3ef (26.06)	1.0b (5.73)	40.6de (39.58)	58.1d (49.66)	42.0e (40.40)	6.0c
T_4	17.9e (25.03)	3.0c (9.97)	39.8d (39.12)	53.2c (46.84)	44.3f (41.73)	5.6c
T_5	8.5b (16.95)	0a (0.41)	25.0a (30.0)	27.2a (31.44)	25.0a (30.0)	14.2a
T_6	12.3d (20.53)	0a (0.41)	32.9b (35.0)	41.9b (40.34)	34.3c (35.85)	9.8b
T_7	3.6a (10.94)	0a (0.41)	36.8c (37.35)	43.3b (41.15)	37.1d (37.53)	9.3b
T_8	19.5f (26.21)	2.7c (9.46)	40.4de (39.47)	68.0f (55.55)	45.6f (42.48)	4.9c
CD(0.05)	0.99	2.47	1.66	2.25	1.10	1.87

Values in parenthesis is arc-sine transformed values. Means followed by the same letter are not significantly different (p = 0.05) by DMRT on arcsine-transformed values

It was observed that the treatments T_1 and T_5 (*T. harzianum*1 and *T. hamatum* 1) consistently performed well and reduced incidence of all diseases. The fungal antagonists normally do not act on bacterial wilt, but in this case the bacterial wilt in brinjal and chilli crop was considerably reduced in T_1 and T_5. The reason may be that these *Trichoderma* spp exhibited their antagonistic activity on nematode population that involves in complex disease along with *Ralstonia solanacearum*. The chemical control (T_7) using fungicide was effective on fungal diseases but not against bacterial wilt, so its yield was reduced significantly than T_1 and T_5.

EVALUATION OF PGPR BASED BIO-FORMULATION FOR THE MANAGEMENT OF KEY DISEASES OF SOLANACEOUS VEGETABLE CROPS

V. Jayakumar, R. Elanchezhian and Krishna Kumar

Ralstonia solanacearum and nematode complex

Solanaceous vegetables crops *viz.*, brinjal, chilli and tomato showing typical bacterial wilt symptoms were collected from 3 major vegetable producing islands *viz.*, South Andaman, Havelock and Neil. The plants were pulled with root intact and brought to the laboratory and a total of 23 cultures were isolated from that. The wilted plants were tested for bacterial ooze and the presence of nematode.

It was found that among 23 isolates only 15 showed positive ooze test, 19 were infected with nematode and 13 plants (56.5%) were infected by both bacterium and nematode (Table 3). These results exhibit strong association between nematode and bacteria and complex nature of the disease.

Wilting in Tomato

Root knot nematode
Microscopic view (100X)

Tomato- Hairy root

Wilting in Brinjal

Plate 1. Association of *R. solanacearum* with root knot nematode

Table 3. *Ralstonia solanacearum* isolates and their association with Nematode

Sl No	Place of Collection	Island	Host plant	Isolate name	Ooze test reaction	Presence of nematode in root*
1	Garacharma(CARI)	South Andaman	Tomato	PSC1	(+)	(+)
2	Garacharma(CARI)	South Andaman	Tomato	RSC4	(+)	(+)
3	Garacharma(CARI)	South Andaman	Chilli	RSC5	(+)	(+)
4	Sippighat	South Andaman	Tomato	RSS1	(+)	(-)
5	Sippighat	South Andaman	Brinjal	RSS2	(+)	(-)
6	Garacharma(CARI)	South Andaman	Chilli	RSC6	(+)	(+)
7	Kalapather	Havelock	Brinjal	RSH1	(+)	(+)
8	Kalapather	Havelock	Tomato	RSH2	(-)	(-)
9	Govind Nagar	Havelock	Tomato	RSH3	(-)	(+)
10	Govind Nagar	Havelock	Chilli	RSH4	(-)	(+)
11	Govind Nagar	Havelock	Brinjal	RSH5	(+)	(+)
12	Govind Nagar	Havelock	Brinjal	RSH6	(+)	(+)
13	Sitapur	Neil	Tomato	RSN2	(+)	(+)
14	Bharatpur	Neil	Tomato	RSN3	(+)	(+)
15	Bharatpur	Neil	Brinjal	RSN4	(-)	(+)
16	Bharatpur	Neil	Chilli	RSN5	(+)	(+)
17	Laxmanpur	Neil	Brinjal	RSN6	(-)	(+)
18	Laxmanpur	Neil	Brinjal	RSN7	(+)	(+)
19	Laxmanpur	Neil	Chilli	RSN8	(-)	(+)
20	Ram Nagar	Neil	Tomato	RSN9	(-)	(-)
21	Ram Nagar	Neil	Brinjal	RSN10	(+)	(+)
22	Ram Nagar	Neil	Brinjal	RSN11	(+)	(+)
23	Ram Nagar	Neil	Chilli	RSN12	(-)	(+)

* Observation under microscope
+ indicates presence; - indicates absence

Pathogenicity of *R. solanacearum*

All 23 isolates of *R. solanacearum* were inoculated individually to the root zone of tomato plants grown in sterile pot culture. The results show that the first wilt symptom was exhibited between 30 to 35 days after inoculation of pathogen (Table 4). Among 23 isolates, 17 isolates

Table 4. Pathogenicity test of *R. solanacearum* strains in pot culture

Isolate Name	5 DAI*	10 DAI	15 DAI	20 DAI	25 DAI	30 DAI	35 DAI
PSC1	(-)	(-)	(-)	(-)	(-)	(-)	(+)
RSC4	(-)	(-)	(-)	(-)	(-)	(-)	(+)
RSC5	(-)	(-)	(-)	(-)	(-)	(-)	(+)
RSS1	(-)	(-)	(-)	(-)	(-)	(-)	(+)
RSS2	(-)	(-)	(-)	(-)	(-)	(-)	(+)
RSC6	(-)	(-)	(-)	(-)	(-)	(-)	(+)
RSH1	(-)	(-)	(-)	(-)	(-)	(-)	(+)
RSH2	(-)	(-)	(-)	(-)	(-)	(-)	(-)
RSH3	(-)	(-)	(-)	(-)	(-)	(-)	(+)
RSH4	(-)	(-)	(-)	(-)	(-)	(-)	(+)
RSH5	(-)	(-)	(-)	(-)	(-)	(-)	(+)
RSH6	(-)	(-)	(-)	(-)	(-)	(-)	(-)
RSN2	(-)	(-)	(-)	(-)	(-)	(-)	(+)
RSN3	(-)	(-)	(-)	(-)	(-)	(-)	(-)
RSN4	(-)	(-)	(-)	(-)	(-)	(-)	(-)
RSN5	(-)	(-)	(-)	(-)	(-)	(-)	(+)
RSN6	(-)	(-)	(-)	(-)	(-)	(-)	(+)
RSN7	(-)	(-)	(-)	(-)	(-)	(-)	(+)
RSN8	(-)	(-)	(-)	(-)	(-)	(-)	(+)
RSN9	(-)	(-)	(-)	(-)	(-)	(-)	(-)
RSN10	(-)	(-)	(-)	(-)	(-)	(-)	(+)
RSN11	(-)	(-)	(-)	(-)	(-)	(-)	(+)
RSN12	(-)	(-)	(-)	(-)	(-)	(-)	(+)

+ indicates presence of any symptom; - indicates absence of symptom
* DAI- Days after inoculation of pathogen

Plate 2. Pathogenicity test in Pot culture- Wilting in tomato crop under artificially pathogen inoculated condition

exhibited prominent wilt symptom. The delayed appearance or absence of wilt in pot culture may be due to lack of predisposing factors such as nematode infection, which is absent in sterile soil of the pot. This finding not only proves the pathogenicity of isolates culture but also the strong complex nature of the disease. In addition, it indicates that the isolates RSH2, RSH6, RSN3, RSN4, RSN6 and RSN9, which did not produce any symptom, may belong to a group of race and the remaining may be of other race.

Field evaluation of PGPRs

The promising bacterial antagonists selected by *in vitro* screening *viz*., PfH1, PfCN1, C26, C27, C28 and C29 (*Pseudo-monas* spp) and BG1, BB2 (*Bacillus* spp) were mass multiplied for field trials. The commercial formulation of these antagonists prepared as talk powder based formulation. The treatment schedule was followed as given below along with similar treatments of *Pseudomonas* sp promising culture (Pf1), chemical treatment and a control.

The field trials show that the treatments T1, T3 and T7 were effective in reducing the incidence of diseases (Table 5). There was no incidence of bacterial wilt in treatment 7 when compared to 45.8 per cent incidence in control field. The incidence of viral disease was reduced significantly in PGPR applied field that shows induction of disease resistance in host.

Table 5. Field evaluation of PGPRs against diseases of Chilli

Treatment	Disease incidence					
	Damping off (%)	Root rot (%)	Anthracnose incidence on leaf (PDI)	Leaf spot (PDI)	Wilt (*R. solanacearum*) (%)	Leaf curl (%)
T_1	7.3b (15.68)	-	8.9c (17.35)	4.3a (11.97)	16.5d (24.0)	13.9b (21.89)
T_2	9.8d (18.24)	-	9.4e (17.85)	7.3d (15.68)	4.1b (11.68)	13.9b (21.89)
T_3	6.3b (14.54)	-	8.3a (16.74)	4.5ab (12.25)	25.0f (30.0)	15.3bc (23.03)
T_4	8.4c (16.85)	-	9.1d (17.55)	9.4f (17.85)	20.8e (27.13)	16.7cd (24.12)
T_5	9.8d (18.24)	-	10.2h (18.63)	13.6i (21.64)	25.0f (30.0)	13.5b (21.56)
T_6	8.3c (16.74)	-	9.3e (17.75)	11.1g (19.46)	20.0e (26.57)	16.7cd (24.12)
T_7	6.9b (15.23)	-	8.7b (17.16)	4.8b (12.66)	0a (0.59)	15.3bc (23.03)
T_8	13.6e (21.64)	-	9.1d (17.56)	8.5e (16.95)	25.0f (30.0)	20.8e (27.13)
T_9	13.1e (21.21)	-	9.8f (18.24)	9.6f (18.05)	12.5c (20.71)	15.4bc (23.11)
T_{10}	5.4a (13.44)	-	8.3a (16.74)	6.1c (14.30)	45.8g (42.59)	11.1a (19.46)
T_{11}	13.9e (21.89)	-	10.0g (18.44)	12.3h (20.53)	45.8g (42.59)	18.1de (25.18)
CD (0.05)	1.09	-	0.186	0.63	1.83	2.08

Values in parenthesis is arc-sine transformed values for per cent data

Means followed by the same letter are not significantly different (p = 0.05) by DMRT on arcsine-transformed values

Treatments: T_1- Seed treatment with C26 @4g/kg of seed + Soil application of C26 @2.5kg/ha + 50kg of FYM on 0, 45 & 90 DAP + spray of C26 @0.1% on 30, 60 & 90 DAP; T_2- Seed treatment with C27 @4g/kg of seed + Soil application of C27 @2.5kg/ha + 50kg of FYM on 0, 45 & 90 DAP + spray of C27 @0.1% on 30, 60 & 90 DAP; T_3- Seed treatment with C28 @4g/kg of seed + Soil application of C28 @2.5kg/ha + 50kg of FYM on 0, 45 & 90 DAP + spray of C28 @0.1% on 30, 60 & 90 DAP; T_4- Seed treatment with C29 @4g/kg of seed + Soil application of C29 @2.5kg/ha + 50kg of FYM on 0, 45 & 90 DAP + spray of C29 @0.1% on 30, 60 & 90 DAP; T_5- Seed treatment with PfH1 @4g/kg of seed + Soil application of PfH1@2.5kg/ha + 50kg of FYM on 0, 45 & 90 DAP + spray of PfH1@0.1% on 30, 60 & 90 DAP; T_6- Seed treatment with PfCN1 @4g/kg of seed + Soil application of PfCN1 @2.5kg/ha + 50kg of FYM on 0, 45 & 90 DAP + spray of PfCN1 @0.1% on 30, 60 & 90 DAP; T_7- Seed treatment with BG1 @4g/kg of seed + Soil application of BG1 @2.5kg/ha + 50kg of FYM on 0, 45 & 90 DAP + spray of BG1 @0.1% on 30, 60 & 90 DAP; T_8- Seed treatment with BB2@4g/kg of seed + Soil application of BB2 @2.5kg/ha + 50kg of FYM on 0, 45 & 90 DAP + spray of BB2 @0.1% on 30, 60 & 90 DAP; T_9- Seed treatment with Pf1@4g/kg of seed + Soil application of Pf1 @2.5kg/ha + 50kg of FYM on 0, 45 & 90 DAP + spray of Pf1 @0.1% on 30, 60 & 90 DAP; T_{10}- Seed treatment with Thiram@2.5g/kg of seed + Spray of Fytolan (CoC) @ 2.5g/lt of water at 0, 45 & 90 DAP ; T_{11} –Control.

ASSESSMENT OF CROP LOSSES AND EPIDEMIOLOGY OF MAJOR VEGETABLE DISEASES OF SOUTH ANDAMAN

Krishna Kumar, V. Jayakumar, T. Damodaran and M. Balakrishnan

Systematic surveys of major vegetable growing areas of South Andaman were undertaken to assess the prevalence (incidence and severity) of diseases. Symptom produced by each disease of vegetable crops was recorded and samples were preserved adopting standard procedures for further research. A total of 26 diseases were recorded from 14 vegetable crops comprising 4 families i.e. Cucurbitaceae, Solanaceae, Malvaceae and Leguminosae as described in Table 6. Disease incidence ranged from 1 to 100 % and severity from 1 to 60 % in different crops surveyed. Wilt of brinjal, leaf spot of little gourd , frog eye spot of chilli, leaf spot of snake gourd and leaf curl were major diseases recorded in vegetable crops.

Table 6. Survey of vegetable diseases

(A) Cucurbitaceae					
Sl. No	Crop/Stage	Disease	Disease Incidence (%)	Disease Severity (%)	Symptom
1.	Bitter gourd (Fruiting)	Blight/ Leaf spot	10-30	20-40	Blighting and yellowing
		Anthracnose	20-32	11-20	Light brown to dark brown sunken spots on the leaves

2.	Ash gourd (Fruiting)	Blight	50	10-20	Blighting starts from leaf margins finally shot holes are formed
3.	Ridge gourd (Fruiting)	Blight & spot	30-65	20-30	Irregular spots having brownish center outlined with irregular margins giving blighted appearance of the leaves.
4.	Snake gourd (Fruiting)	Anthracnose	80-100	20-50	Light brown to yellow brown spots having yellow halo.
		Blight	80-100	40-60	1 to 3 cm brown to dark brown spots with yellow halo with white colour central spots
5	Little gourd (Fruiting)	Anthracnose /leaf spot	80-100	40-50	Circular to irregular spots with white centre, sunken and blighting starts from margins
6.	Bottle gourd (Fruiting)	Blight/ Anthracnose	10-30	20-40	Spots scattered on whole leaf, light brown spots with yellow halo. Fruits become malformed and canckered
7.	Cucumber (pre flowering)	Cucumber mosaic	5-10	1-3	Mosaic, mottling, yellowing, stunting of plants and shortening of leaves.
8.	Pumpkin (Flowering and fruiting)	Leaf spot and Anthracnose	10-30	20-25	Spot starts from margin and causes leaf necrosis
B. Solanaceae					
9.	Chilli (Flowering and fruiting)	Mosaic and leaf curl	10-20	30	Curling mosaic, reduction in size of leaves and stunted plant growth.
		Anthracnose	5-10	5	Small circular yellowish sunken spot on infected fruit looks straw color having numerous dot like acervuli in rings
		Frog eye leaf spot	70-80	60	Leaf lesions typically brown and circular with small to large light grey centers and dark brown margins, some times

					coalesce. Stem, petiole and calyx lesions also have light grey centers with dark borders.
		Little leaf	1-2	7	Reduction in leaf size and shortening of internodes giving bushy appearance of plants
10.	Brinjal (Fruiting)	Root rot/ wilting	10	10	Root rotting and wilting of the plants
		Phomopsis blight	2-5	10	Pale and sunken spot, later stage if covers entire fruit spot become warty producing soft rot. Dot like pycnidia are seen on spots. Fruit appear back and mummified.
		Little leaf	2-5	2-3	Reduction in leaf lamina and stunted growth of plants
		Leaf spot	50-60	20-22	Brownish spots with yellow halo. Blighting starts from leaf margins.
11.	Tomato (Flowing and fruiting)	Leaf curl	10 and 100	5 - 50	Curling, mosaic, vein thickening, yellowing and stunted growth of plants.
		Damping off/ root rot	5-10	10	Water soaked and brown spots at collar region of stem. Softening of tissue, shriveling, collapse and topping of plants are common symptoms.
C. Malvaceae					
12.	Okra (Fruiting)	Powdery mildew	60-80	35-40	White powdery growth both on lower leaves and drying of leaves are common.
		Yellow vein Mosaic virus	50-60	20-40	Yellow vein, mosaic,vein thickening, curling of leaves
D. Leguminosae					
13.	Cowpea (pre-flowering)	Powdery mildew	60	25-30	Brownish powdery growth, shriveled, drying and defoliation of leaf as severe infection occur.
		Mosaic	2-5	2-5	Mosaic, mottling, yellowing of leaf lamina and stunting of plants

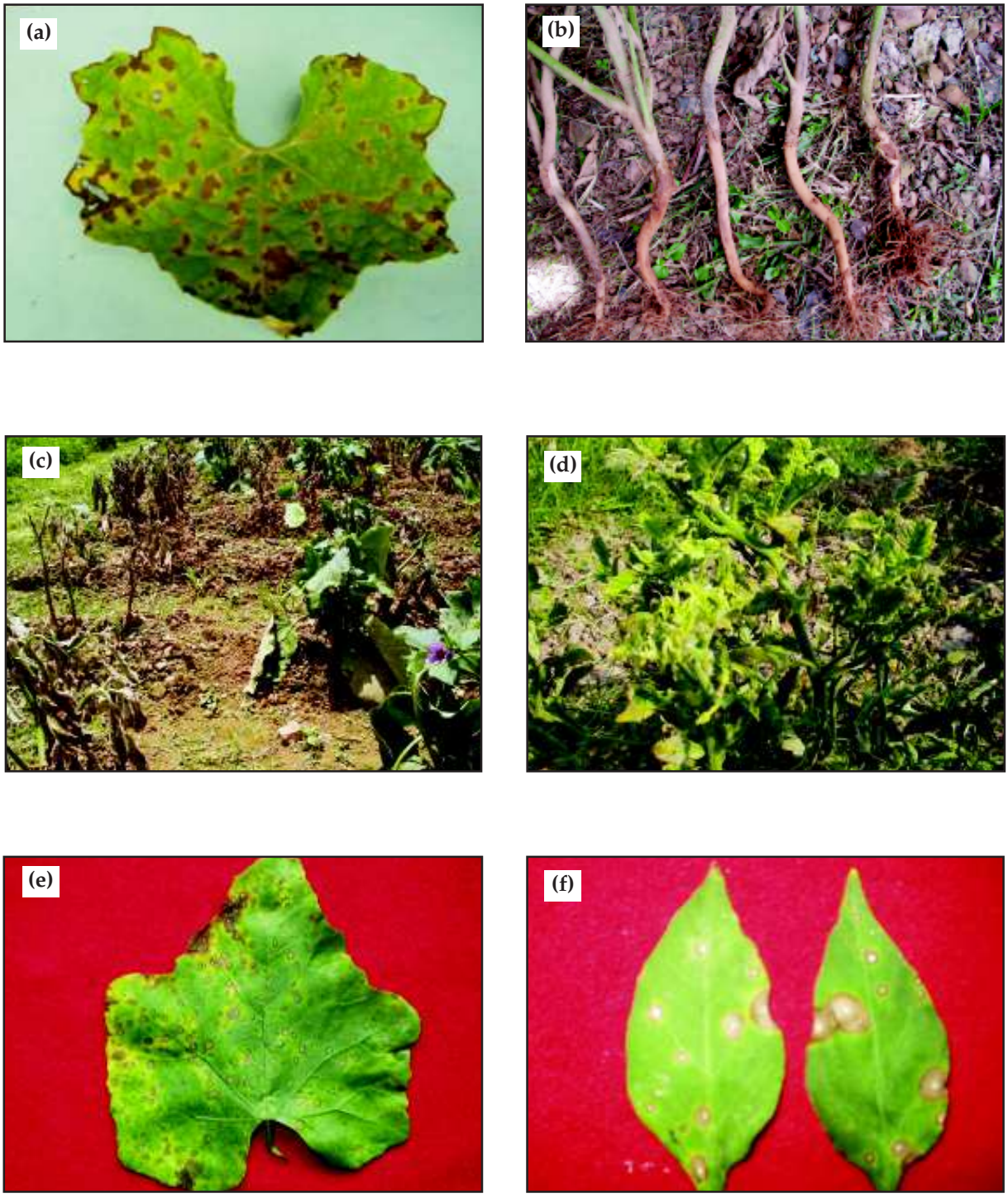


Plate 3. Diseases severity in vegetable crops
(a) leaf spot of ridge gourd (b) rot and wilt symptom of brinjal (c) wilt of brinjal
(d) leaf curl of tomato (e) leaf spot of little gourd (f) frog eye spot of chilli

APPLICATION OF MICROORGANISMS IN AGRICULTURE AND ALLIED SECTORS- MICROBIAL DIVERSITY AND IDENTIFICATION

V. Jayakumar

Survey and Collection of samples

From the revenue map of Andaman & Nicobar Islands, the villages were identified and each village was taken for survey work for collection of plant and soil samples from hot humid eco region. The microorganisms associated with vegetable crops, spices and wild legumes were taken for the research work. Initially the samples, *viz*., infected plants, rhizosphere soil and wild legumes were collected from the villages of South Andaman, Havelock and Neil Islands.

Isolation and characterization of microbes

Beneficial free-living rhizosphere soil bacteria, fungi and the pathogens associated with the various symptoms of mentioned crops were isolated and cultured in the media as per requirement. For bacterial pathogens the classical cultural and biochemical methods (as per Bergy's Manual) are used to determine the characters of the isolates and the genus and species were determined. For fungus microscopic studies and other standard techniques are followed for identification. The wild legumes found abundant in extreme environments were and using YEMA medium *Rhizobium* spp were isolated from wild legumes and identified by using cultural and biochemical method.

From the collected samples 194 bacteria, 22 *Trichoderma*, 20 fungal pathogens, 25 bacterial pathogens and 12 *Rhizobium* spp were isolated. The places surveyed and the associated organisms isolated are given in Table 7.

Table 7. Place of collection of samples and the isolated microorganisms

Sl No.	Place of collection	Antagonists			Pathogen		*Rhizobium* spp associated with wild legumes
		Pseudomonas spp	*Bacillus* spp	*Trichoderma* spp	Bacteria	Fungi	
1	Calicut	-	1	-	-	1	-
2	Humfrigunj	10	9	1	-	1	-
3	Guptapara	9	11	1	-	-	3
4	New Mangulton	6	7	3	-	-	-
5	Sippighat	17	14	3	2	6	1
6	Mittakhari	5	7	1	-	4	-
7	Manpur	2	2	1	-	2	-

8	Tirur	8	7	4	-	-	-
9	Wandoor	13	15	5	-	-	-
10	Mangulton	12	11	3	-	2	2
11	CARI	2	1	-	4	1	-
12	Burmanalla	2	-	-	-		-
13	Maccapahad	4	-	-	-	1	-
14	Bloomsdale	5	2	-	-		-
15	Chouldari	2	-	-	-		-
16	Manjery	-	-	-	-	2	3
17	Pongibalu	-	-	-	-		1
18	Nayasahar	-	-	-	-		2
19	Neil Island	4	-	-	13		-
20	Havelock	3	3	-	6		-
	Total	**104**	**90**	**22**	**25**	**20**	**12**

Among these isolates 33 antagonistic bacteria, 25 bacterial pathogens (*Ralstonia* sp) and 22 fungal antagonists (*Trichoderma* spp) were identified by cultural, biochemical and morphological methods. Among the *Rhizobium* spp associated with wild legume nodulation, 12 were isolated and biochemically characterized.

Plate 4. Disease symptoms associated with crops cultivated in South Andaman

DIGITAL DATABASE ON PLANT RESOURCES OF ANDAMAN & NICOBAR ISLANDS

T.V.R.S. Sharma, V. Jayakumar, M. Balakrishnan, R.P. Pandey, S. Jayamurthy and K. N. Ganeshiah

Literature survey

A total of 197 published references were collected from journals. This contains the description of 280 plant species i.e. 22 herbs, 62 shrubs, 137 trees, 29 climber, 17 liana, 11 epiphyte and 1 lithophyte. A compilation of medicinal plants of Andaman & Nicobar Islands was done, which amounts to 120 medicinal plants utilized by tribes & local people.

The list of plants for which the details collected were as given below:

Convolvulaceae: *Ipomea aculeata (creeper)*

Connaraceae: *Connarrus andamanicus (Liana)*

Symplocaceae: *Symplocos oxyphylla (Tree)*

Anacardiaceae: *Spondias cyathera* (Tree)

Euphorbiaceae: *Exoecaria indica* (Tree), *Glochidion airyshawii* (Tree), *G. bilobulatum* (Tree), *G. sumatranum* (Tree), *Bridelia nicobarica* (Tree), *Dimorphocalyx balakrishnanii* (Tree), *D. dilipianus (Shrub), Glochidion zeylanicum (Shrub, Cleistanthus acuminalis (Shrub), Cleistanthus balakrishnanii (Shrub), Cleistanthus collimns (Shrub/Tree), Cleistanthus ferruginens (Tree), Cleistanthus helferi (Shrub), Cleistanthus malaarium (Shrub), Cleistanthus meeboldii (Tree), Cleistanthus pallidum (Tree), Cleistanthus papyraceae (Shrub), Cleistanthus potulus (Tree) andCleistanthus robustia (Tree).*

Acanthaceae: *Hypoestes thothathri* (herb)

Flacourtiaceae: *Caesaria insularis* (shrub)

Linaceae: *Indorouchera griffithiana* (shrub)

Myrsinaceae: *Embelia viridiflor*a (climber), *Embelia ribes (Shrub), Ishaemum zeylanicolum (Shrub), Malvastrum coromandelianum (Herb)* and *Sporobolus tenuissimus (Herb)*

Lauraceae: *Nothaphoebe panduriformis* (tree)

Malphigiaceae: *Hiptage thothathri* (climber)

Celastraceae : *Bhesa robusta* (tree), *Celastrus paniculatus* (shrub), *Euonymus cochinchinensis* (tree), *E. javanicus* (tree), *Glycopetalum calacarpum* (shrub), *Hypocratea andamanica* (climber), *H. ding-houi* (climber), *H. macarantha* (liana), *H. majumdarii* (climber), *H. nicobarica* (liana), *H. park*insonii (climber), *Nicobariodendron sleumeri* (tree), *Salacia chinensis* (climber), *Siphonodon celastrineus* (tree), *Glyptopetalum* (shrub) and *Loesenerilla cumingii (Shrub)*

Myrtaceae: *Syzygium flosculiferum* (Tree)

Oleaceae: *Chionanthus roxburghii* (Tree)

Rutaceae: *Mitragyna rotundifolia* (Tree) and *Uncaria attentuata* (Liana)

Zingiberaceae : *Zingiber odoriferum* (Herb)

Verbenaceae : *Clerobendrum paniculatum* (Shrub) and *Clerobendrum philippinum* (Shrub)

Bigoniaceae : *Begonia andamensis* (Herb)

Clusiaceae : *Garcinia andamanica* (Tree)

Rubiaceae: *Diplospora andamanica (Shrub)*, *Hedyotis paradoxa (Herb), Ixora barbata (Shrub), Ixora brunnescens (Shrub), Ixora cuneifolia (Shrub), Ixora nicobarica (Shrub), Ixora rosella (Shrub), Jania nicobarica (Shrub), Lasianthus andamanicus (Shrub), Neonauclea gageana (Tree), Ophiorrhiza infundibularis (Herb), Ophiorrhiza nicobarica (Herb), Psychotria andamanica (Shrub), Psychotria balakrishnanii (Shrub), Psychotria kurzii (Shrub), Psychotria nicobarica (Shrub), Psychotria pendula (Shrub), Psychotria platyneura (Shrub), Psychotria tylophora (Shrub), Fubistylus andamanica (Tree), Randia andamanica (Tree)* and *Tarenna weberaefolia (Tree)*

Arecaceae: *Arenga pinnata (Tree)*

Orchidaceae : *Erythrorchis altissima (Climber), Tropidia thwaitesii (Herb)* and *Trias oblonga (Epiphytic herb)*

Onagraceae : *Ludwigia peruviana (Shrub)*

Proteaceae : *Helicia exelsa (Shrub)*

Xyridaceae : *Xyris indica (Tree)*

Nyctaginaceae : *Boerhavia procumbens (Herb)*

Lauraceae : *Cyptocarya balakrishnanii (Tree)* and *Cryptocarya cavei (Tree)*

Preparation of data sheets

The data sheets were prepared in MS Access format according to districts, taluks and Islands of Andaman.

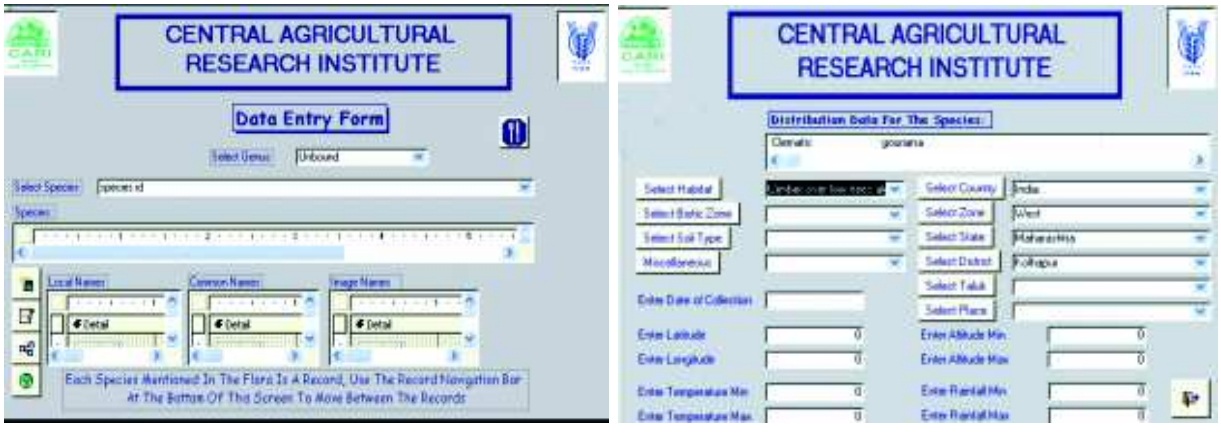
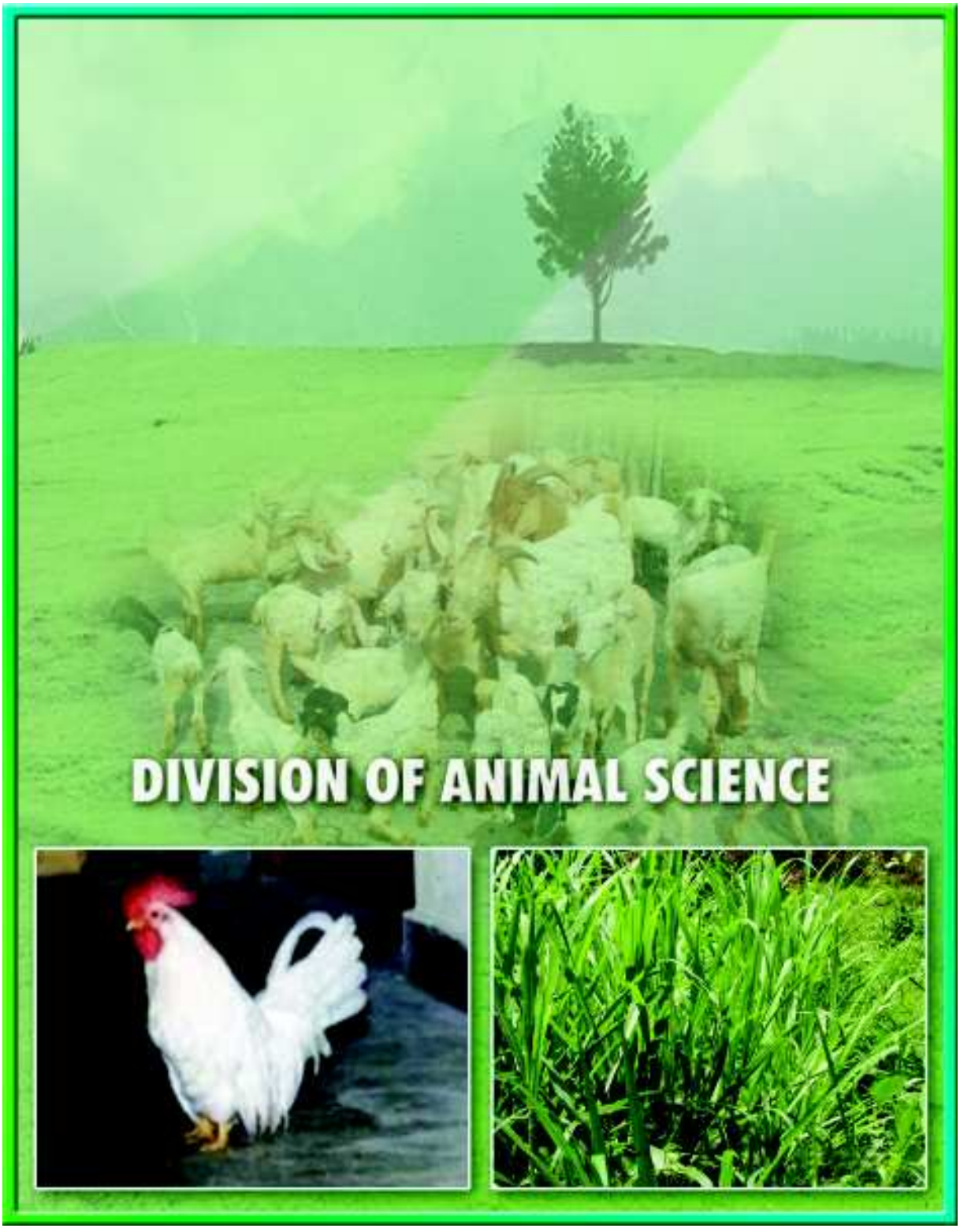


Plate 5. Data entry sheets developed for digitization of plant resources of Andaman


DIVISION OF ANIMAL SCIENCE

FACTORS INFLUENCING PRODUCTIVE AND REPRODUCTIVE PERFORMANCE IN DAIRY CATTLE UNDER ISLAND ECOSYSTEM

S. Jeyakumar, A. Kundu, Jai Sunder, B.Ganesh Kumar, M. Din, T. Sujatha, M. Balakrishnan, M.S. Kundu and S.K. Verma

Performance of cross bred cows

Productive and reproductive performance (Mean±SE) of cross bred cows *viz.* the lactation length (days), lactation yield (lit), average milk yield / lactation length (lit), and days to attain peak yield was found to be 265.73±13.5, 1033.28±165.2, 3.74±0.5, and 26.33±2.3, respectively. The age at first calving (days) and inter calving interval (days) was observed to be 1076.58±63.9 and 507.0±17.1, respectively.

Milk yield pattern during different season and climatic conditions

The entire lactation period of cross bred cows were divided in to pre-monsoon, monsoon and post-monsoon season. The total milk yield (lit) (Mean±SE) was found to be 663.38±37.6; 675.92±145.2 and 1550.25±40.9 during pre monsoon, monsoon and post-monsoon season respectively (Fig 1).

The various macroclimatic parameters *viz.* temperature, rain fall and relative humidity were related with total monthly milk yield of four cows during their entire lactation

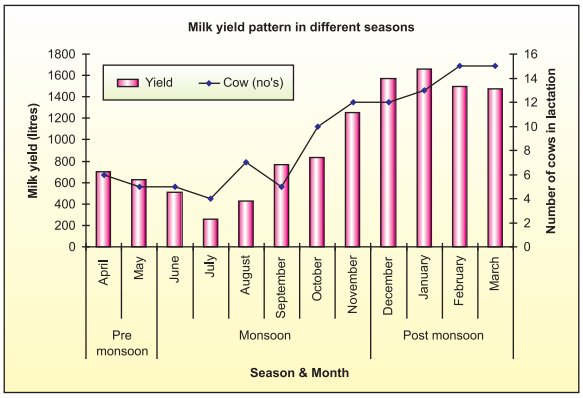


Fig 1. Milk yield pattern during different season in crossbred dairy cattle

period (lit) (Fig 2). Correlation (multiple) and regression analysis of the data revealed no significant relationship between milk yield and climatic parameters.

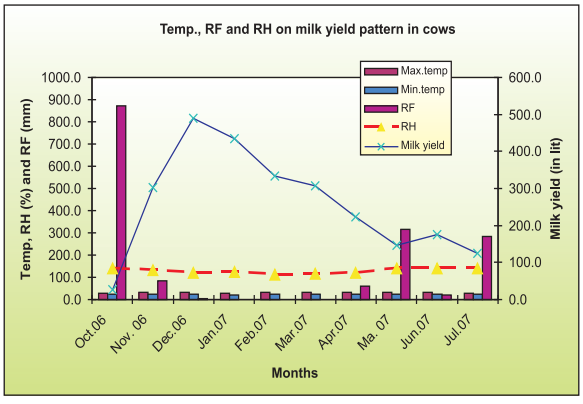


Fig 2. Relationship of monthly milk yield with temperature, rain fall and RH

Reproductive managemental interventions to enhance productivity

In order to manage the infertility problem (anestrum, repeat breeding), controlled

breeding programme technology was implemented to enhance the productivity. Oestrous synchronization by using both PGF_2 alpha (shortening of luteal phase) and CIDR (lengthening of luteal phase) method resulted in synchronized calving and leading to higher milk production in the monsoon and post-monsoon season (Fig.3)

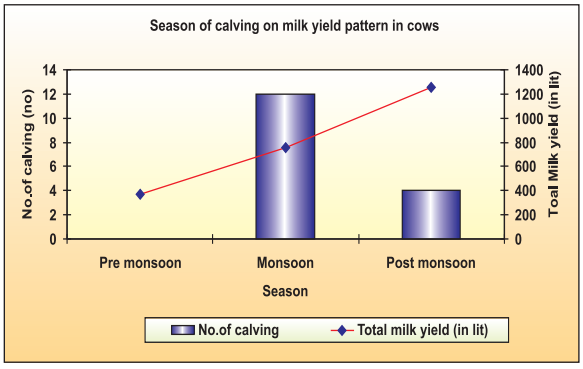


Fig 3. Effect of controlled breeding on calving pattern and milk yield

Health and managemental interventions to enhance productivity

Health factors *viz.* post FMD complications (infertility, lameness due to hoof lesions), and mastitis were the most common problems which directly or indirectly influenced the productive and reproductive performance of the cows. Clinical and reproductive ultrasonography has been found to be valuable diagnostic tool in diagnosing various pathological conditions (ovarian cyst/abscess and abscess). A breeding calendar for better reproductive management of both heifers and postpartum cattle has been developed (Fig.4).

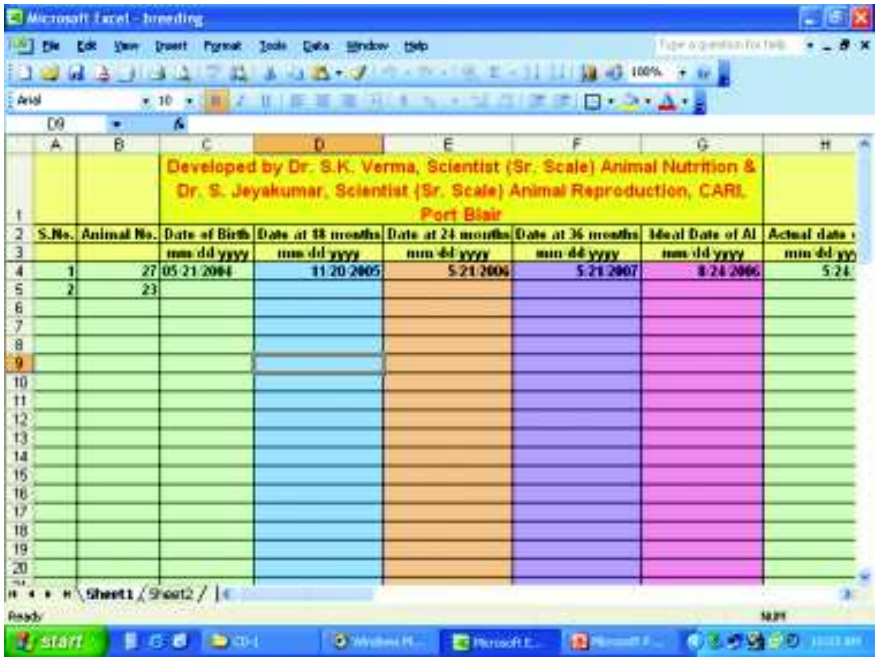


Fig 4. Breeding calendar and database for performance evaluation of dairy cattle

SERO-SURVEILLANCE & ANTIGENIC CHARACTERIZATION OF ETIOLOGICAL AGENTS OF MAJOR LIVESTOCK & POULTRY DISEASES OF A&N ISLANDS

Jai Sunder, A. Kundu, S. Jeyakumar and B. Ganesh Kumar

Sero surveillance of important livestock and poultry diseases

Sera samples of dairy cattle with history of infertility from different areas of the South Andaman were screened for Leptospira (n 46) (MAT test) and Brucella (n 11) (SAT method) and a total of 16 and 2 samples were found positive for leptospirosis [L.*grippotyphosa* (4), *CH31* (1), L.a*ustralis* (1), L.p*omona* (1), L. i*cterohaemorrhagica* (2), L.h*ardjo* (1), L. b*allam* (6) and L. p*yrogen* (1)] and brucellosis respectively. The seroprevalence of Blue tongue was reported in 10 goats.

Plate 1. *Oxyspirura mansoni* worm in eye

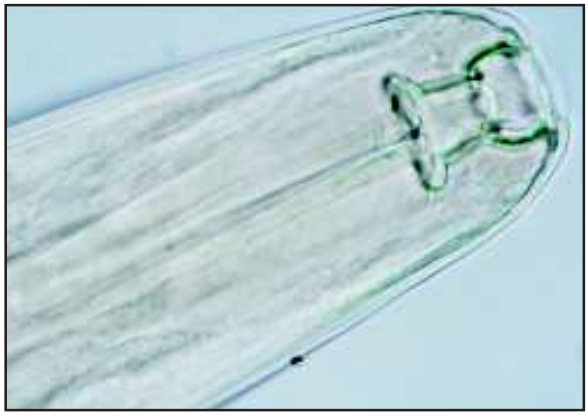


Plate 2. Microscopic view *of O. mansoni* worm

The infection of eye worm *Oxyspirura mansoni* in poultry was reported and isolated for the first time from Andaman islands.

Table 1. Incidence of certain diseases in captive wild animals of A&N islands

S.no	Species	Sample	Findings	Diagnosis
1.	Nicobari Monkey	Liver	Fatty changes and focal hepatocellular necrosis, bile duct hyperplasia, periportal fibrosis with mild mononuclear cell infiltration.	Acute toxic hepatitis
2.	Hog deer	Stomach content	Parasitic load and found positive for eggs of S*trongyle sp.*	Parasitic infection
3.	Andaman wild pig	Faecal sample	Egg of *Strongyle sp.*+++ Egg of *Ascaris sp.* +++ Egg of *Trichuris sp.*+	Parasitic infection
4.	Elephant	Stomach content and larvae	Larvae of Bot fly (*Cabboldia elephantis*)	Parasitic infection

ADAPTABILITY AND PRODUCTIVITY OF TURKEY AND GUINEAFOWL UNDER ISLAND ECOSYSTEM

A.Kundu, T.Sujatha, S.Jeyakumar and Jai Sunder

Carcass and egg qualities of turkey (Table 2) and carcass quality of Guinea fowl (Table 3) under islands ecosystem was carried out in both on farm and out farm situation. The lighting for turkeys has also been evaluated in terms of light intensity, light color, and photo period. A lower level of light intensity were found to result in eye abnormalities, leg abnormality and substantially reduces activities levels, increased adrenal gland size

Table 2. Carcass qualities of Turkey meat

Parameters	Average (%)	Male (%)	Female (%)
Live wt (kg)	6.34 ± 0.8	8.52 ± 0.5	3.68 ± 0.2
Dressing %	86.20 ± 1.1	88.00 ± 0.8	87.89 ± 1.8
Ready to cook	83.28 ± 1.9	85.22 ± 0.9	77.49 ± 1.6
Neck	4.57 ± 0.3	4.05 ± 0.4	5.77 ± 0.8
Wing	8.09 ± 0.3	7.77 ± 0.4	8.49 ± 0.5
Breast	19.22 ± 1.2	19.47 ± 2.0	18.92 ± 1.4
Back	16.18 ± 1.0	15.02 ± 1.1	17.59 ± 1.8
Thigh	17.16 ± 0.8	17.38 ± 1.1	16.91 ± 1.2
Lung	0.62 ± 0.0	0.57 ± 0.0	0.68 ± 0.0
Giblets	5.01 ± 0.4	3.32 ± 0.1	5.52 ± 0.2

Table 3. Carcass qualities of Guinea fowl meat

Parameters	Average (%)	Male (%)	Female (%)
Live wt (g)	1287.50 ± 63.9	1300.00 ± 70.7	1275 ± 118.1
Dressing %	87.49 ± 2.7	84.33 ± 5.1	90.66 ± 0.7
Ready to cook	80.91 ± 2.5	82.77 ± 3.3	79.06 ± 4.1
Neck	5.78 ± 0.3	4.50 ± 0.5	4.17 ± 0.4
Wing	9.64 ± 0.7	9.38 ± 1.0	9.89 ± 1.2
Breast	20.77 ± 0.8	22.59 ± 1.1	18.94 ± 0.5
Back	20.51 ± 2.1	22.87 ± 1.2	18.16 ± 4.0
Thigh	21.53 ± 0.7	21.85 ± 0.9	21.20 ± 1.3
Lung	1.08 ± 0.1	1.06 ± 0.0	1.11 ± 0.2
Giblets	5.92 ± 0.3	6.04 ± 0.5	5.80 ± 0.5

and suppression of normal behaviour. Photo period of 16 -17 hours required for optimum performance. The turkey meat contains excellent source of protein (25.6 -28.6 gm), low sodium and it is good choice for those on low salt diet. Turkey meat is a short fibre meat which is easily digested.

Table 4. Egg Quality Parameters of Turkey egg

Parameters	Average (%)
Egg weight (gm)	73.23 ± 1.6
Egg length (cm)	6.32 ± 0.0
Egg width (cm)	4.57 ± 0.0
Shape index (%)	72.39 ± 0.4
Shell weight (gm)	8.25 ± 0.2
Shell percent	11.15 ± 0.0
Shell Thickness (mm)	0.43 ± 0.0
Albumin weight (gm)	38.17 ± 0.9
Albumin diameter (cm)	6.95 ± 0.1
Albumin height (cm)	6.15 ± 0.2
Albumin pH	8.5 ± 0.0
Albumin percent	56.32 ± 0.8
Albumin Index	0.88 ± 0.0
Yolk weight (gm)	23.05 + 0.8
Yolk diameter (cm)	4.61 ± 0.1
Yolk height(cm)	3.48 ± 0.1
Yolk pH	6.0 ± 0.0
Yolk percent	31.53 ± 0.5
Yolk index	0.75 ± 0.0
Haugh unit	72.18 ± 1.4

ENHANCEMENT AND SUSTAINABLE DAIRY PRODUCTION IN BAY ISLANDS

S. Jeyakumar, A. Kundu, M.S. Kundu, Jai Sunder, S.P. Yadav, T. Sujatha, R. Raja, B. Ganesh Kumar, Prashanth Deshmukh

Productive and reproductive performance of Holstein Frisian (HF) cross and Jersey crossbred cows were studied. Among the various productive and reproductive parameters, except age at first calving, other parameters did not differ significantly between the cross breeds studied. Age at first calving was found to be significantly lower in HF cross than Jersey cross (Table 5).

Table 5. Productive and reproductive performance

Parameters	HF (n=7)	Jersey (n=5)
LL (days)	282.71±9.01	441.80±183.07
LY (liters)	1202.97±233.20	795.80±204.65
PY (days)	27.86±3.5	24.20±3.8
DMY(liters)	4.22±0.77	3.06±0.55
AFC (days)	885.0±40.31c(29.5 months)	1140.44±711d**(38.0 months)
ICP (days)	559.80±56.01 (18.63months)	499.17±24.85 (16.63months)
Birth wt. (Calf) (kg)	23.11±1.87	18.71±1.24

EVALUATION OF THERAPEUTIC AND IMMUNOMODULATORY PROPERTIES OF *MORINDA CITRIFOLIA* IN POULTRY

Jai Sunder, D.R.Singh, A.Kundu and S.P.Yadav

Growth performance and immunomodulatory property of leaf extract of *M.citrifolia* in poultry

Morinda citrifolia is one of the traditional folk medicinal plants that have been used over centuries in many countries. In the present study the immunoenhancer effect of *M.citrifolia* leaf extract was studied in poultry. The humoral and cellular mediated immune response was assessed in the poultry fed with leaf extract of *M. citrifolia.*

The leaf of *M. citrifolia* was boiled, grounded and then sieved to get the extract. The extract was fed to the poultry by mixing it @ 5% in drinking water. A total of 40 Nicobari day old chicks (Black, White & Brown) were used for the experiment. The birds were divided into 2 subgroups with 20 birds in each group.

Group A: Control fed with normal basal ration.

Group B: Morinda leaf extract supplement @ 5 % in the water with normal basal ration.

All the birds were maintained under standard deep litter system of rearing and fed with normal chick ration. Standard feeding and managemental conditions were precisely followed. Fresh water was given *ad libitum* during the whole experimental period and no medication, antibiotics, dewormer etc were given to the birds. Daily mortality, health status were also noted in all the groups. The body weight gain, at weekly interval till 4th week and then fortnightly from 5th week, FCR and performance index {live weight (g)/ FCR} of all the groups were recorded. Mortality and post mortem of dead birds recorded daily, and studied Humoral and CMI response.

Table 6. Growth performances of the two group of birds at different week interval

Week	Body weight gain		Feed conversion ratio		Performanceindex	
	Control	Morinda	Control	Morinda	Control	Morinda
0-4	44.8±7.3	43.3±10.8	2.6±0.3	2.7±0.4	18.6±4.5	18.7±7.4
4-8	76±19.1	74.3±15.5	4.6±1.0	4.5±1.2	21.3±8.8	21.5±7.5
8-12	87.5±19.5	79±11	5±1.1	4.4±0.8	23.2±10.3	19.8±4.4
0-12	69.4±10.1	65.5±8.1	4.1±0.5	3.9±0.5	21±4.4	20±3.5

The growth performances in terms of body weight gain, FCR, feed efficiency and performance index at weekly interval of both the groups are presented in the Table 6. However, no significant difference was recorded in terms of body weight gain, FCR, feed efficiency and performance index in the both the control and Morinda fed group.

Humoral immune response

The results of the HA test with means along with standard errors for antibody response (HA titer) are given in Table 7. The results revealed the appearance of antibody in both the groups A and B on 1st and 2nd week of immunization. The antibody titer reached its peak at 1 week PI in both the groups. The HA titer values in Morinda fed group was found to be significantly higher ($p<0.05$) than control.

Table 7. Means and standard errors of HA titer (log2) of different group of birds

Week	Control	Morinda
0	0	0
1	4.6	31.4
2	0.5	1.12
3	0	0
4	0	0
Avg.	1.02±0.9	6.5±6.2

Cellular mediated immune response

The results of the cellular mediated immune response are given in Table 8. The cellular mediated immune response showed no significant T cell response in both the groups. The values were group A (0.58 ± 0.02), group B (0.43 ± 0.09).

Table 8. Cellular mediated response of the two groups of birds of different breeds

Bird	Control	Morinda
Brown Nicobari	0.6	0.4
White Nicobari	0.6	0.6
Black Nicobari	0.55	0.3
Avg.	0.58± 0.02	0.43±0.09

Total serum protein concentration

The results of the protein content are given in Table 9.The protein content of both the group showed no significant difference. The average values were group A (37.6 ± 1.8), group B (36.2 ± 1.9).

Mineral concentration in leaves and fruits

Morinda citrifolia fruit and leaves were subjected to dry ashing for the preparation of acid-mineral extract (Jones *et al.*, 1969) for micronutrients and macronutrients analysis by atomic absorption spectrophotometer and result is given below in ppm.

Table 9. Micronutrients and macronutrients of *M. citrifolia*

Plant parts	Zn	Mn	Fe	Cu	Ca	Mg	Na	K
Morinda citrifolia (fruit)	26	14.5	33	6.7	1592	533	336	11548
Morinda citrifolia (leaf)	52	23.4	44	4.0	6008	776	845.5	13903

IMPROVEMENT, EVALUATION AND PROPAGATION OF INDIGENOUS NICOBARI FOWL AND DUCKS AND DISSEMINATION OF TECHNOLOGY IN TSUNAMI AFFECTED AREA

A. Kundu, T. Sujatha, S.Jeyakumar, Jai Sunder and B.Ganesh Kumar

Hatching eggs of Peckin and Khaki Campbell ducks (50 No. each) were procured from Hessarghatta, Bangalore. They were hatched out and ducklings are under the process of multiplication and performance evaluation (Table 10).

1. Cross breeding programmes

i) Black rock male X Black Nicobari female

ii) Black rock male X white Nicobari female

iii) Brown Nicobari male X ILI -80 female

Table 10. Number of hatching eggs, hatchability, chick weight and progenies produced

Type of cross eggs (Nos.)	Hatching (%)	Hatchability weight (gms)	Day old chick (Nos.)	Progenies
i) Black rock male X Black Nicobari female	1159	24.9 ± 2.5	24.3 ± 1.2	283
ii) Black rock male X white Nicobari female	198	47.5 ± 5.5	29.6 ± 1.1	81
iii) Brown Nicobari male X ILI -80 female	459	29.7 ± 4.4	31.4 ± 0.6	109

EVALUATION AND UTILIZATION OF AZOLLA AS A FEED SUPPLEMENT FOR BACKYARD POULTRY IN BAY ISLANDS

T. Sujatha, A. Kundu, M.S. Kundu, S. Jeyakumar, Jai Sunder, Abhay Kumar Singh, Satyanarayana Sethi and Prasanth Deshmukh

Introduction and proximate analysis of Azolla

The aim of the project was to introduce, evaluate and utilize nutritive value of Azolla under this hot humid tropical condition of these Islands. *Azolla pinnata* was brought from TNAU, Coimbatore and introduced at the institute farm during the month of August (monsoon season) and maintained under the standard condition. Azolla yielded approximately 700 gm/m^2 once in two or three days. Proximate composition of sun dried Azolla powder

was carried out as per the standard procedure. The moisture, crude protein, crude fiber, ether extract and total ash were found to be 4.92, 21.17, 4.60, 4.59 and 19.91 per cent respectively. The mineral content *viz*. calcium, phosphorus, Iron and Manganese were 1.05, 0.69, 0.49 and 0.20 per cent respectively. The results of the present study demonstrated that Azolla could be grown and cultivable under this island ecosystem and its nutritive value showed the feasibility of its utilization as a feed supplement for livestock and poultry.

Supplementation of Azolla in the feed of growing quails

A 42 days period of trial was conducted using 40 quail chicks of 10 days old. Quail chicks were divided into two groups having four replications in each group with five chicks in each replicate. Both groups were fed adlibitum with quail starter mash. In one group, Azolla was supplemented along with quail starter mash at the rate of 10 gms/bird/day. And the other group was fed with quail starter mash alone without any supplementation and kept as a control group. Residual feed was quantified every day and weekly feed consumption and body weight was measured. Based on weekly feed consumption and body weight, feed conversion efficiency was arrived at weekly intervals. Mortality was monitored through out the trial period. At the end of 42nd day, 5 male and 5 female from each group were randomly selected and slaughtered. The carcass quality parameters namely dressing, giblet, eviscerated yield and ready to cook percentage were obtained. All these data were subjected to statistical analysis.

Results pertaining to the parameter are depicted in the Table 11. Weekly body weights of quail chicks were comparatively and numerically low up to fourth week with Azolla supplemented group than control group. But they are not statistically significant. Body weights of azolla fed and control group in fifth and sixth week did not differ significantly. Azolla supplementation in quail feed up to the age of marketing did not affect feed intake adversely. No significant difference was observed in feed intake between azolla fed and control groups. Initially there was reduction in feed intake, which might be due to sudden introduction of azolla in the regular feed and less palatable to small chicks, but from fourth week onwards, feed intake got stabilised and was at par with control group. However inspite of comparatively less feed intake during starting phase of azolla supplementation, body weights were not affected adversely. Feed conversion efficiency did not differ significantly between azolla fed and control groups. Though not significantly, numerically better FCR and carcass yield was obtained with azolla fed group.

Table 11. Effect of Azolla supplementation on production performance of growing quails

Parameters	Azolla group	Control group
Average body weight ^{NS}	108.51±3.37	109.50±4.09
Feed consumption ^{NS}	141.16± 0.23	134.88± 0.36
Average feed intake (gms) / bird/ day after Azolla supplementation		
Age in weeks	**Azolla group**	**Control group**
2nd ^{NS}	6.32	9.45
3rd ^{NS}	8.92	9.22
4th ^{NS}	13.44	13.35
5th ^{NS}	18.00	18.43
6th ^{NS}	23.52	22.48
Feed conversion ratio ^{NS}	4.14	4.19
Carcass quality		
Carcass qualities	**Azolla group**	**Control group**
Eviscerated carcass yield% ^{NS}	63.13±2.16	61.95±1.19
Giblets % ^{NS}	7.07±0.45	6.24±0.37
Dressing % ^{NS}	84.43±4.28	81.57±2.52
Ready to cook % ^{NS}	70.20±2.28	68.18±1.37

Feed cost benefit with azolla supplementation

Groups	Total feed intake per bird (gms)	Feed saved per week per quail over control (gms)	Feed cost saved per quail	Averg. feed saved for 200 birds at market age (kg)	feed cost saved (Rs.) per flock (200 birds)
Azolla fed	448.97	10.73	16.09 paise	2.145	32.175
Control	459.70				

Azolla supplementation replaced 2-3% of commercial feed which in turn saved the feed cost which will fetch a premium benefit for small scale broiler quail farming community.

Effect of Azolla feeding on productive and immuno competency status of indigenous fowl

A study was undertaken to investigate the productive and immuno competency effect of azolla supplementation in Nicobari fowl feeding. 40 Nicobari fowls were randomly divided in to two groups with 5 replications in each group and 5 birds in each replicate. The basal layer ration was supplemented with azolla at the rate of 40% in one group. Another group was fed with basal layer feed alone without azolla supplementation and kept as a control. The production performance and immunocompetency effect on 0, 7th, 14th, 21st d postimmunisation against 2% GRBC (Goat Red blood cell) was monitored. It was found that azolla supplementation did not have any adverse effect on egg production (azolla: 26.56 nos Vs.22 nos control) with comparatively less commercial feed consumption (azolla: 2.16kgs vs. 3.356kgs control). Further it was observed that azolla supplementation saved feed cost of 59 paise/egg. Overall HA titer (azolla 1.20±0.22vs control 0.96±0.15) and MER titer (Azolla 0.15±0.15 vs. control 0.4±0.18) was high with azolla supplementation but CMI titer did not differ significantly between two groups (azolla 0.44 vs control 0.63). Total serum protein, the main contributing factor in antibodies production was significantly high with azolla fed group (azolla 70.71 mg/ ml vs control 57.48 mg / ml). It was concluded that azolla supplementation influenced immune system of chicken and produced higher titer value against GRBC without any adverse affect on production performance.

CHARACTERIZATION OF LHβ AND FSHβ AND THEIR RECEPTOR GENES IN GOAT BREEDS OF ANDAMAN AND NICOBAR ISLANDS

S.P. Yadav, S. Jeyakumar, A. Kundu and Jai Sunder

FSH and LH, central hormone of the mammalian reproduction system are heterodimer of a common á-subunit and hormone specific â-subunit. The study was undertaken with the objective to deduce the nucleotide sequence of LHâ, FSHâ and their receptor genes and to reveal the single nucleotide polymorphism (SNP) in the different exons of these genes in the three goat breeds of A&N Islands (Local Andaman, Teressa and Malabari). The study was also aimed to see the nucleotide polymorphism with respect to the reproductive status of the animal. Primers were designed for various exons of LHâ and FSHâ gene using web-based software primer3 (http://www-genome.wi.mit.edu/cgi- bin/primer/primer3-www.cgi). Primers for LHâ (exon 1,2 and intron 1, Accession no. AY853270) (forward: 5'-AGGCACCAAGGATGGAGATG-3';

reverse: 5′-TCACCATGCTGGGGCAGTAG-3′) and primers for FSHâ (exon 2 and exon 3, Accession no. AY853270) were (forward: 5′–CAGCCCAGGATGAAGTCC-3; reverse: 5′-AGCAAAGCAAAGTGCCTACC-3′) and (forward : 5′ – T C C T A A A C C A C T C A G G A C T T G G -3 ′; reverse: 5′ GCATCTGCTGCTCTTTATTCTC-3′).

PCR was performed in a final volume of 20 µl containing 100 ng of genomic DNA, 1X PCR reaction buffer (10 mM Tris-HCl, 50 mM KCl and 1.5 mM $MgCl_2$, pH 8.3), 0.2 mM of deoxyribonucleotides triphosphate, 0.4µM of each of forward and reverse primer and 1 U of Taq DNA polymerase. For exon 2 (187 bp) and exon 3 (260 bp) of FSHâ the PCR cycle conditions were 94 ^{0}C for 4 min, 35 cycles of 94^{0}C for 45 s, 55^{0}C for 30 s, 72^{0}C for 30 s and a final extension step at 72^{0}C for 4 min. However in case of LHâ (exon 1,2 and intron 1, 495 bp) the PCR conditions were remaining same except the annealing temp. of 58^{0}C for 30 s. The PCR products when visualized in agarose gel (2%) gives sharp bands of expected length (Fig 5 a & b).

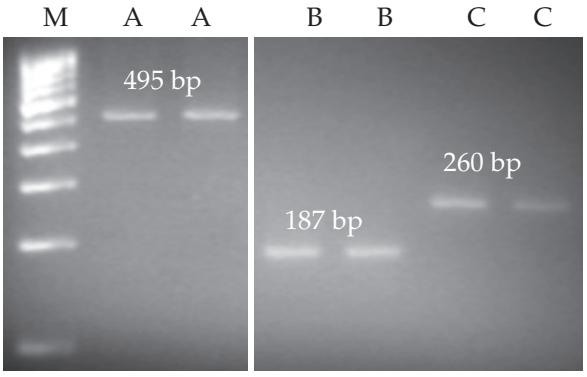


Fig 5. (a & b) : AA=PCR amplified products of LHâ (exon 1,2 & intorn 1), BB=FSHâ (exon 2), CC= FSHâ (exon 3) in 2% agarose gel. M=100 bp step ladder as stranded DNA marker

The PCR products were subject to the Single-Strand Conformation Polymorphism (SSCP) to analysis and screening of point mutations in LHâ (exon 1, 2 and intron 1). PCR product (5 µl) was mixed with equal amount of the loading buffer (95% formamide, 20 mM EDTA, 0.05% bromophenol blue, and 0.05% xylene cyanol). The samples when resolved on non- denaturing polyacrylamide gel (10%, 100 V for 8 hours at 17-20^{o}C) and silver-stained. Two different variants were observed in Teressa, local Andaman and Malabari goat breeds (Fig 6). The variant frequency in the different population and sequencing and sequencing analysis is in progress.

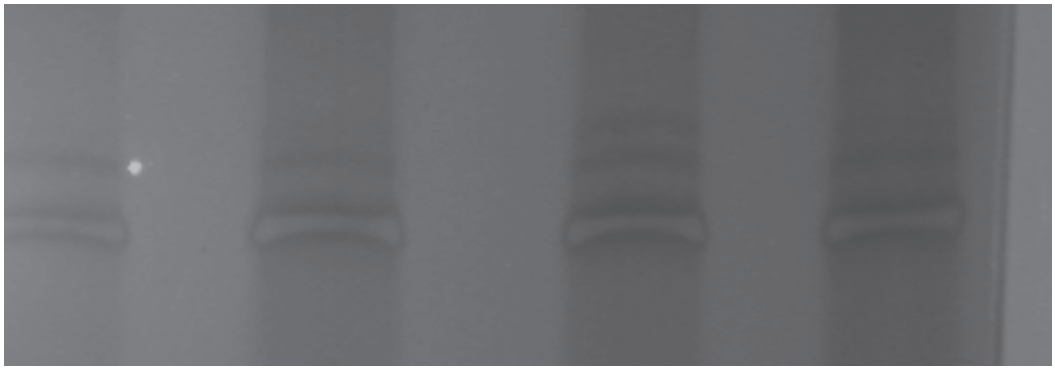


Fig 6. SSCP pattern (A &B) of the Local Andaman goat LHβ (495 bp)

CHARACTERIZATION OF LIVESTOCK PRODUCTION SUB SYSTEM AND ASSESSMENT OF CRITICAL NUTRITIONAL GAP IN BAY ISLANDS

S.K. Verma, A. Kundu, M.S. Kundu, Subhash Chand, Jai Sunder and S.P. Yadav

Survey of Livestock Production System

Survey was carried out to assess the status of livestock production system and the nutritional gap. After the havoc of *Tsunami*, production of milk which was 25000 MT during 2003-2004 reduced to 20000 MT in 2005-2006 due to the shortage of feeds and fodder, while the required quantity of milk is 33000 MT. The prime factor responsible for the shortage of dry fodder is reduction in the net area sown of rice by 25 percent, reducing the availability of paddy straw for livestock feeding. Beside this availability of concentrate feeds is also less because these Islands are fully dependent on mainland for the supply of concentrate feeds. Therefore livestock mainly depend upon grazing alone on fallow land, waste land, community land or grazing lands and stall-feeding in not a general practice. Feeding of top feeds to livestock is not in fashion and the farmers are not well aware about the fodder tree species. Very less emphasis has been given on augmentation of fodder resource base in these Islands.

To bridge these nutritional gaps following steps can be undertaken

1. Feed and fodder resource base has to be increased.
2. Planting fodder trees and grasses in community controlled areas.
3. Enhancing the productivity of fodder grasses and fodder trees from private farms. Uncultivable community and private lands, marginal lands, terrace risers should also be used for planting of fodder species (trees, grasses and shrubs).
4. Fodder supply can also be increased by utilizing intercropping spaces in coconut and areca nut plantations by planting suitable grasses.
5. In low lying areas and inundated areas due to saline water after *Tsunami*, sowing of Coix may be a better choice.
6. On hilly slopes, Teosinte and Rice Bean may be grown after making small terraces and on terrace riser plantation of hybrid Napier can provide fodder as well as can serve as soil and water conservation measures.
7. Efficient use of agricultural residues *viz.* ammonia (urea) treatment of crop residues and dry forest grasses as well as their supplementation with urea-molasses mineral blocks.
8. Surplus crop residues produced in North and Middle Andaman region may be used for creation of fodder banks to be utilized during fodder scarcity and natural disasters.

CHARACTERIZATION AND CONSERVATION OF NICOBARI PIG

S. Jeyakumar, Jai Sunder, S.P. Yadav and A. Kundu

Survey was conducted in Teressa, Katchal and Champin Islands to record information about the population status, physical characters, slaughter and carcass processing among the tribes Nicobar group of Islands.

In Teressa Island a total of 19 families were interviewed from four villages (Alurong, Chukmachi, Minyuk, and Innam). The population distribution of pig under various age groups were found to be 26, 45, 68, 42, 61 and 47, for male piglet, female piglet, male grower, female grower, adult male and adult female, respectively. The herd composition revealed that the average holding per family was 15.21. The herd composition of various age group of Nicobari pig was 8.99, 15.57, 23.52, 14.53, 21.10 and 16.26 per cent for piglet male, female, grower male, female, adult male and female, respectively.

Five families were interviewed from two villages (Japan Tikrey and Mildera) of Katchal Island. The population distribution of pig under various age groups were found to 4, 1, 2, 6, 6 and 4, for male piglet, female piglet, male grower, female grower, adult male and adult female respectively. The herd composition revealed that the average holding per family was 4.6 and herd composition of various age of Nicobari pig was 17.39, 4.34, 8.69, 26.08, 26.08 and 17.39 per cent of piglet male, female, grower male, female, adult male and female, respectively.

In Champin Island, a total of 100 families were interviewed from 11 villages (Balu Basti, Hitui, Hinpova, Panam, Hinvoha, Lapat, Pauha, Nuot, Munak, Chota Enaka and Sanuh). The population distribution of pigs under various age groups were 395, 199, 270, 312, 223 and 986 for male piglet, female piglet, male grower, female grower, male adult and female adult, respectively. The herd composition revealed that the average holding per family was 23.85 and herd composition of various age of Nicobari pig was 16.56, 8.34, 11.32, 13.08, 9.35 and 41.34 per cent of piglet male, female, grower male, female, adult male and female, respectively.

Physical Characters

Majority of Nicobari pigs appeared short, black and brownish in colour. The coat colour and eyelid was found to be black. The ears were straight with an average ear length and width length in boar is 5.61 ± 0.39, 3.89 ± 0.25 inches, respectively. The hoof color in Nicobari pig is greyish white with an average circumference of 4.5". The head and tail length were recorded as 3.00 and 7.61 ± 0.37 inches. The whole body length and chest girth of male were 33.42 ± 3.45 and 33.29 ± 2.38 inch, respectively. The height of male Nicobari pig was recorded 22.84 ± 2.15 inch. The average abdominal circumference and neck girth were 35.97 ± 3.19 and 32.00 ± 3.08 inch respectively.

Nicobari pig slaughter and carcass processing

Pigs were reared mainly for pork consumption among Nicobari tribals. During the pig festival (Canahaun), which is celebrated after Christmas in the month of Jan. – Feb. Nicobari families select a grown up swine from their stock, slaughter and distribute it among themselves. Pigs were slaughtered by direct cardiac puncture using a sharp-ended stick, which was passed through a small slit made just in front of xiphoid sternum. Then, the entire pig was roasted in fire for scalding and subjected for cut off parts for consumption. It was interesting to observe that slaughter processor was done very systematically by the tribal. Further is was reported that in Teressa island after consumption of pork pig blood was smeared over the abdomen believing that this practices improves their digestion. In Chowra Island pig blood was smeared all over the body for medicinal purpose. The pig fat was smeared over the processed or uncooked meat (pork) for preservation for short duration.

Plate 3. Nicobari tribal woman feeding fresh coconut to Nicobari pig

Plate 4. Shelter of a Nicobari tribal family at Teressa Island

Plate 5. Slaughter and preparation of cut off parts

Plate 6. Cut off parts ready for consumption

CHARACTERIZATION CONSERVATION EVALUATION AND IMPROVEMENT OF NATIVE TERESSA GOAT - AN UNREPORTED INDIGENOUS GERMPLASM

S. Jeyakumar, Jai Sunder, S.P. Yadav and A. Kundu

Survey was conducted in Teressa, Katchal and Champin Islands to record information about to the population status, physical characters of Teressa goat among the tribes Nicobar group of Islands.

In Teressa Islands a total of 32 families were interviewed from four villages (Alurong, Chukmachi, Minyuk, and Innam). The population distribution of goat under various age groups were found to be 4, 5, 9, 5, 20 and 23male kid, female kid, grower male, grower female, adult male, and adult female respectively. The herd composition revealed that the average holding per family was found to be 11.67.

Two families were interviewed from two villages (Japan and Mildera) of Katchal Island. The population distribution of goat under various are groups were found to 3, 7, 3, 1, 2, 8 , male kid, female kid, male grower, female grower, adult male and adult female, respectively. The herd composition revealed that the average holding per family was found to be 3.

In Champin Island, a total of 2 families were interviewed. The population distribution of goat under various age groups were found to2, 1, 4, 4, 1and 7 be for male kid, female kid, male grower, female grower, male adult and female adult, respectively. The herd composition revealed that the average holding per family was found to be 3.60.

Physical Characters

Majority of the goats appeared tall, brownish or dark tan or black or white in colour with white and black patches. The goats were

Plate 7. Teressa goat under the Nicobari shelter in Alurong village of Teressa island

Plate 8. Teressa goat is being fed with coconut at Teressa island

healthy and timid in nature. Dorsal midline was lined by black hairs up to the tail. Muzzle, eyelids and hoofs were black in colour. These breeds were sturdy and very tall compared to other local breeds. Their height ranged from 26 to 32 inches. Castrated male reached even more than this height. Average height of an adult was 26.9 ± 0.36 inches. In some goats bear and wattle were absent. Head length was 8.5 ± 0.22, tail was generally medium to long, horns were large, flat at base and directed backwards with an average length of horn was 4.0± 0.1 inches. Ears were little erect and directed downwards with an average length of 4.3 ± 0.41 and width of 2.3 ± 0.12 inches.

Carcass Character

Goats were reared mainly for meat consumption. Some farmers used the milk for consumption. Few farmers used the skin of the goat for preparing drum like musical instrument. The average age (months) at slaughter and live weight (kg) at slaughter was 14.1 ± 0.8 and 45.7 ± 2.3, respectively.

STUDIES ON THE STATUS OF MINERAL PROFILE IN BOVINES IN RELATION TO DISEASE AND PRODUCTION

Jai Sunder, A. Kundu, S. Jeyakumar and R.B.Rai

Soil

Overall Fe, Cu, and Mn were found higher than the critical level in all the season mainly the monsoon season, but the Zn was low in all the villages in pre-monsoon and dry season but was again high in monsoon season. Comparatively the level was high in the valley region.

The level of Ca and K was found close to their critical level in almost all the villages. Season wise comparison shows that it was low in dry with slight variation in premonsoon and monsoon. Irrespective of season, Mg was higher than its critical level. Na concentration actually varies from trace amounts to large portions (43ppm to 126 ppm). Sodium was almost the same in premonsoon and dry season and low in monsoon season. Individual villages showed low P concentration but when averaged for 3 seasons it was within the critical level. Ca Mg and Na was recorded high in the valley region; and K and P was high in the hill top.

Fodder

The level of Zn was found lower than the critical level. Overall, the level of Fe in fodder in all the season was found to be very high and at some of the places very high concentration was detected. The level of Cu was found towards the lower side of the critical limit. At hill tops, Mn was

within critical level, while Zn & Cu were high, whereas in the valley, Fe & Mn was high.

Overall the level of macronutrients Mg, K and P was found to be lower their critical level except Ca and Na which were found within the normal range.

Water

Zn concentration was found below the critical level Fe, Mn and Cu concentration was higher than their critical level. Ca, Mg and Na were above their critical limit in all the villages in premonsoon and dry but below the critical level in monsoon. K was below its critical limit.

Serum

Serum analysis (Table 12) revealed that in micro minerals Fe and Mn was within the normal range but was deficient in Cu and Zn. In macro minerals Ca and P was within the normal range but was deficient in Mg, Na and K. Fe, Cu, Mn and Zn showed no significant difference but Ca, Mg and K concentration are significantly higher in fertile animals than in calf and infertile cows. The average P level was lower in the nonlactating cattle serum when compared with the calf and the lactating cattle serum. Overall, the level of both micro and macro minerals were higher in fertile than in infertile animals and calf except the level of Cu. Ca:P ratio was found to be closer to the required ratio (2:1) in lactating (1.94) than in calf (1.5) and non-lactating (1.86). The sera sample analysis of the cattle representing the each village suggests that the level of Mg, Na, K and Ca was found lower than normal value. Ca:P ratio of the cattle of the infertile zone was lower than the fertile zone.

Table 12. Mineral concentration (in ppm) in sera of calf, fertile and infertile cows

	Fe (ns)	Cu (ns)	Mn (ns)	Zn (ns)	Ca (**)	Mg (*)	Na (ns)	K (*)	P (*)
Calf	1.5± 0.13	0.57± 0.07	0.03± 0.006	0.5± 0.06	88.7± 3.5 ^{b}	12.4± 1.4 ^{b}	1019± 24.7	68.1± 3 ^{ab}	59.06 ± 4.9^{a}
Infertile	1.45± 0.13	0.5± 0.07	0.04± 0.006	0.52± 0.06	93.8± 4.2 ^{b}	13.4± 1.6 ^{ab}	1049± 27.8	62.9± 3 ^{b}	50.3± 5.09^{b}
Fertile	1.7± 0.14	0.5± 0.05	0.04± 0.007	0.53± 0.03	107.3± 5.2 ^{a}	16.7± 1.3 ^{a}	1095± 25.6	72.4± 3 ^{a}	54.45± 3.28^{ab}

** → *Means with different superscripts in a column differ significantly (P< 0.05)*
* → *Means with different superscripts in a column differ significantly (P< 0.01)*
NS → *not significant*

CONSERVATION AND PHENOTYPIC AND MOLECULAR CHARACTERIZATION OF INDIGENOUS GOATS OF ANDAMAN AND NICOBAR ISLANDS

S.P. Yadav, S. Jeyakumar, Jai Sunder and A. Kundu

Goat farming serves as an asset for landless, marginal farmers and tribals of A & N Islands. The objective of the present study was phenotypic characterization of indigenous goats of Andaman & Nicobar Islands, three breeds *viz.* Teressa, Local Andaman goat (indigenous) and Malabari goat (introduced from mainland India). Survey was conducted and physical parameters were recorded in a total of 33 villages belonging to 18 villages of South Andaman, nine villages of North/Middle Andaman & six villages of Little Andaman (Table 13).

On statistical analysis, numerical differences in physical parameters were observed. The sexual dimorphism within breeds was also observed and some of the parameters showed significant difference ($p<0.05$) between male and female. In Local Andaman goat the abdomen circumference (Male 26.63±0.49; Female 30.06±0.41), Chest Circumference (Male 25.98±0.35; Female 24.09±0.32), Neck Circumference (Male 13.07±0.67; Female 11.31±0.16), Hoof Circumference (Male 5.98±0.09; Female 5.68±0.08), Horn Length (Male 3.96±0.23; Female 2.40±0.14) and Tail Length (Male 4.77±0.16; Female-4.18±0.07) were found to be statistically significant ($p<0.05$). In Malabari goat the Ear Width (Male 2.92±0.08; Female 2.67±0.06), Horn Length (Male 5.47±1.23; Female-3.30±0.32) and Tail Length (Male 6.17±0.60; Female 4.26±0.17) was found to be statistically significant. Though numerical difference in some parameters were found in Teressa goat, but significant difference in sexual dimorphisms was not observed. The Scrotum Circumference (7.30±0.24); Udder circumference (8.73±0.43) of adult Local Andaman goat were also found statistically significant ($p<0.05$) from adult Malabari goat. The values of Scrotum Circumference and Udder Circumference for Malabari goat were 8.08±0.30 & 9.74±0.67 respectively. Teressa goat show the maximum body weight (Male 34.92±4.26; Female 32.36±1.47) followed by Malabari (Male 30.44±7.09; Female 27.68±1.69) and Local Andaman goat (Male 28.21±0.95; Female 23.45±0.70). Regarding rearing practices the Local Andaman and Malabari goats were reared in semi intensive system while Teressa goats were maintained under free range system.

Plate 9. An adult male Local Andaman Goat

Plate 10. An adult female Local Andaman Goat

Plate 11. An adult male Teressa Goat

Plate 12. An adult female Teressa Goat

Table 13. Physical Parameters of Adult Goat Breeds (Mean ± SE)

Body Measurements (in inches)	Local Andaman Goat		Malabari Goat		Teressa Goat	
	Male (n=33)	Female (n=145)	Male (n=12)	Female (n=18)	Male (n=14)	Female (n=27)
Length	21.76 ± 0.34	21.28 ± 0.38	22.33 ± 1.68	21.87 ± 0.61	27.61 ± 1.54	24.40 ± 0.81
Height	22.59 ± 0.49	22.28 ± 0.18	23.42 ± 1.35	22.45 ± 0.49	25.50 ± 1.13	25.13 ± 0.42
Abdomen circumference	26.63 ± 0.49*	30.06 ± 0.41*	30.75 ± 2.92	32.18 ± 0.96	31.22 ± 1.12	32.14 ± 1.21

Chest circumference	25.98 ± 0.35*	24.09 ± 0.32*	26.42 ± 2.15	25.79 ± 0.61	27.38 ± 1.52	27.99 ± 0.50
Neck circumference	13.07 ± 0.67*	11.31 ± 0.16*	15.58 ± 2.68	11.37 ± 0.61	14.20 ± 1.34	11.84 ± 0.47
Head length	6.80 ± 0.18	6.59 ± 0.08	7.37 ± 0.52	6.24 ± 0.28	7.20 ± 0.90	6.14 ± 0.18
Leg length	18.38 ± 0.26	18.24 ± 0.25	16.50 ± 1.43	16.11 ± 0.45	20.30 ± 1.78	18.99 ± 0.60
Hoof circumference	5.98 ± 0.09*	5.68 ± 0.08*	6.25 ± 0.42	6.05 ± 0.18	6.60 ± 0.51	5.99 ± 0.23
Ear length	5.33 ± 0.07	5.18 ± 0.06	5.50 ± 0.18	5.25 ± 0.17	4.81 ± 0.33	5.20 ± 0.12
Ear width	3.00 ± 0.04	3.04 ± 0.05	2.92 ± 0.08*	2.67 ± 0.06*	2.37 ± 0.15	2.60 ± 0.05
Ear circumference	4.95 ± 0.12	4.79 ± 0.10	5.58 ±0.20	5.26 ± 0.12	4.69 ± 0.18	4.96 ± 0.17
Horn length	3.96 ± 0.23*	2.40 ± 0.14*	5.47 ± 1.23*	3.30 ± 0.32*	5.64 ± 1.22	4.06 ± 0.31
Tail length	4.77 ± 0.16*	4.18 ± 0.07*	6.17 ± 0.60*	4.26 ± 0.17*	4.62 ± 0.24	5.05 ± 0.29

* Indicate statistically significance at P<0.05
SE: Standard Error
n=Sample size

DIVISION OF FISHERIES SCIENCE

ASSESSMENT OF CORAL REEF HEALTH USING SATELLITE DATA

S. Dam Roy, Grinson George, P. Krishnan, Kamal Sarma and S. Murugesan

Coral reef ecosystem is one of the most productive, diverse and beautiful of the ecosystems, which is studied to a bare minimum, owing to their discontinuous and sparse distribution. Despite widespread recognition that coral reefs are severely threatened, information about the status and nature of threats, pertaining to a particular reef like Andaman and Nicobar reefs is limited. This creates problem for taking up effective management measures to safeguard and conserve the resource. To study the coral of Andaman, the line transect survey was employed assisted by two diving assistants. Survey stations were selected from topographic maps. The total species recorded from Andaman and Nicobar are 192 under 57 genera in 15 families.

Surveys were conducted, using Line Intercept Transect (LIT) method, in Havelock Island, Boat Island and Tarmugli Island. Observations with respect to hydrographical parameters, percentage cover of different substrata including live corals were made. Salient observations made in different zones of selected coral reefs are furnished.

Havelock Island 2006

During the 2006 survey in all 7 transects were completed around the Havelock Island. The average hydrographical parameters during the survey were Air temperature 31.3 °C, water temperature surface 31 °C and bottom 30.5 °C, salinity 34.2 ppt, pH 7.6, Dissolved oxygen 4.2 ppm, carbon dioxide 0 ml/lit, Alkalinity 138.3 ppm, transparency 7.7 m. The analysis of LIT data indicated that live coral formed between 17-49 % and soft coral around 2 %. The other major components were rock 14 %, rock with algae 1 %, sand silted on rock 1 %, sand about 21 %, dead coral 22 %, sand with dead coral 7 %, dead coral with algae 5 % and others below 1 %. In the actual reef area (reef flat and reef slope), the live coral formed between 32 and 68 % with an average of 51 %, the dead coral formed 20 – 52 % with an average of 34 %. The soft coral also formed a significant component accounting to around 3 %. While the live coral percentage in reef flat varied from 36 to 58% with an average of 50 %, in the reef slope live coral percentage varied between 64 and 86 % with an average of 76 %. Soft corals were more abundant in the reef flat (6%) than reef slope (3 %). Among the live coral species, *Porites sp* were dominant. *P. lutea* was found to be the single largest component in the reef flat with 15% followed by *Porites nigrescens* (8 %), *Acropora hyacinths* (7 %), *Porites solida* (6%), *Symphyllia recta* (4 %) etc. The dominant coral species in the reef slope were *Acropora grandis* 44 %, *Porites lutea* (23 %) *Acropora robusta* 5 %, *Acropora nobilis* 5 % and *Diplostrea heliopora* 5 %.

Tarmugli Island 2006

During the 2006 survey, 5 transect were completed around the Tarmugli Island. The average hydrographical parameters during the survey were air temperature 31.6° C, water temperature surface 30.3 °C and bottom 29.8° C, salinity 34.9 ppt, pH 8.0, Dissolved

oxygen 4.6 ppm, carbon dioxide 0 ml/lit, Alkalinity 146.8 ppm, transparency 8.4 m. The analysis of LIT data indicated that live coral formed between 9 and 14 % with an average of 11 %, the soft coral below 1 %. The other major components were sand about 35 %, sand with algae was 2 %, sand and dead coral 12 %, sand with algae and grass 1 %, dead coral with algae 16 %, dead coral 21 %, sand with dead coral and algae below 1 %, algae 1 % and others below 1 %. In the actual reef area (reef flat and reef slope), the live coral formed ranged between 10 to 15 % with an average of 13 %, the dead coral formed ranged from 12 – 35% with an average of 23 %. The soft coral formed below 1 %. While the live coral percentage in reef flat varied from 12 to 16% with an average of 14 %, in the reef slope it was between 30 to 36 % with an average of 23 %. Soft corals were present below 1 % in the reef flat and in the reef slope it was 6 %. Among the live coral species, Porites sp were dominant. *Porites solida* and *Porites lutea* were found to be dominant components in the reef flat 18 %, and 18 % respectively, followed by *Heleopora coerulea* (13 %), *Porites lobata* (7 %) *Acropora palifera* (4 %), *Millepora exaesa* (4 %), *Stylophora pistillata* (2 %), *Goniastrea retiiformis* (2 %), *Porites nigrescens* (2 %), *Acropora humilis* (2 %), *Montipora peltiformis* (2 %), *Favites complanata* (2 %), *Favites abdita* (2 %), *Acropora gemmifera* (2 %) etc. *The dominant coral species reef slope were Acropora palifera (18 %), followed by Acropora ceralis* (16 %), *Psammacora digitata* (16 %), *Porites lutea* (14 %), *Seriatopora hystrix* (8 %) *Porites lobata* (9 %), *Montipora peltiformis* (3 %)and *Goniopora stokesi* (3 %).

Boat Island 2006

During the 2006 survey, 6 transects were completed around the Boat Island. The average hydrographical parameters during the survey were air temperature 32.3 °C, water temperature surface 31.2 °C and bottom 30.7 °C, salinity 34.7 ppt, pH 7.9, Dissolved oxygen 4.8 ppm, carbon dioxide 0 ppm, Alkalinity 142 ppm, transparency 11.3 m. The analysis of LIT data indicated that live coral formed between 9 and 23 % with an average of 16 %, the soft coral was below 1 %. The other major components were rock 4 %, sand 22 %, sand with dead coral 4 %, dead coral 37 %, dead coral with algae 8 %, sand with dead coral and algae 10 %, and the others below 1 %. In the actual reef area (reef flat and reef slope), the live coral formed between 23 and 60 % with an average of 33 %, the dead coral formed 40 – 71 % with an average of 52 %. The soft coral formed only1 %. While the live coral percentage in reef flat varied from 22 to 66 % with an average of 33 %, in the reef slope area ranged between 11 to 57 % with an average of 34 %. Soft corals were present upto 1 % in the reef flat and in the reef slope it was 3 %. Among the live coral species, *Porites* sp were dominant. *Porites solida* and *Porites lobata* were found to be the dominant components in the reef flat with 23 % and 15 %, respectively, followed by *Montipora capricornis* (13 %), *Porites lutea* (5 %) *Heleopora coerulea* (4 %), *Pocillopora eydouxi* (3 %), *Porites nigrescens* (3%), *Millepora exaesa* (3 %), *Acropora hyacinthus* (3 %), *Porites cylindrica* (2 %), *Acropora robusta* (2 %), *Acropora monticulosa* (2 %), etc. The dominant coral species reef slope were *Porites lutea* (15 %), followed by *Acropora hyacinthus* (13 %), *Seriatopora hystrix* (9 %), *Millepora exaesa* (7 %), *Acropora muricata* (7 %), *Porites nigrescens* (6 %), *Porites solida* (6 %), *Pavona venosa* (5 %) and *Millepora platyphylla* (4%).

Plate 1. *Acropora* sp (digitate)

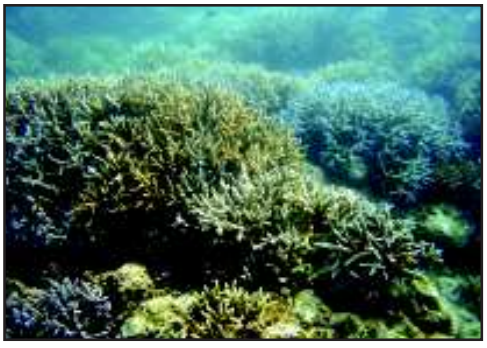


Plate 2. *Acropora* sp (branched)

Plate 3. *Acropora* sp

Plate 4. *Diaseries* sp

Plate 5. *Echinopora* sp

Plate 6. *Euphyllia* sp

Plate 7. *Favites* sp

Plate 8. *Favites* sp

BROOD STOCK DEVELOPMENT AND BREEDING OF DAMSELFISHES OF ANDAMAN AND NICOBAR ISLANDS

Grinson George, S. Dam Roy, C.S. Chaturvedi, K. Sarma, S. Murugesan and B. Varghese

Andaman and Nicobar islands posses a rich diversity of marine ornamental fishery resources. Damselfishes are the commonly found ornamental fishes of Andaman, which are having significant demand in domestic as well as export market. These fishes are living in association with many other organisms like sea anemone etc in the coral reef areas. There are about 15 varieties of species harbouring in this island. A need was felt to develop suitable techniques to enhance the culture of these species in this island to safe guard the natural population. The importance of Damsel fish species in aquarium trade and as well as its availability in these islands paves the opportunity to carryout research in the various aspects of biology and ecology of Damsel fish species. Hence, this project has been taken up with the objectives to survey the Damselfish species and develop a brood stock for breeding them.

The possibility of sustainable harvest of ornamental fish resources for artificial aquarium was mooted up with the initial success obtained in *Amphiprion percula*, a damselfish species available in Andaman reefs. Line Intercept Transect (LIT) method, (English *et.al*, 1994) was devised for successful estimation of ornamental fish resources of the islands (Photo 1-8). Resource estimation at major reef sites- Jolly Buoy, Tarmugli and Boat Island at Mahatma Gandhi Marine National Park was done along with Havelock Island at Rani Jhansi Marine National Park. In all, 115 species of reef fishes were recorded in the surveys. Percentage wise abundance of different species was recorded for selected transects (Table 1). Brood stock development is being done at Marine Research Laboratory, Marine Hill in aquarium tanks, where the hydrographic and feeding features are mimicked in resemblance with the natural conditions of the brooders. Live feed like rotifers and various mixed algal diets are tried upon in addition to shrimp meat and egg yolk. Rotifers and algae are collected from brackish and marine waters, isolated and mass-cultured for feeding the brooders. Brood fishes were collected from wild from the reef waters mentioned above.

Table 1. Percentage availability of different species of *ornamental reef* fishes in South Andaman waters

Sl.No.	Name of the species	HL	JB	TM	BT
1	*Abudefduf bengalensis*	0.00	1.47	0.33	0.00
2	*Abudefduf notatus*	0.37	2.53	0.11	0.00
3	*Abudefduf sexfasciatus*	0.44	0.00	0.00	0.00
4	*Abudefduf sexatilis*	0.00	0.00	0.00	11.23
5	*Acanthurus gahhm*	0.00	0.00	0.00	0.55
6	*Acanthurus leucosternon*	0.03	0.35	0.41	2.26
7	*Acanthurus lineatus*	1.25	0.21	0.10	2.42
8	*Acanthurus nigricaudus*	0.51	0.59	0.61	0.00
9	*Acanthurus triostegus*	0.27	0.00	0.00	0.84
10	*Anyperodon leucogrammicus*	0.05	0.00	0.00	0.00
11	*Amphiprion akallopisos*	0.10	0.02	0.00	0.00
12	*Amphiprion clarkii*	0.00	0.00	0.00	0.42
13	*Amphiprion ephippium*	0.42	0.29	0.24	0.49
14	*Amphiprion nigripes*	0.00	0.09	0.00	0.00
15	*Amphiprion ocellaris*	0.00	0.15	0.05	0.00
16	*Amphiprion percula*	0.51	0.26	0.30	1.93
17	*Anyperodon leucogrammicus*	0.00	0.05	0.00	0.00
18	*Apogon hyalasoma*	0.00	0.00	0.00	1.57
19	*Arothron nigropunctatus*	0.13	0.00	0.00	0.00
20	*Arothron stellatus*	0.06	0.00	0.00	0.00
21	*Balistus undulatus*	0.09	0.21	0.22	0.93
22	*Balistus viridiscens*	0.08	0.14	0.16	0.20
23	*Caesio xanthonatus*	0.00	0.40	0.00	0.00
24	*Caranx ignobilis*	0.56	0.54	0.11	8.53
25	*Caranx hippos*	0.02	0.00	0.00	0.00
26	*Cephalopholis argus*	0.22	0.15	0.13	1.02
27	*Cephalopholis leopardus*	0.07	0.10	0.07	0.62
28	*Cephalopholis miniata*	0.00	0.06	0.00	0.89
29	*Chaetodon plebeius*	0.09	0.00	0.00	0.00
30	*Chaetodon auriga*	0.22	0.31	0.26	0.31

31	*Chaetodon bennetti*	0.11	0.00	0.00	0.00
32	*Chaetodon collare*	0.18	0.10	0.09	2.30
33	*Chaetodon decussatus*	0.24	0.15	0.16	0.18
34	*Chaetodon falcula*	0.16	0.15	0.18	2.26
35	*Chaetodon fasciatus*	0.00	0.00	0.04	0.00
36	*Chaetodon lineolatus*	0.07	0.04	0.05	0.00
37	*Chaetodon meyeri*	0.10	0.11	0.05	0.29
38	*Chaetodon oxycephalus*	0.00	0.12	0.02	0.00
39	*Chaetodon plebeius*	0.00	0.03	0.00	0.13
40	*Chaetodon punctatofasciatus*	0.20	0.00	0.00	0.00
41	*Chaetodon triangulum*	0.31	0.00	0.00	0.00
42	*Chaetodon trifascialis*	0.00	0.00	0.04	0.00
43	*Chaetodon trifasciatus*	0.26	0.10	0.17	2.35
44	*Chaetodon vagabundas*	0.11	0.04	0.05	1.60
45	*Chaetodon xanthocephalus*	0.00	0.00	0.11	0.00
46	*Chromis dimidiatus*	26.04	10.59	1.33	32.57
47	*Chromis nigrura*	47.93	69.89	57.18	0.00
48	*Chromis opercularis*	1.38	1.88	2.40	0.00
49	*Chromis virida*	2.07	1.36	15.07	0.00
50	*Corythoichthys amplexus*	0.21	0.00	0.00	0.00
51	*Dascyllus aruanaus*	1.00	0.24	0.29	3.10
52	*Dascyllus carneus*	0.49	0.00	0.00	0.00
53	*Dascyllus trimaculatus*	0.29	0.00	0.00	0.00
54	*Epinepheleus hexagonatus*	0.30	0.17	0.14	2.33
55	*Epinepheleus malabaricus*	0.06	0.02	0.14	0.00
56	*Epinepheleus merra*	0.25	0.20	0.15	0.49
57	*Epinepheleus tauvina*	0.00	0.00	0.00	0.20
58	*Forcipiger flavissimus*	0.00	0.00	0.00	0.16
59	*Gnathanodon speciosus*	0.00	0.15	0.12	0.00
60	*Gymnothroax breedeni*	0.00	0.04	0.00	0.00
61	*Gymnothorax flavimarginatus*	0.18	0.00	0.00	0.00
62	*Gymnothorax javanicus*	0.00	0.00	0.04	0.00

63	*Halichoeres hortulanus*	0.61	0.29	0.12	0.00
64	*Halichoeres hovenii*	0.00	0.03	0.00	0.00
65	*H. biocellatus*	0.75	0.00	0.00	0.00
66	*Heniochus pleurotaenia*	0.22	0.18	0.31	0.00
67	*Heniochus acuminatus*	0.12	0.00	0.04	1.24
68	*Holocentrus rubrum*	0.25	0.00	0.00	0.35
69	*Lepidozygus tapeinosoma*	0.00	0.00	0.32	0.00
70	*Lutjanus argentimaculatus*	0.15	0.07	0.03	0.00
71	*Lutjanus decussatus*	0.48	1.31	1.46	2.86
72	*Lutjanus fulviflamma*	0.00	0.07	0.05	0.00
73	*Lutjanus gibbus*	0.00	0.00	0.00	0.51
74	*Lutjanus kasmira*	0.31	0.25	0.11	3.68
75	*Lutjanus notatus*	0.18	0.00	0.00	0.00
76	*Lutjanus vitta*	0.00	0.00	0.00	0.82
77	*Macolor niger*	0.02	0.05	0.00	0.38
78	*Naso brevirostris*	0.20	0.00	0.00	0.00
79	*Naso lituratus*	0.17	0.00	0.00	0.00
80	*Parupeneus barberinus*	0.41	0.20	0.00	0.00
81	*Plagiotremus rhinorhynchos*	0.35	0.30	0.07	0.00
82	*Platax tiere*	0.09	0.00	0.00	0.00
83	*Plectorynchus gaterinus*	0.00	0.00	0.00	0.51
84	*Plectorynchus orientalis*	0.06	0.24	0.13	0.11
85	*Plectorynchus picus*	0.10	0.11	0.02	0.20
86	*Plectroglyphidodon leucozonus*	0.80	0.60	0.00	0.00
87	*Pomacanthus caeruleus*	0.17	0.00	0.00	0.00
88	*Pomacanthus imperator*	0.37	0.00	0.00	0.00
89	*Pomacentrus pikei*	0.16	0.00	0.00	0.00
90	*Pomacentrus chrysurus*	2.21	0.00	0.00	0.00
91	*Pterois volitans*	0.12	0.04	0.00	0.04
92	*Rhinobatos sp.*	0.00	0.00	0.03	0.00
93	*Scarus atrilunula*	0.38	0.18	0.16	0.00
94	*Scarus caudofasciatus*	0.02	0.00	0.00	0.00

95	*Scarus cyabascebs*	0.19	0.00	0.00	0.11
96	*Scarus cyanescens*	0.05	0.24	0.10	0.00
97	*Scarus dimidiatus*	0.06	0.13	0.15	0.00
98	*Scarus psittacus*	0.29	0.00	0.00	0.00
99	*Scarus russelli*	0.06	0.11	0.12	1.04
100	*Scarus ghobban*	0.32	0.15	0.07	0.00
101	*Scarus gibbus*	0.00	0.30	0.21	0.00
102	*Scarus niger*	0.07	0.13	0.19	0.00
103	*Scarus scaber*	0.00	0.00	0.00	1.00
104	*Scolopsis billineatus*	0.15	0.28	0.00	1.60
105	*Siganus doliatus*	0.37	0.93	13.36	0.00
106	*Siganus guttatus*	0.26	0.00	0.58	0.00
107	*Siganus puelloides*	0.18	0.00	0.45	0.00
108	*Siganus spinus*	0.00	0.04	0.00	0.07
109	*Siganus stellatus*	0.00	0.00	0.00	1.48
110	*Stegastes fasciolatus*	0.00	0.00	0.33	0.00
111	*Stegastes insularis*	0.45	0.14	0.48	0.00
112	*Upeneus tragula*	0.16	0.10	0.05	0.00
113	*Zanclus cornutus*	0.96	0.24	0.07	1.79
114	*Zebrasoma scopus*	0.33	0.00	0.05	0.00
115	*Zebrasoma rostraum*	0.00	0.00	0.00	0.04
		100.0	100.0	100.0	100.0

HL: Havelock Island , JB: Jolly Buoy Island, TM: Tarmugli Island, BT: Boat Island

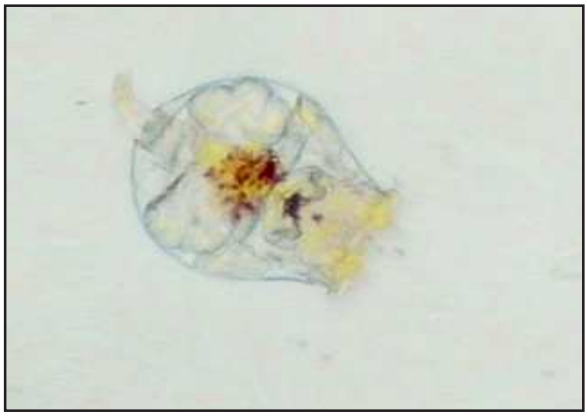


Plate 9. Rotifer

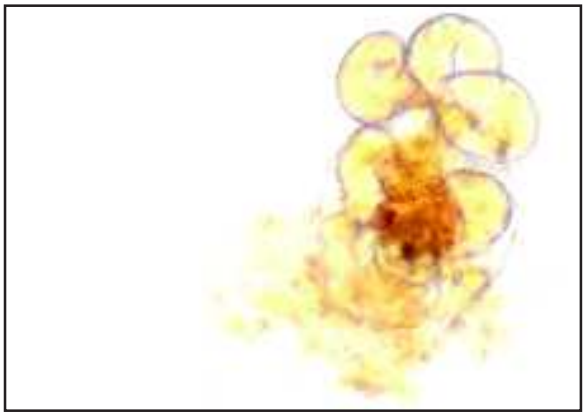


Plate 10. Rotifer

Plate 11. *Amphiprion percula*

Plate 12. *Amphiprion akollapisos*

Plate 13. *Acanthurus lineatus*

Plate 14. *Balistapus undulatus*

Plate 15. *Casio xanthonatus*

Plate 16. *Chaetodon collare*

Plate 17. *Chaetodon auriga*

Plate 18. *Dascyllus carneus*

WSSV INCIDENCE AND MOLECULAR CHARACTERIZATION OF TIGER PRAWN, *PENAEUS MONODON* OF ANDAMAN WATER

S.N. Sethi, S.Dam Roy, P. Krishnan and S. Jai Sunder

Aquaculture is the world's fastest growing food industry. The disease outbreaks in shrimp farming caused serious economic losses in many South East Asian countries. According to a recent World Bank report, global losses as a result of disease are around US $ 3000 million (Lundin, 1996). This disease caused by white spot syndrome virus (WSSV) is characterized by the presence of white spots in the exoskeleton of infected shrimps. WSSV can be detected by various techniques, includes histopathology, immunological methods, polymerase chain reaction (PCR) techniques, *in situ* hybridization methods using DNA probes etc. Among these techniques polymerase chain reaction (PCR) technique has been considered as the most effective to detect the WSSV. At present, PCR technique is widely used to detect WSSV using either conventional amplification with single sence / antisence primer set or nested amplification. Nested PCR provides an increased level of sensitivity compared with conventional single primer– pair PCR.

Tiger Prawn, *Penaeus monodon* were collected from different landing centres of Andaman sea. Pleopod and muscle of all the prawns were collected and kept in absolute ethanol during transportation and were stored at –80°C. DNA from the muscle tissue were isolated following the SDS-phenol chloroform method as described by Lo *et al* (1996) with some modification.

The Nested PCR kit from Genei developed by CIBA was used for PCR amplification. The kit primers were developed based on a WSSV specific DNA fragments. In the first PCR specific external primers, amplify a 650 bp segment of viral genome. In second step, Nested PCR, specific internal primers amplify 300 bp segment of first PCR amplified product.

Results showed that 36 shrimp samples were positive for WSSV out of 100 samples examined (Table 2). None of the samples were positive for first step reaction, where as 36 samples showed positive for second step PCR (nested). The percentage of infection of WSSV in tiger shrimp is around 36% (Fig 1). Nine samples showed white spot on carapace out of 100 samples (Fig 2). The infection rate of WSSV is mild (36%) in Tiger prawn of South and North Andaman compared to mainland India.

Table 2. Occurrence of WSSV in Tiger prawn, *Penaeus monodon* of Andaman

No. of Samples	Male	Female	Average Length (mm)	Average Weight (gm)	Positive in First step PCR	Positive in Nested step PCR
100	50	50	19.625± 2.69	60.17± 24.96	0 %	36 %

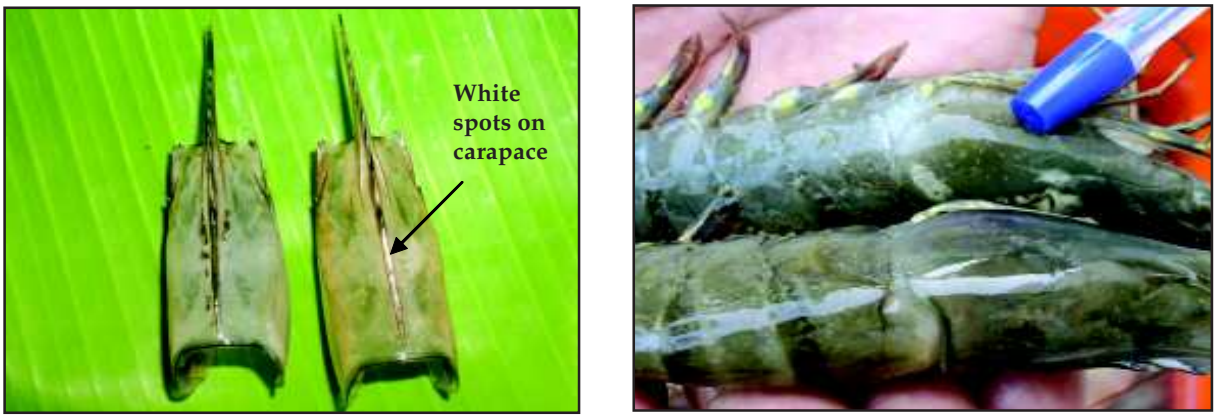


Plate 19. Tiger prawn, *Penaeus monodon* showing white spots on the carapace of the body.

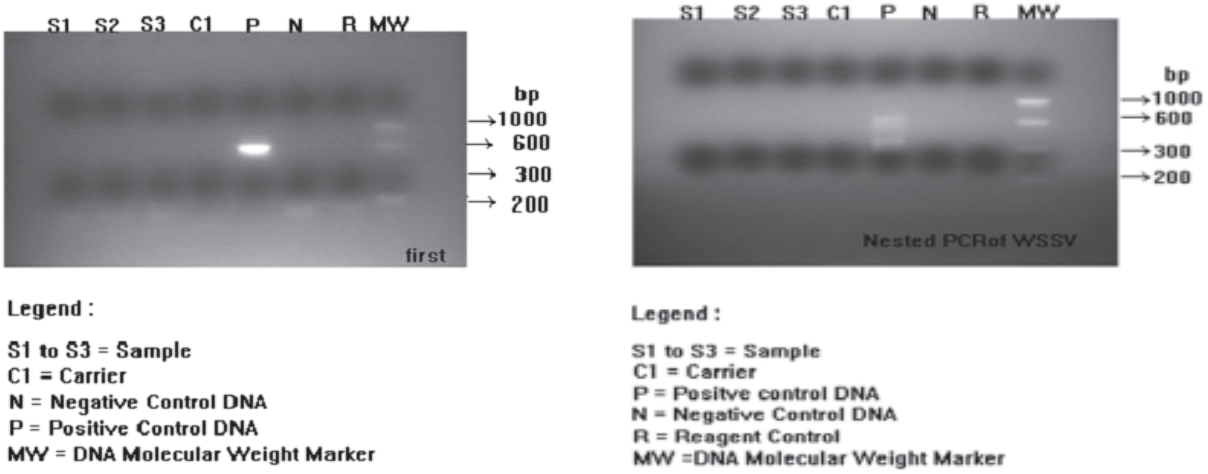


Fig 1. White Spot Syndrome Virus (WSSV) occurrence in brood stocks of Tiger Shrimp in Andaman:

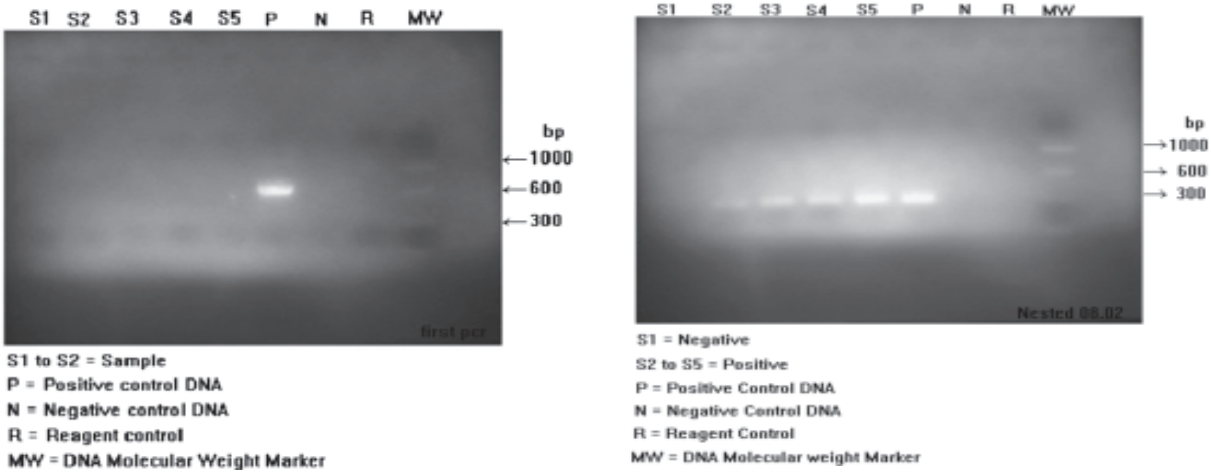


Fig 2. Four (4) significant bands of WSSV infection in Tiger shrimps.

BREEDING, SEED PRODUCTION AND BACKYARD HATCHERY DEVELOPMENT OF GIANT FRESHWATER PRAWN, *M. ROSENBERGII* IN ANDAMAN

S. Dam Roy, S.N. Sethi, and P. Krishnan

The giant freshwater prawn, *Macrobrachium rosenbergii*, known as scampi in commercial parlance, is a highly valued delicious food and commonds very good demand in both domestic and export market. It is fast becoming one of the most important cultured species in the inland aquaculture system in the country due to its fast growth rate, high market demand, attractive price and its compatibility to grow with carps. The production of this species in India has shown a substantial increase in recent years from less than 500 MT in 1997 to more than 30,000 MT in 2003-04.

This species can also be cultured in low saline brackishwater areas (salinity < 10 %) and can be cultured either alone (monoculture) or in combination with carps (poly- culture). This is also a suitable species for incorporation in paddy-cum-fish culture. There is huge demand of quality seeds of this species in Andaman.

Plate 20. Male prawn, *M. rosenbergii*

Plate 21. Female prawn, *M. rosenbergii*

Plate 22. Berried females

Plate 23. PL packed in polythene sheet

CARI has established a backyard hatchery in this island. Seeds have been distributed to the farmers of middle and south Andaman regularly. More than two thousand post larvae (PL) have been distributed to the fish farmers during 2006-2007. CARI in collaboration with KVK, conducts several training on seed production and hatchery management of fresh water prawns in Andaman.

IMPACT OF NATURAL STRESSORS (LIKE EARTHQUAKE, TSUNAMI ETC) AND ANTHROPOGENIC ACTIVITIES ON MANGROVE ECOLOGY OF ANDAMANS.

S. Dam Roy, Grinson George, P. Krishnan, K. Sarma, S.N. Sethi, B. Varghese & S. Murugesan

The islands are bestowed with large tracts of brackish water bays, lagoons, tidal mud flats and mangrove swamps, which have potential for mariculture, brackish water aquaculture and freshwater fish culture with available finfish and shellfish resources. There are about 35,000 ha of mangrove areas in the islands, which are subjected to regular tidal inundation. In the post tsunami scenario, due to the subduction of land by about 1.25 m, the level of submergence due to tidal influence has also increased. A survey conducted reveals that approximately 4000 ha areas of agricultural farmlands have been submerged, out of which 630.12 ha of area are found to be suitable for coastal aquaculture (Table 3). However, as coastal marshy wetlands are of acid sulphate nature, there have been a lot of apprehensions among the entrepreneurs, scientists, planners and administrators regarding technical viability and success of these ventures. As per the available technology at present, these acidic soils can be reclaimed with low cost techniques. A feasibility study conducted along the coastal marshy wetlands of South Andaman explored this possibility. The ecology and scope for fisheries in mangrove areas of Andaman and Nicobar islands was explored in detail. The reduction is fish catch during 2004-2005 as revealed in the basic statistics of Andaman & Nicobar Administration makes this study imperative as an alternate source of fish/shrimp production through coastal aquaculture.

Plate 24. Ingression of seawater through mangrove creeks into arable lands

Table 3. Area affected after Tsunami and found suitable for aquaculture in South Andaman

Sl. No	Area	Area (in ha)	Site specific issues
1.	Sipighat	103.72	The Sipighat creek is in the sea front. So a buffer zone of mangroves and a proper drainage channel with dual-purpose sluice is essential to control rainwater as well as for seawater inlet.
2.	Dhanikhari	7.36	The area is fully infested by swampy marsh weeds and only a meager area is available for aquaculture.
3.	Chouldari	60.00	Chouldari area is facing the sea front, wherein water can be brought in through sluice gate to channel for flushing in sea water to the respective unit of farm
4.	Crickbad	20.66	Pump fed system can be ideal
5.	Badmaspahar	36.33	Proper drainage channel to bring in water to the upper stretches of the field.
6.	Port Mout	37.45	Ideal site for aquaculture but a sea wall construction is a must to prevent any seawater ingression to the field.
7.	Lalpahar	23.30	Lalpahar area is also facing the sea front , wherein water can be brought in through sluice gate to channel for flushing in sea water to the respective unit of farm
8.	Mithakhadi	144.53	An inlet channel already exists, which can be suitably modified for free water exchange, other wise suitable for aquaculture.
9.	Danduspoint	20.31	Ideal site with proper tidal amplitude. Site ready for culture with slight modifications as required for a farm.
10.	Ograbranj	66.23	A productive ground for aquaculture but also the habitat of Andaman teal and cranes. Big catchment area, so fresh water influx is very high during rainy season
11.	Muslimbasti	48.35	Vast areas under coconut plantation is submerged and initial clearing of area for aquaculture is going to be labour intensive
12.	Kadakachang	21.85	Ideal site with proper tidal amplitude. Site ready for culture with slight modifications as required for a farm.
	Total	**630.12**	

INDUCTION OF SPAWNING AND LARVAL REARING OF *TROCHUS NILOTICUS* AND SUBSEQUENT SEA RANCHING PROGRAMME

S. Dam Roy, Kamal Sarma, Grinson George and P. Krishnan

Top shell, *Trochus niloticus* is very important because of its ornamental value. The present project has been initiated with an objective to induce breeding and larval rearing of this species and subsequent sea ranching programme to conserve and replenish the natural stock. Species were collected and reared in the Marine Hill Laboratories for this purpose. Feeding experiment was initiated by providing macroalgae such as *Ulva lactuca* to *Trochus niloticus* and it was observed that the animal feeds on the macroalgae. Even mixed algal culture was initiated in 500 L FRP tank and the algal developed was provided to Trochus as feed. Height, width and weight of the species have been recorded (Table 4) and relationship derived for these are: Y = 1.01743 + 0.44259 log l for height and width & Y = 1.80700 + 0.36486 log l for height and weight. Few breeding trials have been conducted by changing temperature and salinity condition. However, no response has been recorded (Table 5). Again trials will be initiated to achieve the spawning results by changing rearing condition as well as stimuli.

Table 4. Height, width and weight of *Trochus niloticus* collected from Andaman waters.

Sl No.	Date of collection	Average			Minimum& Maximum		
		Height (cm)	Width (cm)	Total wt (g)	Height (cm)	Width (cm)	Total wt (g)
1	28.03.06	103.8	94.8	443.8	83 - 120	80 – 118	244.7 - 770.3
2	24.10.06	101.3	103.2	418.9	90 - 110	85 – 115	358.3 -450.7
3	17.01.07	115.0	116.7	545.7	100 - 130	100 - 130	337.9 - 776.9

Table 5. Induce breeding trial of *Trochus niloticus* under temperature and salinity variation

Date of induction	Nos. of trochus	Temperature		Spawning response
		Ambient	Raised to	
03.02.2007	10 nos. of *Trochus* kept at FRP tank	29 ° C	34 ° C	No response
10.02.2007	10 nos. of *Trochus* kept at FRP tank	30 ° C	35 ° C	No response
25.02.2007	10 nos. of *Trochus* kept at FRP tank	30 ° C	35 ° C	No response
		Salinity		
07.02.2007	10 nos. of *Trochus* kept at FRP tank	35 ppt	20 ppt	No response

SEED PRODUCTION OF COMMERCIALLY IMPORTANT CAT FISHES: *CLARIAS BATRACHUS* (INDIAN MAGUR) AND *HETEROPNEUSTES FOSSILIS* (SINGHI) IN ANDAMAN AND NICOBAR ISLANDS

C.S. Chaturvedi, S. Dam Roy, K. Sarma, S.N. Sethi, Grinson George and B. Varghese

Magur and Singhi are some of the most important air breathing fishes of Andaman and Nicobar Islands and fetching very good price (>Rs 180 /kg) at the local market. However, availability of quality seed is the main constraint in this island. At present no magur seeds have been produced in this island. To standardized the technology suitable for the island condition as well as to demonstrate the breeding technology to farmer's level a hatchery has been set up at CARI.

Plate 25. Magur Fry

Plate 26. Magur brooder

NETWORK OF FISH GERMPLASM EXPLORATION, CATALOGUING AND CONSERVATION OF FISH AND SHELLFISH RESOURCES OF INDIA

S. Dam Roy and Grinson George

Coral reef ecosystems are the most productive and diverse of the marine ecosystems. Andaman & Nicobar Islands are endowed with coral reefs, which are rich in diverse flora and fauna. Previous and ongoing studies from CARI, Port Blair revealed bleaching, mortality and destruction of these ecosystems which habitats a large variety of ornamental fin and shellfishes. The extent of damage to the ecosystem was not quantified, as there was a lack of geo-referenced data on the flora and fauna of coral ecosystem. A proper

database on marine ornamental shell and fin fishes have not yet been prepared with spatial and temporal references. An exhaustive study is required for comprehensive coverage of Andaman & Nicobar waters to develop a database on ornamental fin and shellfishes. Government of India has taken initiatives in connivance with Biological Diversity Act 2002, which shows that the study is imperative in this era of genomic trade. Geographic indications which decides the patent rights of a particular thing in the new IPR regime prompts us to be ready with a geographically referenced database to challenge any conflict which may arise in the future for genomic rights on our own species with geographical indications.

The fish fauna of Andaman and Nicobar Islands (Table 6) contributes more than 1200 species of which over 250 species are of ornament in nature. Molecular level coding of faunal resources is relevant in the present regime. So collection of specimens and molecular coding is done to have a proper data sheet on various fish and shellfish resources of Andaman. The specimens are collected from fish landing centers at Dignabad, Junglighat and other reef sites like Wandoor, North Bay and Chidiyatapu. The collected specimen are preserved in formalin and kept in the museum after identification. The tissue samples are collected and sent to NBFGR, Lucknow for molecular coding works. So far 55 species of finfishes and 7 species of shellfishes have been collected and processed. A network is being established under the aegis of NBFGR and various related organizations all over India are also being linked for the purpose.

Table 6. Fish fauna of Andaman and Nicobar Islands

Code No.	Fishes variety	Species Name
2001	Shell fish	*Pinctata margaritifera*
1001	Fin fish	*Cephalopholi miniata* (grouper)
1002 A		*Lutjanus kasmira*
1002 B		*Lutjanus quinqualinatus*
1003		*Lutjanus decussates*
1004		*Lethrinella minata*
1005		*Monolacus grandoculus*
1006		(Unid) *Monolacus, Pentapolus vitta*
1007		*Scolopsis citimum*
1008		(Unid) *Namipterus*
1009		(Unid) *Prestipomida sp.*
1010		(Unid) *Pristipomoides sp.*
	Shell fish	
2002		*Perna viridis*
2003		*Crastostrea gryphoides*

2004		*Crasostrea ruvularis*
2005		*Saccostrea cuculata*
2006		*Cellona zeglerica*
2007		*Anadora granosa*
	Fin fish	
1011		*Sardinella serum*
1012		*Chaitalur collau*
1013		*Siganus canaliculatus*
1014		*Siganus virgatus*
1015		*Abdefduf virigiensis*
1016 F		*Oreochromis urolepis*
1016 S		*Oreochromis urolepis*
1017		*Parapeneaus barbarious*
1018		*Thalasoma lunare*
1019		*Epinephelus faciatus*
1020		*Plectropomus sp.*
1021		*Epinephelus tauvina*
1022		*Parapeneus indicus*
1023		*Appogon kallopterus*
1024		*Chaetodon trifaciatus*
1025		*Stolephorus heterolobus*
1026		*Sardinella fimbriata*
1027		*Sardinella dussumiera*
1028		*Epinephelus hexogonatus*
1029		*Parapercis hexopthalma*
1030		*Scolophis bilineatus*
1031		*Cephalopolis sp.*

1032		*Chaetodon decussates*
1033		*Pomocanthus impoeratus*
1034		Un identified
1035		*Chaetodon Linda*
1036		*Heniochus acuminatus*
1037		*Plectorhingus fleximocular*
1038		*Chaetodon falcula*
1039		*Chalirus tricobatus*
1040		*Scarus sp.*
1041		*Pempterus vanicolensis*
1042		*Neoniphon samonara*
1043		*Scorpaenopsis*
1044		*Hyppcampus xanthopterus*
1045		*Parupenaeus pleurostigma*
1046		*Nemipterus*
1047		*Lutjanus luthrinus*
1048		Un identified
1049		*Monotaxis*
1050		*Monodactylus fateriformes*
1051		*Amphiprion percula*
1052		(Unid)*Amphiprion sp.*
1053		*Amphiprion ephippium*
1054		*Amphiprion akallipsis*
1055		*Platar teire* (juvenile)

(Unid)- unidentified specimen, but identified till genus level.

CAGE CULTURE OF COMMERCIALLY IMPORTANT MARINE AND BRACKISH WATER FISHES IN PROTECTED BAYS & CREEKS OF ANDAMAN & NICOBAR ISLANDS.

S. Dam Roy, Kamal Sarma, S. N. Sethi, Grinson George, P. Krishnan and B. Varghese

The Grouper under the family Serranidae and sub family Epinephelinae are mostly reef dwelling marine fishes confined to tropical and sub tropical marine waters. Because of the growing demand and export potential, demand of these fishes is growing every day. There are about 137 species (Fig 1), found throughout the world and out of this 43 species (31.4%) are found in Andaman waters. Every year sizable quantities of these species are being exported from Andaman. Because of growing demand, culture of many of these species is in progress in many South East Asian countries and also in India. The most common type of culture of these species is in open water cages. To study the culture feasibility and to develop technology for culture of some of these species, cage culture project has been initiated.

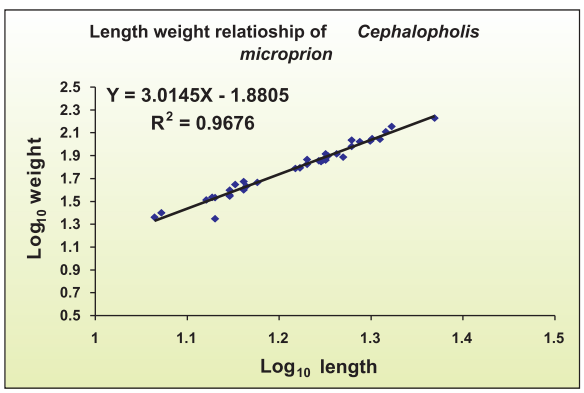


Fig 1. Length weight relationship of *Cephalopholis microprion*

Grouper species collected

1. *Cephalopholis formosa*
2. *Cephalopholis boenak*
3. *Cephalopholis argus*
4. *Cephalopholis miniata*
5. *Cephalopholis sonnerata*
6. *Cephalopholis leopardus*
7. *Cephalopholis microprion*
8. *Epinephilus malabaricus*
9. *E. hexagonatus*
10. *E. merra*
11. *E. fuscoguttatus*
12. *E. fasiatus*
13. *E. areolatus*
14. *E. argus*
15. *E. undulosus*

INDUCED BREEDING, SEED PRODUCTION AND CULTURE OF INDIAN MAJOR CARPS AND EXOTIC CARPS

S. N. Sethi, S. Dam Roy and B. Varghese

Indian Major carps contribute 85% of the freshwater aquaculture production in India. Availability of required quantity of fish seed of the desired species at the appropriate time is one of the prime factors that lead to success of aquaculture operation. Though remarkable success has been achieved over the years in spawning the carps, availability of seed of desired size still remains a constraint.

Induced breeding and seed production are the regular activities of division to cater the needs of the fish farmers of the island.

Plate 27. Portable Carp Hatchery brought from CIFA, Orissa.

Plate 28. Hatching Happa frame made up of G.I. Pipe

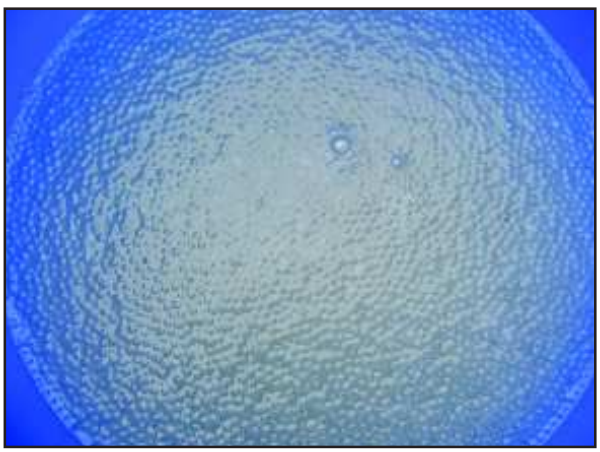


Plate 29. Transparent fertilized Eggs of IMC

SOCIAL SCIENCE SECTION

SOCIO-ECONOMIC IMPACT ASSESSMENT ON AGRICULTURE, ANIMAL HUSBANDRY & AQUACULTURE IN THE TSUNAMI-HIT ANDAMAN

B. Ganesh Kumar, R. Raja, V. Jayakumar, S. Jeyakumar and S.N. Sethi

A multi-disciplinary project was undertaken to assess the damage to the field and loss to the farming community; to analyze the change in cropping pattern/ livestock holdings; to record the plant / animal diseases; to observe the change in aquaculture practices; and to rank the constraints in all these farming in the post-*Tsunami* scenario and suggest suitable policy measures. Data collection from the farmers of the five affected villages namely Chouldari, Mithakari, Guptapara, Wandoor and Stewartgunj were done thrice; one, immediately after *Tsunami* and another two at one year interval.

It was found that just after *Tsunami* the agricultural activities were in stand-still, but slowly it is gaining momentum particularly in plantation and vegetable cultivation than paddy cultivation. Paddy cultivation has been started in Guptapara, Chouldari and in some pockets of Wandoor but the yield has been reduced by 40 % compared to pre-*Tsunami* scenario. It has been observed that most of the paddy fields were dried off due to upward rise of land mass by tectonic activities and construction of bunds. The rain water has been checked from draining into the sea, as a result the field is flooded by a mixture of saline and rain water mostly in Stewartgunj, Mithakari and Wandoor.

It has been seen that out of the five villages surveyed, Stewartgunj, Mithakari and Wandoor are still severely affected, whereas Chouldari and Guptapara villages which are affected and less affected are being developed through intervention of new technologies by the effort of State Govt., CARI, Non-Govt. agencies and local people.

ECONOMIC STATUS AND SCOPE OF DAIRY FARMING IN ANDAMAN & NICOBAR ISLANDS – A MICROLEVEL ANALYSIS

B. Ganesh Kumar, S. Jeyakumar and Raj Vir Singh

A study was conducted to compare tehsil and village wise distribution of milch animals, farmer size categories, type of house hold and source of motivation to practice dairy farming. The total households of the selected Port Blair and Ferrargunj tehsil were post-stratified according to the number of milch animals into small (1-2 animals), medium (3-4 animals) and large (5 and above animals)

with a view to study various aspects of dairy farming in different socio-economic strata. A total of 186 dairy farm households (107 dairy farmers from Port Blair and 79 dairy farmers from Ferrargunj) were visited and the data were collected through personal interviews.

The study revealed that in Port Blair tehsil 74.77, 15.89 and 9.35% of farmers were under the farm size category of small, medium and large dairy farmer, respectively whereas in Ferrargunj tehsil the respective distribution of farmers were found to be 84.81, 10.13 and 5.06 % with an overall distribution of farmers to be in the tune of 79.03, 13.44 and 7.53%, respectively in same categories of farmers. In both the tehsil, percentage of small farmers were maximum followed by medium and large. The comparative study indicated that the percentage of small farmer were highest in Ferrargunj tehsil whereas medium and large farmers were highest in Port Blair tehsil. The average holding size of milch animals were found to be 2.18, of which local cows, crossbred cows and buffalos were in the tune of 0.75, 0.48 and 0.05 for small dairy farmers; 1.40, 1.88 and 0.12 for medium and 2.00, 4.29 and 3.07 for large category of farmers, respectively. The tehsil wise comparative study indicated that the average holding size of local cow were more in Port Blair tehsil as compared to Ferrargunj tehsil where crossbred cows were more (Fig. 1).

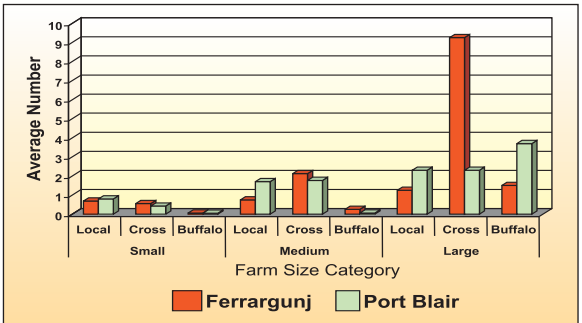


Fig 1. Average holding of milch animals

The perusal of data (Fig. 2) revealed that 66.67, 11.29 and 22.04% of dairy farm households in the study area are living in pucca, semi-pucca and katcha type of houses,

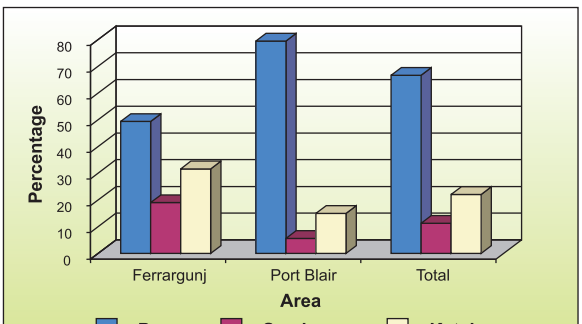


Fig 2. Housing pattern of dairy farmers

respectively. The percentage of pucca type of houses were more in Port Blair tehsil (79.44%) than Ferrargunj (49.37%) whereas semi-pucca and katcha houses were more in Ferrargunj in the tune of 18.99 and 31.65% than Port Blair tehsil with corresponding figures of 5.61 and 14.95%, respectively. Further it was noticed that, majority of the farmers were motivated by their relatives (81.18%) to start dairy farming followed by Dept. of AH & VS (11.83%), CARI (3.76%) and friends (3.23%). The extension activities of Dept. of AH & VS and CARI were found to

be more in Ferrargunj tehsil representing 16.46 and 6.33% compared to Port Blair with 8.41 and 1.87%, respectively.

Constraint Analysis of Rural Dairy Farms

The information on constraints were recorded on 0-6 scale and ranked through Garret ranking method. The study revealed that among the economic constraints, lack of marketing infrastructure and proper governmental policies ranked as first constraints. Inadequate pricing of milk followed by poor milk co-operative societies was second constraint followed by non-availability of labour, lack of finance and loan, insufficient land space for animal and non-availability of feed and concentrates in the city as well as in rural areas. The constraints expressed by the farmers are really crucial and need immediate attention of policy makers and state administration. This Island is far away from mainland and the input supplies are mainly dependent on mainland which is most often uncertain.

Technological constraints as expressed by the respondents have reflected that shortage of fodder especially during summer season is a major constraint although, these islands receive more than 3000 mm rainfall / annum mainly during rainy season. After *Tsunami* most of the valley lands used for grazing is inundated by sea and hence, farmers are facing severe deficiency of fodder. Similarly during summer, farmers face acute deficiency of fodder. During the study, it was found that lack of technological knowledge, incidence of diseases and poor infrastructure were other major technological constraints. These problems needs to be addressed in future programme and officials/researchers should find the solution to minimize the constraints, because, these islands have good potential to increase fodder production and productivity which will lead to higher livestock production.

DEVELOPMENT OF ARTIFICIAL NEURAL NETWORKS (ANN) BASED FORECASTING MODEL FOR STUDYING VARIETAL DIVERSITY, YIELD AND PRODUCTION IN PROMINENT RICE CULTIVARS OF BAY ISLANDS

M. Balakrishnan, N. Ravisankar, R. Elanchezhian, B. Ganeshkumar, Subhash Chand, R.C. Srivastava and S.K Zamir Ahmed

More than 10 rice varieties have been released in the bay islands and several others are cultivated, but information on their actual distribution in different rice growing areas of the Islands for various ecosystems is presently not available. Therefore, collection of this information and subsequent documentation would help in classifying different rice areas for different rice growing ecologies of the islands.

The project was conceived during August 2006 with the specific objectives to study the rice varietals' spectrum over different rice growing ecosystems (low, medium and upland). Information on various qualitative and quantitative descriptors (yield contributing components and yield) along with information on weather parameters to develop databases and a pre-harvest forecasting model was collected. Schedule for data collection included the parameters such as rice varietal spectrum in the different islands (Table 1 & Fig 3) weather parameters, yield components, soil parameters and pest and disease index. Secondary data were collected from developmental departments, CARI, KVK etc. Compilation of data is in progress for development of algorithm based on the available data.

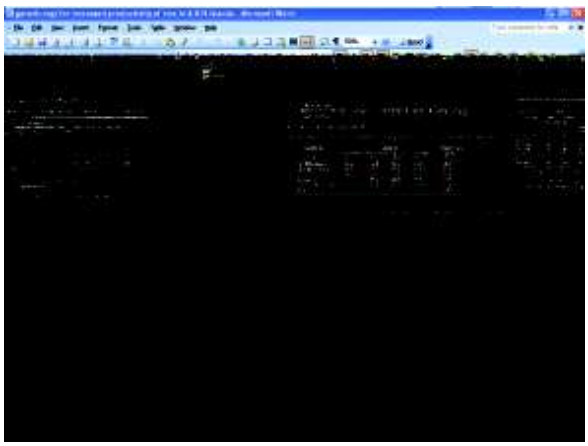


Fig 3. Schedule of database

Table. 1. Descriptors of data for Artificial Neural Network (ANN)

Varietal spectrum	Weather parameters	Ecologies	Yield components	Abiotic stressors	Biotic stressors
Quin Livang No.1, Milyang 55,Nanjing 57161, MTL 113, S1P1 681032, Taichung Sen Yu	Month, Rainfall, Rainy days, Temper-ature, RH,Wind speed,Open pan Evaporation, Sunshine hrs.	Low, Medium & Upland	Crop duration (days),Days to initial flowering , Days to 50% flowering, Plant height (cm), Number of tillers/ plant, Number of ear bearing tillers (EBT) / plant, Panicle Length, Number of grains / panicle, Spikelet sterility (%)100 Seed weight (g)Yield / hectare (tons) Harvest index (%)	Salinity, Drought, P deficiency, Fe toxicity, Al toxicity, Lodging,	BLB, SHB, BLS, Sheath Rot, Hel. Leaf spot, Leaf blast, Neck blast, Stem borer, Gundhi bug, Leaf Folder

DEVELOPMENT OF DATABASE ON ANIMAL GENETIC RESOURCES IN ANDAMAN & NICOBAR ISLANDS

M. Balakrishnan, S. Jeyakumar, B. Ganeshkumar, T. Sujatha and R.C. Srivastava

Animal husbandry is fast emerging as one of the viable enterprises among the farming community of A & N islands which is mainly due to the shrinking land availability for the crop husbandry, especially after *Tsunami*. Hence it was felt important to catalogue and develop a database of information comprising the available livestock breeds of these islands. The project was conceived with the specific objectives to collect primary and secondary data on livestock and poultry germplasm of Andaman & Nicobar Islands; to develop a database on animal genetic resources and farming system of Andaman & Nicobar Islands.

Schedule has been prepared and secondary data was collected from developmental departments and CARI. It contains description and basic set of information on every breed, variety or line of genetic resources of cattle, goats, pigs and poultry in the Island which is entered in the tabular format. Tables & templates using MS access and HTML has been created (Fig 4.).

Fig 4. Animal Genetic Resources of Andaman and Nicobar Islands

INTEGRATED REHABILITATION OF TSUNAMI AFFECTED PEOPLE THROUGH TECHNOLOGICAL INTERVENTION IN THE ANDAMAN & NICOBAR ISLANDS

R.C. Srivastava, T. Damodaran, N. Ravisankar, S. Jeyakumar, Prasanth Deshmukh,S.K. Zamir Ahmed, C.S. Chaturvedi, and M. Balakrishnan

The dreaded *Tsunami* hit the Island on 26th December, 2004 and it destroyed livelihood of thousands of people. CARI on a limited scale initiated process of restoration of livelihood by technological interventions with generous funding by DBT under project entitled "Integrated Rehabilitation of tsunami affected people through technological intervention in the Andaman & Nicobar Islands". The interventions and their impact is presented as follows :

Water Users Association – A Step Towards Empowering the Farmers

An association of farmers of the Manjeri village called *Water Users Association* was formed for the first time in the Islands with the basic purpose to involve the farmers in creation and management of the irrigation facilities along with other technological intervention undertaken by the institute in their villages. The idea got urgency during severe water crisis period in the villages from December 06 to May 07 when villagers had to carry water for about a kilometer by buckets. To sensitize farmers about this concept, a meeting was held on 9-4-07, wherein they immediately agreed to form the association. The bye laws and memorandum was finalized in the next meeting held on 16-04-07 which along with the requisition for registration was submitted in the District Commissioner Office on 30-05-07 for registration of the association. Following have been the major activities of the association in the last six months.

Plate 1. Director CARI (on extreme right) along with his team interacts with WUA member.

Plate 2. Well constructed by WUA

- The contract for ring well and tank construction was awarded to the association and nearly 50% of the work has been successfully completed by community participation.
- Seedlings of vegetables were raised by one member of the association and later on it was distributed to other interested members.
- Cultivation of vegetables during rainy season has been initiated among the farmers.
- The concept of selling the produce to middleman was abolished and now one member (farmer himself) of the association is taking the entire village produce and selling to the retailer directly.

Technology of cultivation of vegetables on raised beds with coconut husk on tsunami affected lands

The areas, which were close to the sea and left as fallow due to the clayey nature and occasional seawater entry during high tide after *Tsunami* could be effectively converted into cultivable land by the raised bed method. Beds were raised to a height of 1 feet from the ground level, coconut husks

Plate 3. Raised bed with coconut husk

which were thrown as waste was chopped and covered over the beds as a layer. Above this layer soil mixed with compost was applied before taking the crops. High value vegetable seeds and seedlings were taken on the surface of the raised beds. This facilitated survival of vegetable crops against the continuous and heavy rains and rise in the level of seawater. An average net profit of about Rs.80,000/- from 1000 m^2 was achieved in the adopted farmers fields.

The advantages of the technology demonstrated :

- It helped in increasing the soil mircrobial content content and the soil pH.
- The coconut husk served as a rich source of potash on decomposition which was aided by the fortnightly spray of glyricidia liquid manure.

Fresh and brackish water pond based IFS

Since the land area was considerably reduced after the tsunami in the coastal villages due to ingression of sea water during the high tide, the alternate farming system intervened to restore the livelihood was pond based IFS in both fresh and

Plate 4. Vegetables on the raised bed

Plate 5. Brackish water based IFS

brackish water. In case of fresh water ponds the embankments was effectively used to grow crops like coconut, arecanut, banana, papaya along with vegetables like pumpkin, bitter gourd, etc. Fodder which was one of the scarce components in the milk production system in the islands were also introduced in the both inner and outer slopes which also protected the ponds against erosion. With regard to brackish water ponds the embankments were effectively used for planting coconut, morinda, banana, sweet potato and fodder grasses which could withstand high soil pH.

Azolla as a feed supplement for backyard poultry

Azolla is a free floating water fern which is distributed in tropical and subtropical countries. It is rich in essential amino acids, vitamins , growth promoter intermediaries, minerals like calcium, phosphorus , potassium, magnesium and carotenoids including antioxidant β – carotene. The rare combination of high nutritive value and rapid biomass production make azolla a potential and effective feed substitute for livestock. Azolla cultivation technology in 2006 - 07 was disseminated to the *Tsunami* affected farmers of Manjeri, New Manglutan and Guptapara village of South Andaman. Seven farmers adopted the azolla cultivation technology and the birds were fed with fresh azolla @ 100 – 300gm /day/bird. It was found that during the time of crisis of grains or concentrate, azolla served as an alternate feed substitute for poultry and other livestock.

Goat farming as a livelihood enterprise for *Tsunami* affected people

Goat is one of the important species of livestock reared mainly for meat by marginal, small and landless farmers. Most of the farmers in *Tsunami* affected villages were traditional paddy cultivators and in post

Plate 6. Goat as livelihood

Tsunami most of their land got inundated with sea water leaving the farmer with no income from agricultural resources. Goat farming was introduced as an immediate alternative livelihood option to sustain their income. Farmers were trained to rear the goats under semi intensive system which they found to be profitable as they could earn a regular income of Rs. 2500 to 3000 through sale of adult bucks in a period of six months and also through sale of kids in a regular manner based on the demand. Utilizing the income generated through goatery, Shri. Biranjan

Das, a farmer of Manjeri ventured into dairying.

Incidence of reproductive disorders and therapeutic measures in cattle under village condition

The incidence of different forms of infertility among cattle in Guptapara and New Manglutan village of South Andaman was studied. A total of 106 animals were treated during the health camps of which 37 animals from Guptapara and 16 animals from New Manglutan village were treated for infertility. In the selected villages the incidence of delayed sexual maturity, anoestrum, repeat breeder, infantile genitalia were found as bottlenecks of infertility among the cross bred and desi cattle. As a therapeutic measure the infertile cattle were dewormed and they were supplemented with mineral mixture and phosphorus injection were given to the affected animals to improve the irhealth condition. Based on the presence or absence of corpus luteum palpated during rectal examination, the animals were administered with PGF2α and CIDR (Controlled Internal Drug Releasing Device) to bring the animal to normal cyclicity. Thirty percent animals were brought to normal cyclicity and lactation.

Family poultry production for nutritional security and livelihood opportunities for *Tsunami* affected farmers

Family poultry production technology was intervened among the group of fifty farmers in cluster of villages *viz.* Guptapara, Manjeri, New Mangluton and Indira Nagar of South Andaman. They were provided each with 30 numbers 2-4 weeks old of dual purpose poultry birds viz. Nicorock and Vanaraja to popularize family poultry production system under backyard with an aim to provide both nutritional and livelihood security. The farmers were able to meet out their family requirements of egg and meat and in addition they were able to earn an additional income of Rs. 3000 per month through sale of eggs and poultry birds.

Plate 7. Diagnostic services

Plate 8. Rural poultry production

Broad Bed and Furrow (BBF) technology

The broad bed and furrow (BBF) is a technique to grow vegetables and fodder right in the midst of rice fields apart from rice and fish. The technology involves making of broad beds and furrows alternatively in rice fields. Broad beds are made in the shape of inverted trapezium by digging soil from either side of the broad bed and putting it in the bed area by cut and fill method. The excavated depressed area is used for rice + fish + azolla cultivation and the raised broad bed area which is above the water level of the paddy field are used for cultivating any seasonal vegetable or fodder crop during monsoon season. The beds of 4-5 m wide and furrows of 5-6 m wide were found suitable for this system of cultivation. BBF technology has been transferred to farmers at Indiranagar (Normal soil).

Plate 9. Crop diversification through BBFS

SRI method of cultivation

After viewing the performance of the SRI method, the farmers of New Manglutan, Manjeri and Indiranagar villages adopted the technology on their own in the second year, but with little modifications in spacing, age of transplanting etc. Seven farmers from New Manglutan, two from Manjeri and one from Indiranagar (Table 2) have adopted the technology with slight modifications according to their need.

Plate 10. Mat nursery

Table 2. Name of farmers and area of adoption of SRI

Sl. No.	Name of Village	Name of farmer	Area of adoption	
			SRI	Conventional
1.	New Manglutan	Shri Maran Banik	1 bigha	4 bigha
2.	New Manglutan	Shri Manik Banik	1 bigha	3 bigha
3.	New Manglutan	Shri Shambu Pal	2 quari	7.5 bigha
4.	New Manglutan	Shri Dayal Das	1 quari	7 bigha
5.	New Manglutan	Shri Anil Sur	4 quari	5 bigha
6.	New Manglutan	Shri Sukdev Biswas	1 bigha	6 bigha
7.	New Manglutan	Shri Nikil Banik	1 bigha	6 bigha
8.	Manjeri	Shri Ramakrishna Das	1 bigha	5 bigha
9.	Manjeri	Shri Shyam Singh	2 quari	6 bigha
10.	Indiranagar	Shri Muthiah	2 quari	1 acre

Note: 1 bigha =1333 m^2, 1 quari = 266.6 m^2, 1 acre : 4000 m^2

Soil Parameters

Soils were acidic in nature having mean pH of 5 in all the places. The organic carbon ranged from 0.48% to 0.56% under SRI method and 0.72% to 1.11% under conventional method. The mean values are 0.55% and 0.90 % under SRI and conventional method inferring the efficiency of SRI in utilizing the N for its productivity. Indiranagar had the high organic carbon compared to other villages. The available K was high in all the villages with the mean value of 90 and 135 kg ha^{-1} for SRI and conventional method of planting (Table 3).

Table 3. pH, Organic carbon and Available K at Transplanting under SRI and Conventional method of cultivation in the study area.

Village	Number of Farmers	pH		Organic Carbon (%)		Available K (kg ha^{-1})	
		SRI	Conventional	SRI	Conventional	SRI	Conventional
New Manglutan	07	5.2	5.3	0.56	0.72	117.00	126
Manjeri	02	5.1	5.2	0.60	0.87	42.00	104
Indiranagar	01	4.7	4.5	0.48	1.11	112.00	175
Mean	-	5.0	5.0	0.55	0.90	90.33	135

System of Rice Intensification (SRI) was taken up under this project using Taichung-sen-Yu, Milyang 55, BTS 24 & Nanjing varieties. The critical stage is the first 20 days of transplanting. Since, bay islands receives higher intensity rainfall, single seedling might get damaged due to continuous rainfall. Farmers method of conventional planting with varieties such as Jaya and Bhavani were also taken for comparison. The parameters *viz.*, nursery area, age of transplanting, spacing adopted by farmers and seed rate under SRI and conventional method of planting in all the three villages where the technology adopted. It indicates that, the mean nursery area used under SRI method was 22 m^2 compared to 447 m^2 under conventional planting which indicates the considerable saving in time, seed, manpower and energy. Indiranagar village farmer used more nursery area for SRI method and conventional method compared to other villages. Similarly, seedling age at transplanting stood at 18 days compared to 28 days under conventional method. It indicates that the farmers are convinced about planting of young seedlings which can produce more productive tillers due to absence of transplanting shock period. Among the villages, Indiranagar farmer planted 15 days old seedling in SRI method compared to Manjeri (20 days) and New Manglutan (19 days).

Plate 11. SRI & Normal planting

Yield

At New Manglutan and Manjeri villages, SRI method registered significantly higher yield compared to conventional method of planting. At Indiranagar conventional planting registered higher yield than SRI planting which may be due to the performance of particular variety and the data is from only one place. Among the varieties tested under SRI method of planting, BTS 24 registered significantly higher yield. Taichung sen Yu and Nanjing also performed better compared to Milyang 55. Hence, BTS 24, Taichung sen Yu and Nanjing can be recommended for planting under SRI method.

Among the varieties planted by farmers under conventional method, Jaya registered higher yield than Bhavani. In the overall performance, SRI method led to significantly higher yield (2613 kg ha^{-1}) compared to conventional method (2400 kg ha^{-1}). The MAT nursery and SRI method is getting momentum among the farmers of adopted villages.

KRISHI VIGYAN KENDRA

TRAINING ACHEIVEMENT

A total of 37 training programmes were conducted / facilitated for the practicing farmers, farm women, rural youths and extension functionaries by the faculty members, wherein 474 male, 641 female and totaling 1115 got trained in agriculture and allied fields.

ABSTRACT OF TRAINING PROGRAMME

Discipline	No. of training programmes	No. of participants		
		Male	Female	Total
Practicing Farmers				
Crop prod./ Agrl. Extn.	06	103	50	153
Horticulture	03	59	49	108
Home Science	04	25	90	115
Livestock production	04	45	92	137
Fishery	02	24	09	33
Total	**19**	**256**	**290**	**546**
Rural Youth				
Crop prod./ Agrl. Extn.	01	04	23	27
Horticulture	03	55	76	131
Home Science	01	-	20	20
Livestock production	08	89	175	264
Fishery	01	23	04	27
Total	**13**	**171**	**298**	**469**
Extension functionaries				
Crop prod./ Agrl. Extn.	01	14	11	25
Horticulture	01	09	02	11
Home Science	01	10	20	30
Fishery	02	14	20	34
Total	**05**	**47**	**53**	**100**
Grand Total	**37**	**474**	**641**	**1115**

FRONTLINE DEMONSTRATION (S) / ON FARM TRIAL(S)

- Front Line Demonstration (FLD) with five selected high yielding varieties of paddy were taken up in the cluster of villages in an area of 0.4 ha each accounting to 12.40 ha, covering 31 farmers in South Andaman. Variety *Taichung Sen Yu* performed better and

gave an yield of 3.79 t/ha over the local check C-14-8 (1.72 t/ha).

- Five demonstration on french bean (Arka komal, Contender), five on vegetable cowpea (Green fall, Lafa) and three on swamp cabbage (Naali bhaji) were conducted at the cluster village of KVK namely Memyo, Guptapara, Portmout covering 5.2 ha. In french bean trial variety Arka komal gave 76.31q/ha followed by Contender 53.8q/ha. In vegetable, cowpea variety, Green fall gave 103.6 q/ha followed by Lafa 72.7q/ha. Swamp cabbage (nali bhaji) yielded 287q/ha.
- Three fish species mixed fish culture were conducted in 05 irrigation ponds (0.08 ha each) for a period of 8 months. The average yield achieved was 129 kg of fish / 0.08ha.
- A varietal trial of chilli with 06 varieties were conducted with three replication. The maximum yield of green chillies was recorded in varieties such as LCA-334 (307q/ha), BC28 (241q/ha), JCA (283q/ha) PantC-3 (230q/ha) and BC-30 (223q/ha). Almost all the varieties recorded 100% survival against the bacterial wilt disease at 150 days after planting.
- On Farm Trials (OFT) on assessment of System of Rice Intensification (SRI) and evaluation of maize varieties in *Tsunami* affected areas were conducted.

Farmers Field School on Integrated Pest Management in Rice

Farmers field school (FFS) was conducted with an objective to reduce the use of chemical pesticides and to increase the use of bio intensive pest management methods for control of pest and diseases in rice. In Indiranagar and New Manjeri cluster of villages by selecting 30 farmers for a 14 week long programme. During the FFS programme, all the farmers were taken to the field every week, provided knowledge and training on insect pest identification and control.

Performance indicators of paddy under IPM Practices in farmers field

Performance Indicator	With Chemical	With IPM
Damage due to YSB infestation (%)	16.5	7.5
Damage due to leaf folder (%)	17.3	Nil
Damage due to Gundhi bug (%)	23.5	Nil
Damage due to Case worm (%)	19.5	Nil

Pesticides usage were not advocated instead neem based formulations were adopted. Damage due to case worm was very minimum when IPM was practiced by the farmers against the chemical.

Input Distribution

Activities	Date	Village	Groups
Poultry birds (150)	25.05.06	Hutbay	Farming women
Breeding buck (4 nos.)	27.04.06	Guptapara	Farmers
Quail birds (1200 nos.)	23.10.06-21.02.07	Hathitappu, Sippighat, Chouldhari, Diglipur	SHG's
Poultry birds (50 nos.)	20.02.07	Namunaghar and Hathitapu	Farm women

Self Help Groups of KVK – CARI

Expenditure Pattern of additional income of SHG's in South Andaman Villages

A study conducted to evaluate the expenditure pattern of additional income generated by SHG's, revealed that education had got maximum share of this income followed by purchase of house hold items, social events, health, nutrition and clothing. The pattern is presented in figure-1.

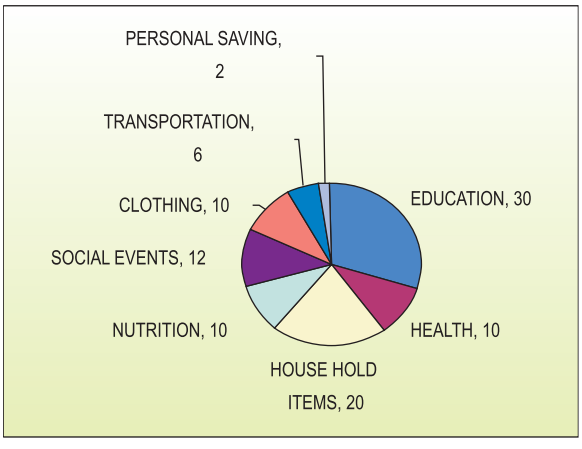


Fig. 1 : Investment pattern of SHG's

New SHG promoted

Two new SHG's (Phool & Kushmeet) were promoted during the year in Dhanikhari and Garacharma villages of South Andaman.

SHG Bank Linkages

Bank linkages were established for two SHG's namely Mallyajsneha Samiti and Vandematram of Sippighat village.

Innovative Methodology of Transfer of Technology developed during the year

- Mat nursery & SRI in Rice
- Trapping Rhinoceros beetle by using pheromone lure with fruit pulp.
- Crab fattening by encircling brackish area with a low cost bamboo mat.
- *Morinda citrifolia* (a salt loving plants) cultivation in the coastal bunds in *Tsunami* affected areas
- Cultivating *Ipomea aquatica* (naali bhaji) along with paddy in low lying areas.
- Azolla propagation technology.

Extension Activities

Activities	Date	Farmers/Rural Youth (Nos.)			Extension Functionaries (Nos.)		
		Male	Female	Total	Male	Female	Total
Field days on Humpsore Treatment	08.04.06	18	16	34	-	-	-
Organic farming	27.04.06	09	02	11	02	03	05
Pond Management	12.05.06	20	15	35	-	-	-
Poultry Disease Mgt.	17.06.06	02	29	31	-	-	-
Campaign on Morinda	24.08.06	39	27	66	03	07	10
Technology Demonstration and exposition on Mat Nursery	30.08.06	23	09	32	06	04	10
Drudgery reducing farm implements.	31.08.06	41	33	74	11	05	16
Pepper propagation	14.09.06	08	23	31	02	-	02
IFS madels	04.01. 2007	79	30	109	-	-	-
Maize and Groundnut improved varieties	11.01.2007	15	10	25	-	-	-
Video Shows	15 Nos.						
Radio Talks	08 Nos.						
TV Show on Green Manuring for rice	26.04.06	Telecasted by Doordarshan Kendra, Port Blair.					
KVK dwara mahilaon ko prashikshan	20.10.06						
Farm School on Air on Package of Practices for rice (13 week)	26.04.06 to 10.06.06	Through Doordarshan, Port Blair					
FFS on IPM on Paddy (14 week)	27.07.06 to 26.10.06	In collaboration with C.I.P.M.C., Port Blair					
Kisan Mela	21.02.07	412	45	457	35	23	58

TECHNOLOGIES ASSESSED AND TRANSFERRED

The technologies generated in agricultural and allied field were assessed for its performance by the scientists of the division of Natural Resource Management, Horticulture & Forestry, Field Crops, Fisheries Science, Animal Science and Social Science in participatory mode and based on the location, need, preference and feed back it was transferred to the target groups through the ATIC and Krishi Vigyan Kendra of the Institute. The progressive farmers, NGO's and the line department have played a vital role in transmission of the below mentioned technologies among the target groups (both tribal and non-tribal of the Island eco-system).

Natural Resource Management

- MAT nursery for paddy cultivation.
- System of Rice Intensification (SRI) method of paddy cultivation.
- Suitability of salt tolerant rice varieties *viz.*, CSR 23, CSR 36 and BTS 24 for cultivation in the tsunami affected areas.
- Crop diversification through broad bed and furrow (BBF) based farming system in low lying paddy areas.
- Integrated farming system (IFS) for four micro-farming situations *viz.*, hilly, slopping hilly, medium upland valley and low lying valley.
- Improved animal drawn puddler and paddy thresher.
- Pedal operated coconut dehusker to farmers of Hut Bay and tribals of Car Nicobar.
- Bio-mass fired coconut/fish dryer.

Horticulture and Forestry

- Cultivation of *Morinda citrifolia* in tsunami affected challenge situation.
- Black pepper cultivation on *Gliricidia* hedge grows for sloppy lands, on Gliricida standards and live fencing for homegardens.
- Raised bed method of vegetable cultivation by husk burial in tsunami affected low land.
- Low cost quick composting.

Field Crops

- *Trichoderma* and *Pseudomonas* in the management of diseases of vegetable crops.
- Oyster mushroom production technology.

Fisheries Science

- Indian Major Carp farming at various locations/ sites.

- Breeding and seed production of tiger shrimp *P. monodon* upto PL-20.

Animal Science

- Controlled breeding in cattle and goats.
- Ultrasonography for early pregnancy diagnosis in cattle and goats.
- Artificial insemination in goats.
- Development of Boer cross goats.
- Therapeutic management of infertility in cows.
- Artificial Insemination in Turkey.
- Mineral mixture supplementation for increased productivity in cows.
- Cultivation of forage crop variety (grass) CO-3.
- Azolla as potential feed supplement for poultry (Chicken, Quail and Duck).
- Control of eye infection and eye worm infestation in poultry.
- Development of bursa based vaccine for IBD control in poultry.

Social Science Section

In addition few need based technologies were transferred through different extension mode namely training, interactive lectures and video shows to the farmers, rural youth and the extension functionaries of these islands which is mentioned below:

- Economics of integrated farming system.
- Poultry economics and marketing.
- Economics of goat production system under field conditions.
- Reservoir fisheries management.
- Shrimp culture.
- Fishing nets fabrication & maintenance.
- Convenience food from fish.
- Drainage for reclamation of soil.
- Organic farming.
- Quality vegetables seedlings production.
- Backyard rearing of Improved Nicobari fowls for increased income.
- Clean milk production.
- IPM on paddy and solanaceous crops.

INFORMATION ON OTHER SECTIONS

LIBRARY

Central Agricultural Research Institute plays an important role in this island as a center for knowledge and information related to the institute's mandate. It serves to fulfill the need of the scientists, research workers, students from local research and educational institutes of these island and mainland. It has 4884 books, 4310 gratis publications and 2455 bound journals. The existing collection of books has extensive collection of resource materials in the fields of Animal Sciences, Horticulture, Field crops, Biotechnology, Social Science and many other related areas which are regularly enriched by adding more current, important scientific and technical books, journal through subscription gifts and on exchange basis. A user-friendly reference collection system under the NATO Scheme like CD-ROM Discs of AGRIS databases (1975-2000), can be accessed through LAN in all Divisions / Sections. Special collection of island related books and publications along with reprographic facility is also available. Besides, efforts have been made to acquire non-conventional literatures such as technical reports, reports on socio-economic study and annual reports from various sources to be kept as a ready reckoner for the users.

PLANNING, MONITORING AND COORDINATION CELL

The Planning, Monitoring and Coordination Cell (PMCC) serves as a vital link between the Institute, Council (ICAR), Government, Semi-Government and other R & D organizations in addition to providing information on various research, training and extension activities of the institute to these agencies. The section reviews and scrutinizes the research projects / proposals and co - ordinates the activities within and outside the institute. During the period under report, the section had prepared different reports and processed research papers.

COMPUTER CELL / ARIS CELL

The information on database developed, CD Room/ E-Book prepared and other activities undertaken is mentioned below:

Database Developed

- Digital photo library for easy searching was updated for

retrieval of the photographs of our institute.

- Medicinal plants, spices, computers & its accessories, pay roll and leave record maintenance.
- "Tsunami Events of Bay islands (E-Book), CARI, Port Blair .
- "Promotion of Spices cultivation in Bay islands", CARI, Port Blair.
- "Information bank of CARI", CARI, Port Blair.

CDROM/E-BOOK PREPARED

SUB DISTRIBUTED INFORMATION CENTRE

BIOINFORMATICS CENTRE

The Distributed Information Sub Centre (Sub-DIC) got established at Central Agricultural Research Institute, Port Blair, in the year 2005 with the support from DBT, Govt. of India with a sole aim to provide a national bio-information network. It is designed to bridge the inter disciplinary gaps in biotechnology information and to establish link among scientists working in organizations involved in R & D and manufacturing activities in biotechnology. The activities involve building up of information resources, developing database on biodiversity, handling tools and techniques, organizing workshops, training courses, symposium and to impart training to researchers and students in the field of Computer and Biosciences.

With the mission to develop database on Biodiversity of Andaman & Nicobar Islands by using appropriate software, the centre has created both on and off line database of medicinal plants resources available in theses Islands (58 used by Shompens), indigenous rice cultivars (11), orchid varieties (99) an economically important plant species (11). The centre also serves as an active site for bioinformatics research and development in the remote union territory of Andaman and Nicobar Islands. It has imparted training / guidance to complete project work to 8 M.Sc., and 2 B.Tech. students from Bharthidasan University, Periyar University, University of Rajashthan and National Institute of Technology (NIT), Durgapur.

Three Workshop cum Seminar with respect to various fields and application of bioinformatics, of which two of National level were conducted wherein scientists and students from mainland as well as island participated. One guest lecture on "Half Century of Structural Biology in India – A Personal Prespective" by Prof. M. Vijayan, Chairman, Task Force Committee For Bioinformatics, DBT & Professor Indian Institute of Science (IIS), Bangalore was also arranged.

DATABASE PREPARED USING VISUAL BASIC & MS ACCESS 2003

- Medicinal Plants
- Indigenous rice cultivars
- Endemic floral taxa
- Orchid varieties
- Economically important plant species

OFFICIAL LANGUAGE CELL

- "Hindi fortnight" was conducted in the month of September, wherein numerous programmes like quiz, noting-drafting, extempore, dictation, essay competition for Scientist, staff, farm ladies and childrens were organized to bring awareness about the importance of increasing use of Hindi in official language.
- Employees of the institute were motivated to write noting and drafting in Hindi under incentive scheme.
- Technical folders in agriculture and allied fields were regularly printed for the benefit of the target group.
- From April 2006, Dweepeon Krishi an innovative half yearly Hindi newsletter carrying the information and achievements on research, development ,extension and other activities of the institute is published for dissemination of the same amongst the line departments, PRI members, NGO's, Peer group and other institution both in island and mainland.

AWARDS AND RECOGNITION

Dr. R.C. Srivastava, Director, CARI

- Was elected '**Fellow - 2006**' of Indian Association of Soil & Water Conservationists for his outstanding contribution in Conservation and Management of Natural Resources held at IASWC, Central Soil & Water Conservation Research & Training Institute, Dehradun.
- Was awarded **Commendation Medal (2004-05)** by Indian Society of Agricultural Engineers for outstanding contribution in Research & Development in Soil & Water Engineering held at XLI Convention of Indian Society of Agricultural Engineers, Junagadh Agricultural University, Gujrat on January 29-31,2007.

Scientists	Award / Recognition	Awarding Agency	Period
S.K. Verma	Team Award	ICAR	18th August, 2006
Simmi Tomar	Best Poster	National seminar on 'Artificial insemination: acceptability, impact, constraints and solutions' at IVRI, Izatnagar (U.P.).	12th-13th October, 2006
T. Damodaran,	Certificate of Merit	CARI, Port Blair	14th October, 2006
D.R. Singh	Best Poster	Indian Society of Ornamental Horticulture , IARI, New Delhi	5th to 6th Dec. 2006
Ghoshal Chaudhuri, S., R. Raja, N. Ravisankar, M. Din and R.C. Srivastava	Best Paper	Bioved Research Society, Vigyan Parishad, University of Allahabad, Allahabad	29th to 30th January, 2007

ON GOING RESEARCH PROJECTS

EXTERNALLY FUNDED

Project Title	Principal Investigator	Budget Outlay (Rs.)	Date of Start	Expected date of Completion
AP CESS FUND, ICAR				
Adoption of improved implements for rice based farming in Andaman and Nicobar Islands.	Dr. M. Din	21,02,300	01.04.2005	31.03.2008
Development of Integrated Farming System (IFS) models under different resource conditions in humid tropics of Bay Islands	Dr. N. Ravisankar	21,27,055	22.04.2004	21.07.2007
Crop diversification through Broad Bed and Furrow (BBF) based farming system in valley areas of Bay Islands		24,06,250	15.07.2005	14.07.2008
Bio-Chemical and molecular characterization of soils of the mangrove forests of Andamans	Dr. S. Ghoshal Chaudhuri	21,03,500	01.04.2005	31.03.2008
Protected cultivation of cut and traditional flowers in A & N Islands	Dr. D.R.Singh	17,75,500	02.09.2004	01.09.2007
Agroforestry for sustainable biomass production in A & N Islands	Dr.C.B.Pandey	22,86,880	01.04.2002	30.03.2007
Breeding seed production and back-yard hatchery development of freshwater	Dr. S. Dam Roy	21,83,500	29.02.2004	28.07.2007

prawn, *Macrobrachium rosenbergii* in Andamans.				
Economic Status and Scope of Dairy Farming in Andaman & Nicobar Islands – A Microlevel Analysis	Dr. B. Ganesh Kumar	11,75,000	01.07.2005	30.06.2008
Conservation and characterization of Nicobari pig	Dr. S.Jeyakumar	13,50,000	01.11.2004	31.10.2007
Characterization,Conservation, Evaluation and Improvement of Native Teressa goat – an unreported indigenous germplasm		9,99,000	01.02.2005	31.01.2007
Studies on the status of mineral profile in Bovine of A & N Islands and its correlation to morbidity and production.	Dr. A. Kundu	19,21,420	05.07.2004	04.07.2007
DEPARTMENT OF BIOTECHNOLOGY				
Integrated Rehabilitation of Tsunami affected people through technological interventions in Andaman Islands	Dr. R.C. Srivastava	77,00,000	01.04.2005	31.03.2008
Establishment of Sub-Distributed Information Centre	Dr.M.Balakrishnan	44,60,000	01.04.2005	31.03.2008
Digital database on plant resources of Andaman & Nicobar islands	Dr. T.V.R.S. Sharma	19,91,000	01.03.2006	28.02.2009
Conservation and phenotypic and molecular characterization of indigenous goat of Andaman and Nicobar Islands.	Dr. Satya Pal Yadav	34,07,000	01.04.2006	31.03.2009

ICAR- NBAIM				
Application of Microorganisms in Agriculture and Allied Sectors- Microbial Diversity and Identification	Dr. V. Jayakumar	14,94,000	01.04.2006	31.03.2008
MINISTRY OF ENVIRONMENT & FORESTS				
Seed germination and natural regeneration in tropical rainforest of Andaman islands	Dr. C.B. Pandey	10,60,800	28.01.2004	27.01.2007
CENTRAL SECTOR SCHEME				
Integrated programme for development of spices	Dr. C.B.Pandey	6,73,000	01.04.2004	31.03.2007
DEPT. OF SCIENCE AND TECHNOLOGY				
Collection, and sustainable commercial exploitation of indigenous orchids of A & N Islands	Dr. D.R.Singh	21,63,620	02.05.2005	02.05.2008
ICAR				
All India Co-ordinated project on tuber crops	Dr. T. Damodaran	9,00,000	01.04.2004	31.03.2007
NATIONAL SEED PROJECT				
Seed production of shrimp	Dr. S. Dam Roy	45,00,000	2005	2007
SPACE APPLICATION CENTRE				
Assessment of coral reef health using satellite data.	Dr. S. Dam Roy	10,40,000	01.04.2004	31.03.2007

INSTITUTE FUNDED

Project Title	Principal Investigator
FIELD CROPS	
Improving the productivity and quality of rice and other crops in rice based cropping system in A & N Islands	Dr. T. V. R. S. Sharma
Utilisation of native bioagents for the management of major diseases of vegetables and cataloguing of crop diseases of Andaman & Nicobar Islands	Dr. V. Jayakumar
Evaluation of PGPR based bio-formulation for the management of key diseases of solanaceous vegetable crops	
Physiological management for improved productivity in cereals with reference to rice and maize	Dr. R. Elanchezhian
Assessment of crop losses and epidemiology of major vegetable diseases of south Andaman	Dr. Krishna Kumar
HORTICULTURE AND FORESTRY	
Varietal evaluation and standardization of agrotechniques in tropical fruits	Dr. T. Damodaran
Improvement and agrotechniques of vegetable crops	
Improvement of coconut and arecanut	
Introduction and evaluation of exotic and less known indigenous fruit crops	Dr.D.R.Singh
Tree soil crop interactions in agroforestry practices of A & N Islands	Dr.C.B.Pandey
NATURAL RESOURCE MANAGEMENT	
Development of fresh and brackish water based Integrated Farming System (IFS) in bay Islands	Dr. R.C. Srivastava
Impact of integrated nutrient management on soil quality under rice-maize cropping system in Andaman	Dr. Babu Lal Meena

Alley cropping system: Effect of prunings on physico-chemical properties of soil and productivity of intercrops in Andaman	Dr. Babu Lal Meena
Performance evaluation of different structures of protected cultivation in the humid tropics of Bay islands	Dr. M. Din
Value addition to horticultural crops and fisheries products through application of renewable and non-renewable sources	
Studies on effective storage of water in ponds	Er. P.S. Deshmukh
Impact of post tsunami agriculture mechanisation inputs on profitability of farmers in South Andaman	
Effect of supplemental irrigation on crop yield and water use efficiency in rice based cropping system of A&N Islands	Dr. R. Raja
Agro techniques for Kalmegh (*Andrographis paniculata*) under Island conditions	
Assessment of spatial and temporal variability in soil physico-chemical and biological properties of Tsunami affected agricultural lands of Andamans	Dr. S. Ghoshal Chaudhuri
Optimising land use based on fertility capability classification (FCC) in coastal paddy soils of South Andaman	Dr. T.P. Swarnam
FISHERIES SCIENCE	
Impact of natural stressors (like Earthquake, Tsunami etc) and anthropogenic activities a mangrove ecology of Andamans.	Dr. S. Dam Roy
Cage culture of commercially important marine and brackishwater fishes in protected Bays & creeks of Andaman & Nicobar Islands.	
Studies on recruitment culture and nutritive value of edible oyster of Andaman waters.	
Induction of spawning and larval rearing of *Trochus niloticus* and subsequent sea ranching programme	

Brood stock development and breeding of damsel fishes	Mr. Grinson George
Breeding and Seed Production technology of Commercially important Cat fishes: *Clarias batrachus* (Indian magur) and *Heteropneustes fossilis* (Singhi) in A & N Islands	Dr. Chaturvedi
Induced breeding, seed production and culture of Indian major carps and exotic carps.	Dr. S.N.Sethi
WSSV Incidence and molecular characterization of tiger shrimp, *P. monodon* of Andaman waters.	
ANIMAL SCIENCE	
Adaptability and Productivity of Turkey and Guinea Fowl in Bay Islands.	Dr. A. Kundu
Improvement, Evaluation & Propagation of Indigenous Nicobari fowl and Ducks and Dissemination of Technology in Tsunami Affected Areas.	
Factors influencing productive and reproductive performance in dairy cattle under island ecosystem	Dr. S. Jeyakumar
Enhancement and sustainable dairy production in Bay Islands	
Productivity enhancement of pigs under island ecosystem	Dr. M.S. Kundu
Evaluation and Utilisation of Azolla as feed supplement for backyard poultry in Bay Islands	Dr. T. Sujatha
Characterization of LHβ and FSHβ and their receptor genes in goat breeds of Andaman and Nicobar Islands.	Dr. Satya Pal Yadav
Identification and evaluation of alternate feed resources in Bay Islands for low cost poultry feed production	Dr. Simmi Tomar
Characterization of livestock production subsystem and assessment of critical nutritional gap in Bay Islands	Dr. S.K. Verma
SOCIAL SCIENCE	
Socio-economic Impact Assessment on Agriculture, Animal Husbandry & Aquaculture in the Tsunami-hit Andaman	Dr. B. Ganesh Kumar

An economic analysis of floriculture potential in Andaman and Nicobar Islands.	Dr. Subhash Chand
Development of database on animal genetic resources in Andaman & Nicobar Islands	Dr. M. Balakrishnan
Development of artificial neural networks (ANN) based forecasting model for studying varietal diversity, yield and production in prominent rice cultivars of Bay Islands	
COMPLETED PROJECT	
Documentation and analysis of fisheries information and forecasting of fisheries in Bay Islands.	Dr. S. Dam Roy
Serosurveillance and antigenic characterization of etiological agents of major livestock and poultry diseases of A & N Islands	Dr. Jai Sunder

LIST OF PUBLICATION

RESEARCH ARTICLE

Balakrishnan, M and K. Meena (2006). A back-propagation algorithm applied to forecast coconut yield, *AMSE international journal*, 69160, tass in la demi-lune (France), Modeling D, Vol. 27, 2 : pp.75-85.

Chatterjee, R.N., Rai, R.B., Kundu, A., Senani, S., and Jai sunder. (2006). Restricted feeding in Nicobari fowl, *Indian Veterinary Journal* 83: 1289-1291.

Chatterjee, R.N., Rai, R.B., Kundu, A., Senani, S., Jai Sunder. (2007). Egg quality traits of indigenous breeds of chicken of Andaman and Nicobar Islands, *Indian Veterinary Journal* 84: 206-208.

Chaturvedi. C.S., Ayyapan.S., & Yadav. A.K., (2006). Successful breeding of *C.batrachus* Indian Magur through induced breeding (Hindi) *CIFRI bull*. 144. P. 171-177.

Dam Roy, S., P. Krishan and V. Sonia (2005). A study of nutritative value of Tilapia *Oreochromis urolepis* from Bay Islands, *Journal of the Indian Society of Coastal Agricultural Research,* 22 : 2.

Das, T., S., A.K. Pal, S.K. Chakraborty, M. Manushm R.S. Dalvi, K. Sarma and S.C. Mukherjee, 2006. Thermal dependence of embryonic development and hatching rate in *Labeo rohita* (Hamilton 1822). *Aquaculture,* 255 : 536 - 541.

Din, M., P.S. Deshmukh, Ravisankar, N, and S. Ghoshal Chaudhuri (2007). Farm mechanization in Andaman and Nicobar Island, *Agricultural Mechanization in Asia, Africa, and Latin America*, 34: 78-82.

Efath Shahnaz, Krishna Kumar, V. K Razdan, A. K. Tewari and B. Singh (2006). Host range and seasonal incidence of tomato leaf curl disease in subtropics of Jammu. *Environment and Ecology,* 24: 302-305.

Ganesh Kumar, B., P. Krishnan and R. Soundararajan (2007). Socio-economic status of fishermen in Andaman islands, *Indian Journal of Fisheries* (Accepted).

Ganesh Kumar, B., R.B. Rai (2006). Cost and returns structure in commercial broiler farming in Andaman and Nicobar islands, *Indian Journal of Animal Sciences,* 76 (12) : 72 – 00.

Ganesh Kumar, B., R.B. Rai (2006). Economic status of poultry farming enterprises in Andaman and Nicobar islands, *Agricultural Economics Research Review,* 19 (2) : 377-386.

Ganesh Kumar, B., S. Jeyakumar, R.B. Rai, Raj Vir Singh, Zachariah George, Kuntola Roy (2006). Economics of cow milk production – A microlevel study in Andaman & Nicobar Islands, *Indian Journal of Dairy*

Science, 59 (6) : 1 – 6.

Jai Sunder, R.B. Rai, A.Kundu, S.Senani, R.N.Chatterjee and S. Jeyakumar (2007). Sero prevalence of poultry diseases in Andaman and Nicobar Islands, *Indian Veterinary Journal*, 84:95 – 96.

Jai Sunder, R.B.Rai, A.Kundu and S. Jeyakumar (2007). Outbreak of FMD in livestock of A & N Islands, *Indian Veterianry Journal*. (Accepted).

Jai Sunder, R.B.Rai, A.Kundu, R.N.Chatterjee and S.Senani (2007). Immunoprophylaxis of IBD infection in the chicken, *Indian Veterinary Journal*. (Accepted).

Jai Sunder, S. Jeyakumar, S.P S . Ahlawat, A. Kundu, S. Senani, R.N.Chatterjee S. K. Saha and S. P Yadav (2007). Antibiotic resistance pattern of bacterial isolates from fishes of Andaman and Nicobar Islands, *Indian Journal of Fisheries* ., 53 (2) : 231-235.

Jayakumar, V., R. Bhaskaran and S. Tsushima (2007). Potential of plant extracts in combination with antagonist treatment as biocontrol agent of red rot of sugarcane, *Canadian Journal of Microbiology*, 53 (2): 196-206.

Jeyakumar, S., B. Ganesh Kumar, Kuntola Roy, Jai Sunder and A. Kundu (2007). Prevalence of parasitic infection in livestock and poultry in Andamans, *Indian Veterinary Journal* (Accepted).

Karthikeyan, M., R. Bhaskaran, K. Radhika, S. Mathiyazhagan, V. Jayakumar, R. Sandosskumar and R. Velazhahan. (2006). Development and comparison of ELISA and PCR methods for early detection of *Ganoderma* disease of coconut. *Archives of Phytopathology and Plant Protection*: 1-11 (Online publication through e- *journal of Taylor and Francis Publication*).

Kavino, M. S. Harish, N. Kumar, T. Damodaran and R. Samiyappan (2007). Rhizosphere and endophytic bacteria for induction of systemic resistance to banana plantlets against bunchy top virus, Soil biology and Biochemistry, 39: 1087-98.

Krishna Kumar, B. Singh and E. Shahnaz (2007). Status of Karnal bunt of wheat in Jammu region, *Annals of Plant Protection Sciences*, 15: 235-236.

Manush, S. M., A.K. Pal, T. Das, N. Chatterjee, K. Sarma and S.C. Mukherjee (2007). Ultrastructure alterations in the gill of *Macrobrachim resenbergii* acclimated to three temperature, *Asian Journal of Cell Biology* 2(1): 1-0.

Medhi, R.P., T. Damodaran, V. Damodaran, A. Venkatesh and G. Kapil Dev (2007). Evaluation of ginger genotypes for

yield and genetic variability under the island ecosystem of Andaman and Nicobar islands, *Indian Journal of Horticulture*, 64(2).

Nirupama. Chatterjee, A.K. Pal, T. Das, S. M. Manush, Kamal Sarma, G. Venkatashwarlu and S.C. Mukherjee (2006). Secondary stress responses in Indian major carps *Labeo rohita* (Hamilton 1822), *Catla catla* (Hamilton 1822) and *Cirrhinus mrigala* (Hamilton 1822) fry to increasing packing densities, *Aquaculture Research*, 37:472-476.

Palanisamy, M., R.P. Pandey, L. Rasingam and R. Raja (2007). *Sebastiania* spengel. (Euphorbiaceae) - A new generic record for Andaman Islands, *Indian Journal of Economic and Taxonomic Botany* 31(2):464-465.

Palanisamy, M., R.P. Pandey, L. Rasingam and R. Raja (2007). *Spermococe latifolia* Aubl. (Rubiaceae) – An additional to the flora of Andamans. *Journal of Economic and Taxonomyic Botany* 31(2):472-473.

Pandey, C. B., Lata, K, Venkatesh, A. and Medhi, R. P. (2006). Diversity and species structure of homegardens in South Andaman, *Tropical Ecology* 72 (2): 1-8.

Pandey, C. B., Sharma, D. K. and Bargali S. S. (2007). Decomposition and nitrogen from *Leucaena leucocephala* in Central India, *Tropical Ecology* (in Press).

Pandey, C. B.., Rai. R. B., and Singh L. 2007. Seasonal dynamics of mineral N pools and N- mineralization in soils under homegardens trees in South Andaman, *Indian Agroforestry Systems* (in Press).

Pandey, C. B.., Rai. R. B., Singh L. and Singh A. K. (2007). Homegardens of Andman and Nicobar, *Indian Agricultural Systems* 92: 1 – 22.

Ravisankar, N, B. Chandrasekaran, R. Raja, M. Din and S. Ghoshal Chaudhuri (2007). Influence of seeding methods, intercropping and weed management practices on productivity and profitability of wet seeded rice (*Oryza sativa* L.), *Indian Journal of Agronomy* (Accepted).

Ravisankar, N., R. Raja, M. Din, R. Elanchezhian and S. Ghoshal Chaudhuri (2007). Response of rice (*Oryza sativa)* varieties and super rice cultures to anaerobic wet seeding in Bay Islands, *Indian Journal of Agricultural Sciences*, 77(1): pp 14-17.

Ravisankar, N., R.Raja, M. Din, R. Elanchezhian and S. Ghoshal Chaudhuri (2007). Evaluation of green manure intercropping in wet seeded and transplanted rice under island ecosystem, *Oryza* 44 (3): 231-233.

Satyanarayan Sethi, Subhash Chandra

Mukherjee, Basanta Kumar Das, Surya Kanta Samal and Shalini Soni (2006). Physiological Changes in Indian River Prawn *Macrobrachium malcolmsonii* Experimentally Infected with *Vibrio alginolyticus* and *Vibrio anguillarum*, *Asian Fisheries Science* 19: 129-137.

Shyam Prasad, G., V. Jayakumar, H.R. Ranganath and V.R. Bhagwat (2007). Bio-suppression of coconut Rhinoceros beetle, *Oryctes rhinoceros* L. (Coleoptera: Scarabidae) by *Oryctes* baculovirus (Kerala isolate) in South Andaman, India, *Crop Protection* (Accepted-available online).

Shyam Prasad, G., V. Jayakumar (2007). Population developments of *Heterorhabditis indica* under *in vitro* culture. Indian Journal of plant Protection, 35 (1) : pp 155 - 156.

Shyam Prasad, G., S. Bhagat and V. Jayakumar (2007). Spiralling whitefly *Aleurodicus dispersus* Russel (Homoptera : Aleurodiae) invades Andamans. Journal of the Bombay Natural History Society, 104 (1) : pp 108-109.

Singh, R.N, Krishna Kumar and Khan, A.T. (2006). *Rhynchosporium* scald of barley in India, *Indian Phytopathology*, 59:128.

Subhash Chand, D.V.Singh, S. Rajkumar, P. Muralidharan, V. Selvi and M.Madhu (2006). Floriculture as a micro enterprise through self help group in Nilgiris, *Indian Horticulture*, pp 30-32.

Subhash Chand, Kuber Ram and P.K. Dixit (2006). Expenditure Pattern of Milk and Milk Products in Urban Area of Western Uttar Pradesh, *The Indian Journal of Dairy and Bio sciences* 14(2): pp 43-47.

POPULAR ARTICLE

Balakrishnan, M. and R. Elanchezhian, (2006). Online Database of Medicinal Plants of Andaman and Nicobar Islands. *Central Agricultural Research Institute, Port Blair.*

Balakrishnan, M., (2006). Database for cartridges management monitoring, *Central Agricultural Research Institute, Port Blair.*

Balakrishnan, M., (2006). Database Marine Fauna, *Central Agricultural Research Institute, Port Blair.*

Balakrishnan, M., T.Damodaran, R.P.Medhi, V.Damodaran and D. Anidath, (2006). Database for spices crops in Andaman & Nicobar Islands, *Central Agricultural Research Institute, Port Blair.*

Elanchezhian, R. and M. Balakrishnan (2006). Online Database of Indigenous Orchids of Andaman and Nicobar Islands. *Central Agricultural Research Institute, Port Blair.*

Elanchezhian, R. and M. Balakrishnan (2006). Database of Rice Germplasm of Andaman and Nicobar Islands. *Central Agricultural Research Institute, Port Blair.*

Elanchezhian, R. and M. Balakrishnan (2006). Database of Timber Yielding Plants of Andaman and Nicobar Islands. *Central Agricultural Research Institute, Port Blair.*

Elanchezhian, R. and M.Balakrishnan (2006). Database of Minor and underutilized fruits of Andaman and Nicobar Islands. *Central Agricultural Research Institute, Port Blair.*

Gupta, S.K., S.K. Ambast, Gurbachan Singh, N.P.S. Yaduvanshi, S. Ghoshal Chaudhuri and R. Raja (2006). Restoring Livelihood options in Tsunami Affected Areas of India and Maldives. *Salinity News, CSSRI, Karnal*, 12(2): 4.

Jeyakumar, S., T. Sujatha. R.B. Rai, A. Kundu and Jai Sunder (2006). Azolla as livestock and poultry feed: A boon to islands farmers. *The Daily Telegram, Port Blair.*

Ravisankar, N., Tapan Kr. Biswas, Nabisat Bibi, Shakila Nawaz, and S.C. Pramanik (2007). Integrated Fish-Poultry-Duck farming in Bay Islands, A & N, *Fishing Chimes* 26 (10): 137-141.

Singh, D.R. Alvira D'Souza and S.Manju, (2005). Pandanus- A pride fruit of Nicobarese, *UTS Voice*, July 1-15. Page -17 Vol-II Issue. *Noni Commercialized UTS Voice* 16-31 Oct.,2006.

Subhash Chand, R.C. Srivastava, D.R. Singh (2007) .Role of people's participation in conservation of water and environment, *Dweep Samachar, CARI, Port Blair.*

PAPER PRESENTED IN SEMINAR / SYMPOSIA / CONFERENCES / WORKSHOPS / MEETINGS

Arun, V. A. Subramanian, S. Balasubramanian, Jeyakumar, S. and Mahalinganainar (2006). "Influence of OPU obtained oocyte quality on maturation rate in cows. *XX*II *Annual convention of ISSAR and national symposium on "Innovative Technologies for Fertility Enhancement in Livestock"* held at Mhow (M.P), 10-12 November.

Arun, V. A. Subramanian, S. Balasubramanian, Jeyakumar, S. and Mahalinganainar (2006). Ultrasound guided follicle aspiration in cows: influence of ovary side on oocyte recovery rate and Quality. *XX*II A*nnual convention of ISSAR and national symposium on "Innovative Technologies for Fertility Enhancement in Livestock"* held at Mhow (M.P), 10-12 November.

Balakrishnan, M. (2007) The Biotechnology Information system in India. *In Proc. of XVIIIth All India BTISnet Coordinators Meeting* organized by DBT, Ministry of Science and Technology at gangtok, Sikkim, 3-4 February, pp.59-63.

Balakrishnan, M., A.K. Singh, Zamir Ahmed, S.K., and N. Ravisankar (2006). Assessment of salt tolerant paddy (*Oryza sativa)* varieties in *Tsunami* affected low lying valley areas (situation I) of Bay Islands, Extended Summaries, 2006, Golden Jubilee Symposium on *Conservation Agriculture and Environment,* October 26-28, Indian Society of Agronomy, Division of Agronomy, IARI, New Delhi, pp 220.

Balakrishnan, M., T.Damodaran, R.P.Medhi, V.Damodaran and D.Anidath (2006). Database for spices crops in Andaman & Nicobar islands, *In Proc. of National workshop on integrated development of spices*, organized by CARI, Port Blair on 12- 14 October pp.71-72.

Banu Saira, S.K. Zamir Ahmed, B. Ganesh Kumar, G. Kapil Dev and T. Damodaran (2006). Adoption constraints faced by farmers and strategies suggested for improvement of spice cultivation in Bay islands. National Workshop on Integrated Development of Spices held at CARI, Port Blair during 12 – 14 October.

Chand Subhash, (2006). Livestock development in watershed programme: A Case study, Coimbatore district of Tamil Nadu. *XXXV Dairy Industry Conference*, Swabhumi, Kolkata held on 23-25 Nov. pp-187-88.

Chand Subhash, A.K. Sikka and V.N. Sharda (2007). An economic analysis of converting natural grass lands into eucalyptus plantations in hydro power catchments in Nilgiris, India. *IIIrd International Conference on Ground water, environment & agriculture present problems & future challenges* held in TNAU, Coimbatore, Tamil Nadu on 7-10 Feb. pp 296-297.

Dam Roy S, Chaturvedi, C.S, S. N. Sethi, Grinson George and B. Varghese (2006). Freshwater Aquaculture vis –a –vis plantation based spices in Bay Islands. In the Proc. of National Workshop on *Integrated Development of Spices*, edited by R.P. Medhi, T. Damodaran and V. Damodaran.

Deshmukh, P.S., M. Din, and Chandrica Ram. Manually operated coconut

dehusker for Andaman and Nicobar (2007),*41st ISAE annual convention & symposium (Theme: Agricultural Engineering for enhanced productivity and employment)*, 29-31 January, at College of Agricultural Engineering and Technology, Junagadh Agricultural University, Junagadh p. 1.27.

Din, M., Deshmukh, N. Ravisankar, S. Ghoshal Chaudhuri and Manoj Kumar (2007). Influence of tillage operations and planting methods on productivity and energetic of paddy under island ecosystem, *41st ISAE annual convention & symposium*, Junagadh, 29-31 January, pp 4-17.

Din, M., P.S. Deshmukh, N. Ravisankar, S. Ghoshal Chaudhuri and Chandrika Ram (2007). Performance of Solar dryers for drying of copra, *Proc. of 3rd International conference on Solar radiation and day lighting* (SOLARIS 2007), (Editors: S.K. Dube, T. Muneer and G.N. Tiwari), 7-9 Febrauary, New Delhi, pp 320-327.

Din, M., P.S. Deshmukh, R.C. Srivastava, R.P. Medhi and N. Ravisankar (2007). Suitability of Greenhouses for vegetable production in high rainfall and humid tropical climate of Andaman Islands, *Proc. of 3rd International conference on Solar radiation and day lighting* (SOLARIS 2007), (Editors: S.K. Dube, T. Muneer and G.N. Tiwari) 7-9 February, New Delhi, pp 279-284.

Ganesh Kumar, B. (2006). Livestock farming as an alternative economically viable enterprise for farmers of Andaman. *National Workshop on 'Livestock based livelihoods: An action programme for the Andaman & Nicobar islands'* organized by Anthra, Pune and Action Aid International, Port Blair, 23 – 24 November.

Ganesh Kumar, B., Kuntola Roy and Zachariah George (2006). Change in income pattern of tsunami affected farmers of South Andaman. *National Seminar on 'Serving Farmer and Saving Farming: Indian Imperatives and Global Perspectives'* , Pant Nagar,10 – 12 January.

Ganesh Kumar, B., S. Jeyakumar, R.B. Rai and Raj Vir Singh (2006). A micro level evidence on economic status of buffalo farming in the District of Andaman. *14th Annual Conference of Agricultural Economics Research Association (India) on 'Sustainable Agriculture and Rural Livelihoods'*, Pantnagar, 27-28 September.

Ganesh Kumar, B., S. Jeyakumar, Raj Vir Singh, Z. George and K. Roy (2006). Comparative economics of milk production for different species of milch animals in Andaman & Nicobar islands. *XXXV Dairy Industry Conference* Swabhumi, Kolkata 23 – 25 November.

Ganesh Kumar, B., Z. George and Kuntola Roy (2007). Impact of Tsunami on Labour Employment Pattern in Agriculture and Animal Husbandry. *International Conference on 21st Century Challenges to Sustainable Agri-Food Systems, Biotechnology, Environment, Nutrition, Trade and Policy* UAS, Bangalore 15-17 March.

Ganesh Kumar, B., Z. George and Kuntola

Roy, Subhash Chand and R.C. Srivastava (2007). Role of NGO in livelihood assistance of tsunami affected farmers of South Andaman. *2nd International Convention on Globalization and Rural Development*, Mumbai 9-10 February.

Ghoshal Chaudhuri, S., R. Raja, N. Ravisankar, M. Din and R.C. Srivastava (2007). Potential and Prospects of Natural Resources of Bay Islands. Paper presented in the *9th Indian Agricultural Scientist and Farmers' Congress organized by Bioved Research Society*, Allahabad, January 29-30.

Ghoshal Chaudhuri, S., R. Raja, V. Jayakumar, R.P. Medhi, and R.C. Srivastava (2006). Organic farming in Andaman and Nicobar Islands. Paper presented in: *India Organic Congress 2006* held at Bangalore on 9 November.

Jai Sunder, R.B.Rai, A.Kundu, S. Jeyakumar and J. Yasmeen (2006). Immune enhancer effect of *Morinda citrifolia* in poultry. *6th Indian Congress and XIII Annual conference of IAAVR*, OUAT, Bhubaneshwar,6-7 April.

Jai Sunder, R.B.Rai, A.Kundu, S. Jeyakumar and J. Yasmeen (2006) . Delectation of IBDV in poultry of A & N Islands. *6th Indian Congress and XIII Annual conference of IAAVR*, OUAT, Bhubaneshwar, 6-7 April.

Jeyakumar, S, A. Kundu, B.Ganesh Kumar, T. Sujatha, Jai Sunder, M. Din, and M. Balakrishnan (2006). *Productive and reproductive performance of Dairy Cows under Island Ecosystem XXXV Dairy Industry Conference*, November 23-25, organized by Indian Dairy association (East zone), Repositioning of Indian Dairy Industry: a Business with Socio-economic Development Objective p. DPM:14.

Jeyakumar, S, S., Rai, R.B., Jai Sunder, Kundu, A., Swapna, T.P. and George, Z. (2007) Ovaro Bursal adhesion in a Gilt – A case report. *6th Indian Veterinary Congress and XIIIth Annual Congress of Indian Association for the Advancement of Veterinary Research and National Symposium on Advancement in Veterinary Research – New Horizon vis – a – vis Biosafety, Biosecurity and Quality Assurance through Livestock Feed,* Bhubaneswar, 20 – 21 January.

Jeyakumar, S., B. Ganesh Kumar, A. Kundu, Jai Sunder, T. Sujatha, M.Din, and M. Balakrishnan (2006). *Influence of season and climatic factors on performance of dairy cows under Island Ecosystem XXXV Dairy Industry Conference*, November 23-25, organized by Indian Dairy association (East zone), Repositioning of Indian Dairy Industry: a Business with Socio-economic Development Objective p. DPM:16.

Jeyakumar, S., C. Veerapandian. S. A. Asokan, A. Subramanian, S. Balasubramanian, Lizsimon, P. Sridevi and J. Kalatharan (2006). Quality and viability assessment of invivo produced bovine embryos. *XX*II *Annual convention of ISSAR and National symposium on Innovative Technologies for Fertility Enhancement in Livestock,* Mhow (M.P*)*, 10-12 November.

Jeyakumar, S., S. A. Asokan, C. Veerapandian, A. Subramanian, P. Sridevi and J. Kalatharan (2006). Ovum pickup in cows: influence of individual donar

variation on oocyte recovery rate and quality. *XXXV Dairy Industry Conference* held at Swabhumi, Kolkata , 23 – 25 November.

Jeyakumar, S., Kundu, A., Rai, R.B., Jai sunder, Nabisat Bibi and Swapna, T.P. (2007). Serum total cholesterol levels in local goats of Andaman. . 6th Indian Veterinary Congress and XIIIth Annual Congress of Indian Association for the Advancement of Veterinary Research and National Symposium on *Advancement in Veterinary Research – New Horizon vis – a – vis Biosafety, Biosecurity and Quality Assurance through Livestock Feed*, Bhubaneswar, 20 – 21 January.

Jeyakumar, S., (2006) The Nicobari pig: A case for conservation, Workshop on *Livestock based Livelihoods*, Organized by Action aid and ANTHRA (NGO) 23-24 November, at Port Blair.

Jeyakumar, S., Jai Sunder, A. Kundu, S.P.Yadav and T.Sujatha (2006).Population distribution, phenotypic characteristics and performance of Teressa goat of Andaman and Nicobar islands. National Seminar on *Innovation and recent advances in Reproduction for augmenting Small Ruminant Production*, Avikanagar, 28 -30 December.

Jeyakumar, S., B. Ganesh Kumar, A. Kundu, Jai Sunder, T. Sujatha, M. Din and M. Balakrishnan (2006). Influence of season and climatic factors on performance of dairy cows under island ecosystem. *XXXV Dairy Industry Conference*, Kolkata, 23 – 25 November.

Jeyakumar, S., C. Veerapandian. S. A. Asokan, A. Subramanian,S. Balasubramanian, Lizsimon, P. Sridevi and J. Kalatharan (2006). Ovum pickup in cows: effect of gonodotropin pre stimulation on follicle number, oocyte recovery rate and it's quality. XXII annual convention of ISSAR and national symposium on *Innovative Technologies for Fertility Enhancement in Livestock,* Mhow (M.P), 10-12 November.

Krishna Kumar, V. Jayakumar, T.V.R.S. Sharma and Neelam Purti (2006). Traditional knowledge for pest management of crops by organic means in Andaman and Nicobar Islands. Paper presented in National seminar on "*Organic crop protection technologies for promoting export Agri-Horticulture*", Chennai, Tamil Nadu, 21-22 November. (Abstracts: pp. 13-14).

Kundu, M.S. (2006) Effect of feeding chelated and organic Cu & Zn on distribution and concentration of these elements in mammary secretion of peripartum cows. Presented in *National conference on XXXV India Dairy Industry*, Kolkata, 23-25 November. (Abstract no DPM-18 vide pp 124).

Medhi, R.P, Damodaran V, Damodaran T, Venkatesh A and CB Pandey. (2006). Effect of fertilization on growth and yield of ginger *(Zingiber officinales)* under different situations of coconut plantations. In Proceedings of National Workshop on *Integrated development of spices*, Port Blair, Oct 12-14, pp 55-57.

Medhi, R.P, Venkatesh A, Damodaran V,

Damodaran T, Brojendra Singh L and Zamir Ahmed SK. (2006). Extension activities – to promote spices cultivation in Andaman and Nicobar Islands. In Proceedings of National Workshop on *Integrated development of spice*s CARI Port Blair, Oct 12-14, pp 88-89.

Medhi, R.P., Damodaran, T., Damodaran, V. and Venkatesh, A. (2006). Evaluation of ginger genotypes for yield and genetic variability under the Islands ecosystem of Andaman and Nicobar Islands. In Proceedings of *National Workshop on Integrated development of spices*, CARI Port Blair, Oct 12-14, pp 35-37.

Ravisankar, N., Shakila Nawaz, Nabisat Bibi, Tapan Kumar Biswas and B. Sajibala (2006). Role of Spices in Integrated Farming System, *Proc. of National Workshop on Integrated Development of Spices*, Port Blair, October 12-14, pp 63-64.

Ravisankar, N., Zamir Ahmed, M. Din, T.V.R.S. Sharma and S. Ghoshal Chaudhuri (2006). Performance of System of Rice Intensification (SRI) under Island Ecosystem, National Symposium on "System of Rice Intensification (SRI) –Present Status and Future Prospects", Hyderabad, 17-18 November.

Sharma, T.V.R.S., V. Jayakumar, R. Elanchezhian, R. Senthilkumar and S. Rajalakshmi (2006). Breeding for diosgenin free tuber crops- A need to protect tribal population of Andaman. *14th Triennial symposium of International society for tropical root crops*, Thiruvananthapuram.

Sharma, T.V.R.S., V. Jayakumar, R.P. Pandey and Neelam Purti (2006). Indigenous perennial vegetable flora of Andaman and Nicobar Islands. International conference on *Indigenous vegetables and legumes*, ICRISAT, Hyderabad, 12-15 December.

Singh, D.R, Subhash Chand and V.B. Pandey (2006). Medicinal importance of spices. In a National Workshop on *Integrated development of spices*, CARI, Port Blair, 12-14th October.

Singh, D.R. (2006). *Morinda citrifolia*- an evergreen tool for Commercial Horticulture. Proceedings of first symposium on *Noni Resea*rch, 7-8 October.

Singh, D.R. (2006). Nutritive value on underutilized fruits of A&N Islands, organized by CFNEU of Ministry of HRD, Dept. of Women Child development, Govt. of India at Junglighat, Port Blair on June.

Singh, D.R., R.C. Srivastava, V.B. Pandey and Alvira D'Souza (2006). Influence of foliar application of nutrients and growth regulators on growth and flowering of Gladiolus cv. American Beauty. National Symposium on *Ornamental Bulbous crops*. (Abstract) P.P. 2.54 , pp 87 , 5-6 December.

Singh, D.R., R.P. Medhi, R.C. Srivastava, Alvira D'Souza and Subhash Chand (2006). Studies on the performance of exotic gladiolus cultivars under hot and humid tropical condition- A comparative analysis. *At National Symposium on Ornamental Bulbous crops* held during 5-6 Dec. at SUBP University of Agril. And Technology, Modipuram,

Meerut.

Singh, D.R., V.B. Pandey and Alvira D'Souza (2006). Performance of single pettaled tuberose cultivars under hot and humid condition of Andaman. *National Symposium on Ornamental Bulbous crops.* (Abstract) P.P.2.53, pp 86, 5-6th Dec.

Srivastava, R.C., S. Ghoshal Chaudhuri and R. Raja (2006). Land and Water Resources of Bay Islands: Potential and Prospects. *7th Water Asia - International Conference* held at Pragati Maidan, New Delhi, 2nd November.

Yadav, S.P., Rai, R.B., Chatterjee, R.N., Kundu, A., Senani S., Jai Sunder and Jeyakumar, S (2006). RAPD analysis of three breeds of goat of Andaman & Nicobar Islands National Seminar on *Innovation and Recent Advances in Reproduction for Augmenting Small Ruminant Production*, CSWRI, Avikanagar, February 23-25.

Zamir Ahmed S. K, Medhi R. P, Venkatesh A, Damodaran V, Damodaran T, Singh L.B and Singh A.K. (2006). Impact of extension approach on participation and knowledge level of the spices trainees in bay islands. In Proceedings of *National Workshop on Integrated development of spices*, CARI Port Blair, Oct 12-14, pp 83-85.

Zamir Ahmed, S.K., N. Ravisankar and A.K. Singh. (2006). Response of rice (*Oryza sativa)* varieties to System of Rice Intensification in Bay Islands, Extended Summaries. 2006. Golden Jubilee Symposium on *Conservation Agriculture and Environment,* October 26-28, Indian Society of Agronomy, Division of Agronomy, IARI, New Delhi, pp 70-71.

BOOKS / BOOK CHAPTERS/ FOLDERS / MANUALS

Balakrishnan, M., K.Meena, Satyanarayan Sethi and Aditya N. Sarangi (2007). Neural Network and its application in Aquaculture on Bioinformatics and statistics in Fisheries Research vol. III, CIFA, Kausalyaganga, Orissa, pp 145-151

Balakrishnan, M, (2007). Recent trends in Networking concepts and communication technologies in Bioinformatics and Statistics in Fisheries research Vol.III, CIFA, Bhubaneshwar, Orissa Vol(3): pp 124-132.

Chaurasia Nisha and D.R. Singh (2006). Plant protection management in Marigold cultivation. Training manual on High Value vegetables-Livelihood promotion through agriculture and allied sector for tsunami affected farmers in bay islands. published by CARI, Port Blair, pp 38-40.

Dam Roy S and Grinson George (2007). Training Manual on Ornamental Fish Rearing. Published by CARI, Port Blair.

Dam Roy, S and Grinson George (2006). Clown Fish Breeding. The Daily Telegram. January 04, 2007.

Dam Roy, S and Sarma. K (2007). Integrated mushroom and fish culture. In Training Manual on Livelihood promotion Agriculture and allied Sector for tsunami affected farmers in bay Islands. Sponsored by CARE India, 20-24 January, pp 20-25.

Dam Roy, S., Grinson George, Chaturvedi.

C.S, and Kamal Sarma (2007). Ecology and scope for fisheries in marshy wetlands in South Andaman. In 4th Indian Fisheries Science Congress organized by Indian Fisheries Society, April 12-13 at Patna.

Dam Roy, S., Grinson George, R.C.Srivastava, Naveen Kumar , Amar Kr. Sadhu and N.C.Choudhury (2007). Metha pani ka Aquarium ek priya shok.

Dam Roy, S., S.N. Sethi, P. Krishnan, B.Varghese, N. Kumar, A. K. Sadhu , R.C. Srivastava (2007). Bulletin on Giant freshwater prawn (*M. rosenbergii*) in Andaman (Hindi & English).

Dam Roy. S (2007). Brackish water aquaculture as an important component in the integrated farming system in island ecosystem of Andaman" In the training manual on Integrated farming System for rural property, Edited by N. Ravisankar, S.K. Zamir Ahmed, R.P. Medhi and R.C. Srivastava.

Damodaran T, Saira Banu, Singh DR, Damodaran V and Kapil Dev G. (2006). Vegetables suitable for hi-tech cultivation. In Training Manual on High Value vegetables- Livelihood promotion through agriculture and allied sector for tsunami affected farmers in bay islands (Edited by Din M *et al*.,) published by CARI, Port Blair, pp 9-12.

Damodaran V, Singh DR, Damodaran T and Kapil Dev G. (2007). Cultivation techniques for marigold. In Training Manual on Marigold Production in Bay Islands- Livelihood promotion through agriculture and allied sector for tsunami affected farmers in bay islands (Edited by. Singh DR *et al.*,) Published by CARI, Port Blair, pp 31-34.

Damodaran V, Singh DR, Damodaran T and Kapil Dev G. (2007). Harvesting, post harvest management and storage of tuberose flowers. In Training Manual on Production technology of tuberose in Bay Islands- Livelihood promotion through agriculture and allied sector for tsunami affected farmers in bay islands (Edited by Singh DR *etal*.,) Published by CARI, Port Blair, pp 20-23.

Damodaran, T., N. Kumar, J. Dole•el, P. Suchánková, M. Soorianathasundaram. (2007). Ploidy Determination in New Banana Hybrids Using Stomatal Density and Flow Cytometry, *Phytomorphology*, 56 (3 & 4), 171-176.

Damodaran, T., Saira Banu, Singh D.R., Damodaran, V. and Kapil Dev G. (2006). Round the year vegetable production in bay islands. In Training Manual on High Value vegetables-Livelihood promotion through agriculture and allied sector for tsunami affected farmers in bay islands (Edited by Din M *et al*.,) published by CARI, Port Blair, pp 41-43.

Damodaran, T., Singh, D.R., Saira Banu, Damodaran, V. and Kapil Dev, G. (2007). Use of growth regulators in enhancing the marigold production. In Training Manual on Marigold Production in Bay Islands- Livelihood promotion through agriculture and allied sector for tsunami affected farmers in bay islands (Edited by Singh

DR *et al.*,) Published by CARI, Port Blair, pp 10-12.

Das, T., S., A.K. Pal, S.K. Chakraborty, M. Manushm R.S. Dalvi, K. Sarma and S.C. Mukherjee, 2006. Thermal dependence of embryonic development and hatching rate in *Labeo rohita* (Hamilton 1822). *Aquaculture,* 255 : 536 - 541.

Ganesh Kumar, B (2006). Livestock farming as an alternative economically viable enterprise for farmers of Andaman In : Livestock Based Livelihoods : an action programme for Andaman and Nicobar Islands, proceedings of Workshop, Ed. Dr. Nitya, S. Ghotge, Anthra, Pune.

George Grinson, D.R.Singh and S.Dam Roy.(2006). Fresh water ornamental fish rearing in small ponds of horticulture farms for additional income. *In Training Manual on High Value vegetables-* Livelihood promotion through agriculture and allied sector for tsunami affected farmers in bay islands published by CARI, Port Blair, pp 44-47.

George Grinson, D.R.Singh and S.Dam Roy (2006). Integration of Aquaculture with floriculture – a new concept. In Training Manual on High Value vegetables- Livelihood promotion through agriculture and allied sector for tsunami affected farmers in bay islands published by CARI, Port Blair, pp 14-16.

George Grinson, Dam Roy. S and Sarma, K. (2007). Breeding and rearing of Marine ornamental fishes "In Training Manual on Ornamental Fish rearing for Livelihood promotion through Agriculture and allied Sector for tsunami affected farmers in bay Islands. Sponsored by CARE India , 2-6 January, pp 11-12.

George Grinson, Varghese, B and Dam Roy, S.(2007)."Setting and Maintenance of Aquarium tank". In Training Manual on Ornamental Fish rearing for Livelihood promotion through Agriculture and allied Sector for tsunami affected farmers in Bay Islands. Sponsored by CARE India, 2-6 January pp16-17.

George, G., Dam Roy, S and Sarma. K. (2007). Food and feeding habit of marine ornamental fishes. In Training Manual on Ornamental Fish rearing for Livelihood promotion through Agriculture and allied Sector for tsunami affected farmers in bay Islands. Sponsored by CARE India, 2-6 January, pp 9-11.

Grinson George, D.R.Singh and S.Dam Roy (2007)."Effective utilization of irrigation water for fish production as an additional source of income". In Training Manual on Floriculture for Livelihood promotion through Agriculture and allied Sector for tsunami affected farmers in Bay Islands. Sponsored by CARE India, 2-6 January.

Grinson George, S.Dam Roy and D.R.Singh (2007). "Fresh water ornamental fish rearing in small ponds of horticulture farms for additional income". In Training Manual on Floriculture for Livelihood promotion through Agriculture and allied Sector for tsunami Affected Farmers in Bay Islands. Sponsored by Central Agricultural Research Institute, Port Blair and CARE India, 2-6 January.

Gupta, S.K., S.K. Ambast, Gurbachan Singh, N.P.S. Yaduvanshi, S. Ghoshal Chaudhuri and R. Raja (2006). Technological options for improved agriculture in tsunami affected Andaman & Nicobar Islands and Maldives. Central Soil Salinity Research Institute, Karnal (India), p 88.

Jai Sunder (2006). Stutus of livestock and poultry diseases in Andaman & Nicobar Islands In : Livestock Based Livelihoods : an action programme for Andaman and Nicobar Islands, proceedings of Workshop, Ed. Dr. Nitya, S. Ghotge, Anthra, Pune.

Jeyakumar and A. Kundu (2006). Livestock and poultry germplasm of Andaman and Nicobar Islands with special reference to Nicobari pig, In : Livestock Based Livelihoods : an action programme for Andaman and Nicobar Islands, proceedings of Workshop, Ed. Dr. Nitya, S. Ghotge, Anthra, Pune.

Jeyakumar, S., R.C. Srivastava, S.K. Verma and A. Kundu (2006). Training manual on Goat farming, CARI, Port Blair.

Jeyakumar, S., Rai, R.B., Kundu, A., Jaisunder, Sujatha, T and B. Ganesh Kumar (2007) Chapter 12. Animal Genetic Resources of Andaman & Nicobar Islands In Book : Biodiversity in India : Issues and concerns, Ed. S. Kanniyan and A. Gopalam, Associated publishing company, New Delhi.

Krishna Kumar, V. Jayakumar, T.V.R.S. Sharma and R.C. Srivastava. (2007). Training manual on Oyster mushroom production technology.

Kundu, A. and Sujatha, T. (2006). Nicobari fowl : a unique germplasm of Andaman and Nicobar Islands, In : Livestock Based Livelihoods : an action programme for Andaman and Nicobar Islands, proceedings of Workshop, Ed. Dr. Nitya, S. Ghotge, Anthra, Pune.

Kundu, M.S., S.P. Yadav, A. Kundu and R.C. Srivastava (2006). Training manual on Pig farming, CARI, Port Blair.

Ravisankar, N., S.K. Zamir Ahmed, M. Din, M. Balakrishnan, T.P. Swarnam and A.K. Singh (2006). Techniques of Upland Rice in Andaman and Nicobar Islands, *In* Techniques of upland rice cultivation in India (Eds: R.K. Singh and C.V. Singh). Central Upland Rice Research Station, Hazaribagh.

Sarma. K, Dam Roy. S and George Grinson (2007)."Water quality management for Aquarium" In Training Manual on Ornamental Fish rearing for Livelihood promotion through Agriculture and allied Sector for tsunami affected farmers in bay Islands. Sponsored by Central Agricultural Research Institute, Port Blair and CARE India, 2-6 Jan. pp 35-38.

Sarma. K, Dam Roy. S and Grinson George (2007). Scope and sustainability of marine ornamental fishes in Andaman and Nicobar Islands." In Training Manual on Ornamental Fish rearing for Livelihood promotion through Agriculture and allied Sector for tsunami affected farmers in Bay Islands. Sponsored by Central Agricultural Research Institute, Port Blair and CARE India, 2-6 Jan., pp 6-8.

Sethi S.N and D. R. Singh (2007). Role of

Floriculture in Integrated Freshwater Aquaculture System, in training manual on Marigold Production in Bay Islands for Livelihood promotion through Agriculture and allied Sector for tsunami Affected Farmers in Bay Islands. Sponsored by CARE India, 2-6 Jan.,pp 25-26.

Sethi S.N and D.R. Singh (2006). Utilization of aquatic ornamental plants. In training manual on High Value vegetables-Livelihood promotion through agriculture and allied sector for tsunami affected farmers in bay islands (Edited by Din M *et al*.,) published by CARI, Port Blair, pp 5.

Sethi S.N. and D. R. Singh (2007). Utilization of Aquatic Ornamental Plants, in training manual on Production Technology of TUBEROSE in Bay Islands for Livelihood promotion through Agriculture and allied Sector for tsunami Affected Farmers in Bay Islands. Sponsored by CARE India, 15-19 Jan., pp 51-53.

Sethi Satyanarayan (2006). Chapter on Fisheries Science in objective AGRICULTURE for all competitive examinations (ARS/NET/ UPSC/ PCS/SAUS Exams), pp 272-285, Third (Revised) Edition: September published by NEW VISHAL PUBLICATIONS, E-153, West Patel Nagar, New Delhi.

Sethi Satyanarayan (2007). Common Diseases of Marine & Freshwater Ornamental fishes, in training manual on Ornamental Fish rearing for Livelihood promotion through Agriculture and allied Sector for tsunami Affected Farmers in Bay Islands. Sponsored by Central Agricultural Research Institute, Port Blair and CARE India, 2-6 Jan., pp 21-24.

Sethi Satyanarayan (2007). Quarantine Measures And Disease Prevention, in training manual on Ornamental Fish rearing for Livelihood promotion through Agriculture and allied Sector for tsunami Affected Farmers in Bay Islands. Sponsored by Central Agricultural Research Institute, Port Blair and CARE India, 2-6 Jan. pp 25-26.

Sethi, S. N. and S. Dam Roy (2007). Utilization of Azolla in Freshwater Aquaculture (Folder, English).

Sethi, S.N. and D.R.Singh (2006). Role of floriculture integrated fresh water aquaculture system. Training manual on High Value vegetables-Livelihood promotion through agriculture and allied sector for tsunami affected farmers in bay islands. Published by CARI, Port Blair, pp 35-36.

Simmi Tomar, A. Kundu and T. Sujatha (2006). Training manual on Quail farming, CARI, Port Blair.

Singh D.R, Damodaran T, Damodaran V and Alvira D'Souza. (2007). Marigold- a source of income in bay islands. Training manual on Marigold Production in Bay Islands- Livelihood promotion through agriculture and allied sector for tsunami affected farmers in bay islands (Edited by. Singh DR *et al*.,). Published by CARI, Port Blair, pp 5-9.

Singh, D. R., Alvira D'Souza and Amit Srivastava (2006). Use of Chemicals in

enhancing the vase life of flowers. Training manual on High Value vegetables-Livelihood promotion through agriculture and allied sector for tsunami affected farmers in bay islands, published by CARI, Port Blair, pp 38-40.

Singh, D. R., T. Damodaran, Abhay Kumar and Alvira D'Souza (2006). Cultivation practices for tuberose cultivation. Training manual on High Value vegetables-Livelihood promotion through agriculture and allied sector for tsunami affected farmers in bay islands, published by CARI, Port Blair, pp 1-6.

Singh, D. R., T. Damodaran, V.Damodaran and Alvira D'Souza (2006). Marigold-A source of income in Bay Islands. Training manual on High Value vegetables-Livelihood promotion through agriculture and allied sector for tsunami affected farmers in bay islands, published by CARI, Port Blair, pp 5-9.

Singh, D. R., V.B.Pandey, Alvira D'Souza and S.Manju (2006). Floriculture in IFS. Published in training manual on IFS in rural prosperity. KVK-CARI, AP Cess funded project, CARI, Port Blair.

Singh, D.R. (2006). Underutilised fruits of Andaman and Nicobar Islands. Accepted to be published in book of Horticulture Plants. Edited by. K.V. Peter, Ex.V.C. (KAU), Kerala.

Singh, D.R., Abhay Kumar and G.Kapil Dev.(2006). Harvesting, post harvest management and storage in Marigold cultivation. Training manual on High Value vegetables-Livelihood promotion through agriculture and allied sector for tsunami affected farmers in bay islands published by CARI, Port Blair, pp 58-60.

Singh, D.R., R.C. Srivastava and Subhash Chand (2006). Training manual on floriculture in Bay Islands.

Singh, D.R., R.C. Srivastava and Subhash Chand (2007). Training manual on floriculture in Bay Islands.

Singh, D.V, V.Selvi, P. Muralidharan, Subhash Chand, R. Ragupathy, P. Sundrambal and D.C. Sahoo.(2005). Book on Conference abstract on Natural Resource Management for Eco-Development and Livelihood Security in Southern India.

Srivastva, R.C and D.R. Singh (2006). Floriculture- A viable enterprises for Andaman and Nicobar Islands. In Training Manual on High Value vegetables-Livelihood promotion through agriculture and allied sector for tsunami affected farmers in bay islands, published by CARI, Port Blair, pp 1-4.

Srivastva, R.C and D.R. Singh (2006). Marigold production in Bay Islands. Training manual on High Value vegetables-Livelihood promotion through agriculture and allied sector for tsunami affected farmers in bay islands, published by CARI, Port Blair, pp 41-43.

V. Damodaran, D.R. Singh, T. Damodaran and G.Kapil Dev.(2006). Harvesting, post harvesting management and storage of Tuberose flowers. Training manual on High Value vegetables-Livelihood promotion through agriculture and allied sector for tsunami affected farmers in bay islands,

published by CARI, Port Blair, pp 20-23.

CD ROM /BOOK

Balakrishnan, M., N.Ravisankar, R.P.Medhi, T.Damodaran N and R.C. Srivastava (2006). Promotion of Spices cultivation in Bay islands, Central Agricultural Research Institute, Port Blair.

Balakrishnan, M. (2006). Information Bank for CARI (E-Book), Central Agricultural Research Institute, Port Blair.

DATABASE DEVELOPED

Balakrishnan, M. (2006). Database for cartridges management monitoring, Central Agricultural Research Institute, Port Blair.

Balakrishnan, M. (2006). Database Marine Fauna, Central Agricultural Research Institute, Port Blair.

Balakrishnan, M., and R. Elanchezhian (2006). Online Database of Medicinal Plants of Andaman and Nicobar Islands. Central Agricultural Research Institute, Port Blair.

Balakrishnan, M., T.Damodaran, R.P.Medhi, V.Damodaran and D.Anidath (2006). Database for spices crops in Andaman & Nicobar Islands, Central Agricultural Research Institute, Port Blair.

Elanchezhian, R. and M. Balakrishnan (2006). Database of Minor and underutilized fruits of Andaman and Nicobar Islands. Central Agricultural Research Institute, Port Blair.

Elanchezhian, R. and M. Balakrishnan (2006). Database of Timber Yielding Plants of Andaman and Nicobar Islands. Central Agricultural Research Institute, Port Blair.

Elanchezhian, R. and M. Balakrishnan (2006). Online Database of Indigenous Orchids of Andaman and Nicobar Islands. Central Agricultural Research Institute, Port Blair.

Elanchezhian, R. and M.Balakrishnan (2006). Database of Rice Germplasm of Andaman and Nicobar Islands. Central Agricultural Research Institute, Port Blair.

STUDENTS GUIDED BY SCIENTIST

Name of the guide	Name of the student	Degree/ Course	Year	Title of Project work / Thesis	College/ University
Dr. Jai Sunder	M.Gayathri Devi	M.Sc., Biotechnology	2006	Immunocompetence studies in indigenous fowls of A & N Islands	KSR College, Periyar University, Tamil Nadu
Dr. T. Sujatha	D.UdhayaKumari	M.Sc. Biotechnology	2007	Effect of Azolla feeding on productive and innate immuno competency status of indigenous fowl in Bay Islands.	Srinath Andavan Arts & Science College, Bharathidarsan University, Tamil Nadu.
Dr. Krishna Kumar	E.Veeraputhiran	PG Biotechnology	2007	Characterisation and molecular characterization of *Kaempferia siphonantha*	Thanthai Hans Roever College, Bharathidasan University, Perambalur, Tamil Nadu
	K. Jayabalan	PG Biotechnology	2007	Molecular characterization of *Eulophia andamanensis*	
Dr. V. Jayakumar	Gnanasekharan	M.Sc. (Microbiology)	2007	Characterisation and diversity analysis of *Ralstonia solanacearum* causing wilt disease of vegetable crops in Bay islands.	J.J. College of Arts & Science, Pudukottai, Tamil Nadu
	S. Thenmozhi	M.Sc. (Microbiology)	2007	Characterisation of *Rhizobium* spp associated with wild legumes of Andaman & Nicobar Islands	

Mr. Grinson George Tamil	P.Thayumanavan	M.Sc. Biotechnology	2007	Depuration microbial status of edible oysters in and Andaman and their protein profile.	Maradupan diyar college of Arts and Science, Thanjavar, Nadu
Dr. S.N. Sethi	V. Mahendran	PG student	2007	Prevellence of white spot syndrome virus in wilt crustaceans of Andaman.	Muthayammal College of Arts & Science, Rasipuram, Tamil Nadu
	M. Kadher Nivas	PG student	2007	Detection of WSSV (White spot syndrome virus) in Tiger prawn of Andaman by using PCR Techniques.	Maradupan diyar college of Arts and Science, Thanjavar, Tamil Nadu
Dr. S. Dam Roy	Pushpa Rai	M.Sc. (Ecology and Management)	2007	Economically important sea weed from Andaman with special reference to Sesostris Bay	Sikkim Manipal University
Dr. T. Damodaran	Murugesan	M.Sc. Biotechnology	2007	Studies on the genetic Diversity of the Musa spp. in the Bay Islands, using Biochemical and Molecular markers.	Thanthai Hans Roever College, Bharathidasan University.
	Ramesh	M.Sc. Biotechnology	2007	Biochemical and molecular characterization of wild mangifera species of Bay Islands, using RAPD markers.	
Dr.M.Balakrishnan	Sathya	P.G Bioinformatics	2007	A database of *Rickettsia typhi* protein models	Bharathidasan University.

	Chandrasekaran	P.G Bioinformatics	2007	Database for Heat shock proteins (HSP) models	Bharathidasan University.
	Azarudhin	B.Tech	2007	Development of database and its applications in agriculture.	NIT, Raipur
	Ankur Bhardwaja	B.Tech	2007	Structure prediction of plastocyanin *Ginko biloba* by homology modelling and comparative analysis of homology modelling servers	University of Rajasthan

PATENTS DEVELOPED / FILED

- *Morinda citrifolia* registered for salinity resistant and nutrient rich indigenous species with National identity as: I.C. 524021 and INGR No. 05028.
- Registered Wild cashewnut for its medicinal properties with registration number INGR-06022 and National identity as IC-547016.
- Registration accepted for Alligator Apple and *Euphorbia epiphylloides* .

PEER RECOGNIZATION TO DIRECTOR IN DIFFERENT COMMITTEE/ PANEL/

SOCIETY

- President, Andaman Science Association, Port Blair.
- Member, State Level Committee for identification of beneficiaries for supply of tractor on Loan-cum-subsidy basis, A & N Administration, Port Blair.
- Member, UT Coordination Committee, A&N Administration, Port Blair.
- Member, Society for Science Centre, A&N Islands, Port Blair.
- Member, Conference for discussion of Draft State Development Report of A&N Islands, Port Blair.

- Member, Executive Committee of SOC, Andaman Nature Club, Port Blair.
- Member, State Level Advisory Committee for Narrowcasting Project under the scheme "Mass Media Support for Agrl. Extension" A&N Islands.
- Member, State Seed Sub-Committee for Agricultural & Horticultural Crops, A&N Islands.
- Member, Inter Departmental working group to monitor and oversee the functioning of "KISAN CALL CENTRE" of A&N Islands.
- Member, UT level Monitoring Committee to Monitor the implementation of programme relating to rehabilitation of animal Husbandry.
- Member, State Level Watershed Development Committee under Watershed Development Project for rainfed areas in A & N Islands.
- Member, High Value Agriculture Development Agency for the UT of A & N Islands.
- Member, UT level Task Force Committee for A & N Islands.
- Member, Agriculture Technology Management Agency Governing Board of A & N Islands.
- Member, Purchase Committee of the Revised Package for Tsunami Rehabilitation for Livestock and Poultry under Animal Husbandry sector of A&N Islands.

PARTICIPATION OF DIRECTOR IN IMPORTANT MEETING/ WORKSHOP AND SYMPOSIUM

Director	Programme	Venue	Date / Duration
Dr. R.C. Srivastava	One day workshop on NAIP Project	CRRI, Cuttack	26th August, 2006
	Microfinance India conference, CARE India	New Delhi	30th & 31st Nov., 2006
	Working Group meeting of Fisheries Division	ICAR, New Delhi	1st Nov., 2006
	KVK-QRT Travel workshop	RAU, Pusa, Bihar	8th & 9th Dec.,2006
	XVIIIth meeting of ICAR Regional Committee No. III	Barapani, Meghalaya	20th & 21st Dec., 2006
	Zonal Workshop on fisheries and aquaculture policy ecosystem and livelihood perspective in east coast states	NAARM, Hyderabad	22nd March, 2007

PARTICIPATION OF SCIENTISTS IN CONFERENCES / SEMINARS/ SYMPOSIA / MEETINGS / TRAININGS

Scientists	Programme	Venue	Date / Duration
Er. P.S. Deshmukh	17th workshop of AICRP on Farm Machinery and Power	Dr. A.S. College of Agricultural Engineering, MPKV, Rahuri	6th to 9th June, '06
Dr. S. N. Sethi, & Mr. G. George	Meeting of Fisheries Scientists from Agricultural Research Institutes.	CIFRI, Barrackpore	6th June,'06
Dr. M. Balakrishnan	"IT sensitization Training Programme for the Finance Officers/ Officials of ICAR Institutions.	NAARM, Hyderabad	27th June to 1st July,'06.
Dr. N. Ravisankar	GIS based decision support system (DSS) for sustainable agriculture.	NAARM, Hyderabad	5th to 25th July, '06
Dr. S.N. Sethi	National Workshop-cum-Training on Bioinformatics and Statistics in Aquaculture Research.	CIFA, Bhubaneswar, Orissa	7th to 10th July, 06.
Dr.M.Balakrishnan	National Workshop on Implementation of personnel Management information System Network in ICAR(PERMISnet) and Intelligent Reporting System(IRS).	IASRI, NASC Complex, New Delhi	21st to 22nd July, '06
Dr.M. Balakrishnan, Dr. V. Jayakumar, Dr. S. Dam Roy & Dr. R. Raja	National Workshop cum training on Bioinformatics tools for gene and protein analyses.	Sub-DIC, CARI, Port Blair	26th to 29th July, '06

Dr. M. Din	Short course on Drainage technologies for enhancing agricultural productivity in vertisols.	CIAE, Bhopal	2nd to 11th Aug., '06
Dr. T. Sujatha	Training programme on participatory extension Management for women extension functionaries.	MANAGE, Hyderabad	21st to 25th Aug.,06,
Dr. S. Ghoshal Chaudhuri	Summer School on Land evaluation for watershed towards micro level planning using remote sensing & Geographical Information System.	NBSS & LUP Regional Station, Kolkata	24th Aug. to 14th Sep., '06
Dr. R. Raja	Seminar on Soil health.	A&N Admn, Port Blair	26th Aug., '06
Dr. B. Ganesh Kumar	National seminar on Emerging opportunities in Andaman & Nicobar islands – Post tsunami context.	Livelihood Resource Centre, CEFI, Port Blair	27th to 28th Aug., '06.
Dr. S.N. Sethi	Regional workshop on Marine Fisheries Resources of Andaman & Nicobar waters of FSI, Port Blair,	Wandoor, S.Andaman. FSI, Port Blair	4th Oct.,'06
Dr. S. Dam Roy, Dr. C.S. Chaturvedi, Dr.S.N. Sethi, Dr. M. Balakrishnan, Dr. B. Ganesh Kumar & Mr. Grinson George	National Workshop on Integrated development of spices.	Division of Horticulture and Forestry CARI, Port Blair.	12th to 14th Oct., '06
Dr. S. Dam Roy	Presented the Pros & Cons of shrimp culture in the inundated areas of Andaman in the post tsunami Scenario *vis-à-vis* SPF Brood stock project of MPEDA which was delivered before the Honourable Minister of State (Commerce).	Port Blair	26th Oct.,'06

Dr. V. Jayakumar	Training on Digitization of Plant Resources.	Department of Genetics and Plant Breeding, University of Agricultural Sciences, Bangalore	27th Oct. to 2nd Nov.,'06.
Dr. S.K. Verma	Advanced training on Clinical Nutrition of Livestock and Pets held at Centre of Advanced Studies in Animal Nutrition.	Indian Veterinary Research Institute, Izatnagar	3rd -23rd Nov., '06.
Dr. B. Ganesh Kumar & Dr. M. Balakrishnan	Seminar on Scope for biological and integrated control of agriculturally important insect pests.	CARI, Port Blair	8th Nov.,'06
Dr. Krishna Kumar	Symposium on rodent-borne diseases and training on rodent pest management	Directorate of Agriculture, A & N Admn. and RMRC, Port Blair	15th-17th Nov. 06
Dr. S. Medhi, R.P., Damodaran, V., Venkatesh, A., Damodaran, T. and Bharathi, L.K.	14th Triennial symposium of the International society for tropical root crops.	CTCRI, Thiruvananthapuram	20th to 26th Nov., '06
Dr. S.P.Yadav	Short term training course on Genome Analysis Techniques in Farm Animals: Cloning, Characterization and in vitro Expression of Gene and Identification of Genetic markers for Economic Traits.	Genetic Division of Indian Veterinary Research Institute, Bareilly (UP).	21st Nov. to 12th Dec., '06
Dr. M. Balakrishnan	Training programme on Design & Development of Web Based Application using Net.	IASRI, New Delhi	22nd Nov. to 12th Dec.,'06

Dr. B. Ganesh Kumar	Workshop on Livestock based livelihoods – An action programme for the Andaman & Nicobar islands.	CARI, Port Blair	23rd to 24th Nov., '06
Dr. M.S. Kundu	XXXV Dairy Industry Conference	Indian Dairy Association, Kolkota	23rd to 25th , Nov., '06
Dr. V. Jayakumar	Winter school on Diagnostic and molecular characterization of pathogens of horticultural crops and their biocontrol organisms.	Indian Institute of Spices Research, Calicut	1st to 21st Dec.,'06
Dr. M. Din	XLI ISAE Annual Convention and Symposium	Junagadh Agri. Univ., Junagadh	29th to 31st Jan., '07
Dr. V. Jayakumar	National workshop cum training program on "Development of database and its application in biodiversity.	Sub-DIC, CARI, Port Blair	19th to 23rd Feb., '07.
Dr. R. Raja	Training on Microbial community analysis through metagenomics.	NBAIM, Mau	3rd to 7th Feb., '07
Dr. M. Din	3rd International Conference on Solar radiation and day lighting: SOLARIS 2007.	IIT, Delhi	7th to 9th Feb, '07
Dr. Subhash Chand	International Conference on Ground water.	TNAU, Coimbatore	13th to 17th Feb.,'07
Dr. M.Balakrishnan &All Scientists of Fisheries Science	Workshop on Andaman & Nicobar Biogeographic Information System.	NIOT and ANOBIS. Port Blair	15th to 16th Feb., '07

Dr. M. Din, Dr. N. Ravisankar, Dr.C.S. Chatruvedi, Dr. Kamal Sarma, Dr. S. P.Yadav, Dr. S. K. Verma & Dr. B. Ganesh Kumar	National Workshop cum training on Development of database and its application in biodiversity.	CARI, Port Blair	19th to 23rd Feb., '07
Dr. Kamal Sarma	Attended as members for selection of beneficiaries for study tour to mainland, organized by Department of Fisheries , Andaman and Nicobar Islands.	Department of Fisheries, Port Blair	1st March'07.
Dr. T. Sujata	Veterinary Parasitiology in focus with special reference to emerging diseases.	Centre of Advanced Studies, Dept. of Parasitology, Veternary College, Hebbal, Bangalore.	10th to 30th March, '07.
Mr. G. George	Network Workshop on climate change.	CMFRI, Kochi	19th to 21st March,'07
Dr. C. S. Chatruvedi, & Dr. S.N. Sethi	Fisheries development in Andaman and Nicobar – opportunities and challenges.	Fishery Survey of India. 23rd March,'07	
Dr. S. Dam Roy	Presented a paper on the Fisheries Policies workshop for the East Coast States.	MANAGE Hyderabad	23rd March 07.
Dr. Subhash Chand	Indian Dairy Association Conference.	Kolkata.	23rd to 25th April, '07

FOREIGN DEPUTATION

Scientists	Programme	Venue	Date / Duration
Dr. S. Ghoshal Chaudhuri	International consultancy on Suggesting cost effective solutions for tsunami affected Andaman-Nicobar Island and Maldives	Maldives and Sri Lanka	9th to 18th May, '06
Dr. R. Raja	-do-	Sri Lanka	12th to 18th May, 06

HUMAN RESOURCE DEVELOPMENT

TRAINING TO STAKEHOLDERS

Title	Period	Partici-pants (Nos.)	Type of Participants	Venue	Collaborating/ Sponsoring Agency
DIVISION OF NATURAL RESOURCE MANAGEMENT					
Integrated Farming system for rural prosperity	7th to 14th August ' 06	30	Extension functionaries of Development departments of Agriculture, Animal husbandry, Fisheries, Officers of Panchayat and NGO's	KVK, Sipighat	CARI, Port Blair KVK, CARI AP Cess fund project on IFS
Revitalization of Tsunami Affected Farmers-A Step Towards Better Tomorrow.	21st to 26th Sep. '06.	45	Tsunami affected farmers of South & Little Andaman	CARI, Port Blair	CSSRI, Karnal, CARI, Port Blair & Action Aid International
Soil and water analysis	16th to 23rd Nov. '06	30	Extension Personnel, NGOs & SHGs	KVK, Sipighat	KVK, CARI.

High Value Vegetables	26th to 30th Dec.'06	30	Tsunami affected farmers	CARI, Port Blair	CARE India
DIVISION OF FIELD CROPS					
Oyster mushroom production technology	24th to 27th Jan. '07	30	Tsunami affected farmers	CARI, Port Blair	CARE India
DIVISION OF ANIMAL SCIENCE					
Scientific management on Dairy farming.	18th to 20th, July, '06	25	Farmers	KVK, Sipighat	KVK, CARI
Revitalization of Tsunami affected farmers-A step towards better tomorrow	21st -26th Sep.'06	25	Farmers	KVK, Sipighat	KVK, CARI
Quail Farming & Pickle preparation technology for SHG	26th to 27th Oct. '06	20	Farm women	KVK, Sipighat	KVK, CARI
Quail Farming & Pickle preparation technology	20th to 22nd Nov.'06	20	SHGs & farmer women	KVK, Sipighat	KVK, CARI
Goat farming	26th to 30th Dec., '06.	30	Tsunami affected farmers	CARI, Port Blair	CARE India
Quail farming	8th to 12th Jan.'07	30	Tsunami affected farmers	CARI, Port Blair	CARE India
Pig farming	15th to 19th Jan.'07.	30	Tsunami affected farmers.	CARI, Port Blair	CARE India
Goat farming	20th to 24th Jan.'07	30	For tsunami affected farmers.	CARI, Port Blair	CARE India
Package and practices of duck, turkey and guinea fowl farming	14th to16th March, '07	15	Farmers	KVK, Sipighat	KVK, CARI
Goat farming	29th to 31st , March, '07	21	Farmers	KVK, Sipighat	KVK, CARI.

DIVISION OF FISHERIES SCIENCE					
Carp Breeding and seed raising.	8th to 12th Aug.'06	16	Farmers	KVK, Sipighat	KVK, CARI.
Composite Fish Farming, nursery and rearing pond management.	24th to 25th Nov.'06	10	Farmers	KVK, Sipighat	KVK, CARI.
Nursery & grow-out management of Indian Major Carps.	24th to 25th Nov.'06	20	Farmers	KVK, Sipighat	KVK, CARI.
Marine ornamental fish breeding	2nd to 6th Jan.'07	39	Farmers	CARI, Port Blair	CARE India
Freshwater aquarium	8th to10 th Jan.'07	19	Farmers	KVK, Sipighat	KVK, CARI.
Freshwater prawn farming.	13th to 14th March '07	18	Farmers	KVK, Sipighat	KVK, CARI.
Integrated fish farming	20th to 21st March '07	23	Farmers	KVK, Sipighat	KVK, CARI.

EXTENSION ACTIVITIES

Title	Period	Partici-pants (Nos.)	Type of Participants	Venue	Conducted by
WORKSHOP					
Integrated Farming System	7th to 14th Aug.'07	30	Extension	KVK,	CARI, Port Blair
National Workshop on Integrated Development of Spices	12th to14th Oct.'06	75	Scientists, Professors	CARI	Horticultural & Forestry Division, CARI, Port Blair
Development of database and its application in biodiversity	19th to 23rd Feb.'07.	22	Scientists, Professors & PG students	Sub-DIC, CARI.	Sub-DIC
EXHIBITION					
Sensitizing programme on Brackish water Aquaculture	3rd to 7th Dec.'06	60	Scientists and Farmers	Wimber ligunj	Fisheries Science
Bharat Nirman Public Information Campaign	2nd to 7th Dec.'06	500	Farmers. Farm women & Rural youth	Wimber lygunj	Social Science Section
Vigilance awareness week	6th to 11th Nov.'06	200	All Staff	CARI	Vigilance Officer, CARI, Port Blair
Kisan mela	21st Feb. '07	500	Farmers. Farm women & Rural masses	CARI	Social Science Section

RADIO TALKS

Title	Date of Broad cast	Expert
Medi aur Nali me sabji aur dhan ke ahlava machilika phalan	11.09.2006	Dr. N. Ravisankar
Dhan Ki Kheti Ke Liye Upyukat Krishi Yantra	15.09.2006	Dr. M. Din
Management of diseases of rice	06.10.2006	Dr. V. Jayakumar
Zamin ki urbarata kaise banaye rakhe	21.10.2006	Dr. S. Ghoshal Chaudhuri
Major diseases of tomato and their management	12.10.2006	Dr. Krishna Kumar
Sustainable Agriculture development with proper planning	26.10.2006.	Dr. Subhash Chand
How to get more profit from fish culture in freshwater ponds	07.11.2006	Dr. S.N. Sethi
Common fish disease and their control	13.11.2006	Dr. C.S. Chaturvedi
Maintenance of Diesel pump and electric motor	13.01.2007	Dr. M. Din
Samyainivat kethi parnali.	20.01.2007	Dr. N. Ravisankar
How to do mushroom cultivation	24.01.2007	Dr. Krishna Kumar
Success story of IFS	14.02.2007	Adopted farmer (Shri Pacehamuthu)
Power tiller ka rakhrakhaw aur sudhar	13.03.2007	Er. P.S. Deshmukh
Use of *Trichoderma* in crop protection	19.03.2007	Dr. V. Jayakumar
Air breathing fish culture	30.03.2007	Dr. C.S. Chaturvedi

DOORDARSHAN INTERVIEW

Title	Date of telecast	Expert
Land preparation for bed and furrow system	21/04/2006	Dr. N. Ravisankar
Seed selection and nursery management in paddy	28/04/2006	Dr. N. Ravisankar
Integrated weed management for paddy	05/05/2006	Dr. N. Ravisankar
Integrated Pest and Disease Management in rice	08/05/2006	Dr. V. Jayakumar
Harvesting and threshing equipment	15/05/2006	Dr. M. Din
Integrated Pest and Disease Management in vegetable crops	23/05/2006	Dr. V. Jayakumar
Cultivation practices of tomato, brinjal and chillies	16/06/06	Dr.T.Damodaran
Vegetable cultivation during monsoon – land management	09/06/2006	Dr.T.Damodaran
Sabji key kheti ke liye upyogi yantra	17/06/2006	Dr. M. Din
Package of practices for bhendi and *lobia*	27/06/2006	Dr. N. Ravisankar
Field preparation for paddy crop	25/07/2006	Dr. M. Din
Cultivation of raddish and amaranthus	11/08/2006	Dr.T.Damodaran
Intercultural operations for paddy	16/8/2006	Dr. N. Ravisankar
Management of broad bed and furrow system for rice + fish + azolla + vegetables	30/08/2006	Dr. N. Ravisankar
Disease management in coconut	02/09/2006	Dr. V. Jayakumar
Improved implements for harvesting, threshing and winnowing for paddy crop	12/09/2006	Dr. M. Din
Power tillers ka upyog aur rakhrakhav	27/09/2006	Dr. M. Din
Tillage implements for second crop of paddy	10/10/2006	Dr. M. Din
IPM of Chilli and brinjal crops	10/11/2006	Dr. Krishna Kumar
Black pepper cultivation by improved method in Andaman and Nicobar islands	10/11/06	Dr. C.B. Pandey
Package of practices for maize	01/12/2006	Dr. N. Ravisankar
Integrated Farming System for farmers	04/01/2007	Dr. R.C. Srivastava
Package of practices for groundnut	10/01/2007	Dr. N. Ravisankar

RESEARCH COORDINATION AND MANAGEMENT

QUINQUENNIAL REVIEW TEAM (QRT)

Indian Council of Agricultural Research appointed QRT under the Chairmanship of Dr. E.A.Siddiq Ex. DDG (Crops) to review the research, extension and development activities of the institute for period of 2001-06. The chairman alongwith the members Dr. I.D.Tyagi, Dr. B.N.Singh, Dr. B.N. Choudhary and Dr. Veeraraghava Thatam had preliminary meeting on 9th Jan. 2007 at Division of Horticulture of ICAR, New Delhi followed by five days visit to the institute from 25th February, 2007 to review the activities of various Divisions. They also visited the experiment and demonstration plots of the Institute as well as the farmers' field which concluded with the interaction with the Scientists and Heads of Development Department of A&N Administration. Dr. S. Dam Roy, Member Secretary, QRT provided the information on the institute activities to the team.

RESEARCH ADVISORY COMMITTEE (RAC)

The RAC meeting was held on 21-22 November, 2006 under the chairmanship of Dr. K. Pradhan with Dr. R.C.Tiwari, Dr.D.R.Sharma and Dr.U. P. Singh as member. Member Secretary Dr. R.P. Medhi presented the action taken report. Salient achievements , new initiatives undertaken during the period and Perspective Plan 2025 were presented by Dr. R.C. Srivastava, Director, CARI.

The RAC committee appreciated the work done by the institute and gave useful suggestions for designing the future road map of the Institute's activities.

STAFF RESEARCH COUNCIL (SRC)

The Staff Research Council (SRC) of CARI for the year 2006 was held on 16th, 17th and 18th August, 2006 ,under the chairmanship of Dr. R.C. Srivastava, Director, CARI. Twenty five ongoing projects were presented by the concerned PIs highlighting the progress made in the preceding year. Nineteen new projects were also presented and approved. The Chairman requested the scientist to come out with the demand driven technologies which could be easily adopted by the target groups of this islands. In order to accommodate the research projects of new scientists, a mini SRC was held in December, 2006 in which five new projects presented were approved.

LINKAGES AND COLLABORATION

NATURAL RESOURCE MANAGEMENT

- Project Directorate of Cropping System Research (PDCSR), Modipuram.
- Central Soil Salinity Research Institute, Karnal and International Tsunami Response Centre (ITRC), Colombo, Sri Lanka in connection with consultancy project on suggesting cost effective solutions for the development of appropriate land reclamation programs in Tsunami affected Andaman & Nicobar Island and Maldives.
- Central Institute of Agricultural Engineering, Bhopal.

HORTICULTURE AND FORESTRY

- Directorate of Arecanut and Spices, Calicut.
- Healthcare India Ltd., Chennai.
- Central Tuber Crops Research Institute, Thiruvananthapuram.
- Indian Institute of Vegetable Research, Varanasi.

FIELD CROPS

- DBT, New Delhi.
- ICAR institutes- DRR, NBAIM, DSR, NBPGR, PDBC and NRC for Sorghum.
- Project Coordinating centre on Sesame and Niger, Jabalpur.
- Department of Agriculture, Animal Husbandry & Veterinary Science of A & N Administration.

ANIMAL SCIENCE

- DBT, New Delhi.
- Indian Council of Medical Research, Port Blair.
- ICAR Institutes IVRI, PDADMAS, CIRG, IGFRI, CARI, Izatnagar.
- Dept. of Animal Husbandry & Veterinary Services, Andaman & Nicobar Administration.
- Tamil Nadu Veterinary & Animal Sciences University, Chennai, Tamil Nadu
- Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu.
- Kerala Livestock Development Board, Kerala.

FISHERIES SCIENCE

- Space Application Centre, Ahmedabad for utilizing satellite images for assessment of coral reef health and coastal zone studies.
- CARE, India, an NGO for promotion of "Marine Ornamental fish breeding and rearing".

- CPR foundation for creation of environmental awareness among student community with particular reference on reef ecosystem and mangroves of bay islands and their conservation.
- ICAR head quarter and other Research Institutes (CIBA, CMFRI, NBFGR, CIFA, CIFRI, CIFE and DSR) for various project implementation and formulation.
- Directorate of Fisheries, Andaman and Nicobar administration, for various developmental works and extension of technologies.
- Andaman and Nicobar administration for effective utilization of inundated waters in S.Andaman.
- Zoological Survey of India and Fishery Survey of India for project implementation and formulation.
- Ministry of Commerce like RGCA, MPEDA and the ministry in particular regarding the feasibility and promotion of established technologies for revitalization of submerged arable lands.
- Ministry of Environment and Forests & Department of Forests, Andaman and Nicobar, for various project implementation and formulation.

SOCIAL SCIENCE

- CIPMC, Port Blair
- A & N Administration.

DISTINGUISHED DIGNITARIES

DIGNITARIES & THEIR IMPRESSIONS ON CARI

Dignitaries	Impressions
Sh. Jairam Ramesh, MOS (Commerce), on27th Oct., '06.	*A very good experience and hope to be back.*
Sh. M.V. Vivekanandan, Central Institute for Research on Cotton Technology, Mumbai, on 28th Oct.,'06.	*The museum is interesting.*
Dr. Dhrula Chakraborty, Asstt. Director (ARB) Kolkata on 31st Oct., '06.	*The museum is very good, may be expanded in future.*
Dr. D.P. Singh, Pr. Scientist (Hort.), Former ADG (VC) on 1st Nov., '06.	*Excellent work being done by CARI on various crop under difficult situation. Please keep up the tempo.*
Prof. P.C. Velavan, Scientific Committee appointed by Govt. of India on 5th Nov.'06.	*Research and development of relevance to A & N Islands being carried out here is significant. Clear-cut directives on the pathway to sustainable agriculture on the principles of low volume, low input, high value agriculture are required to emanate from CARI.*
Dr. Jay G. Varshney, Director, NRC Weed Science, Jabalpur on 20th Nov.,'06.	*I am very happy to see the all round development in CARI. The researches carried out are really very useful to the undeveloped farming system of the A & N Islands. I congratulate the previous and present Directors for giving the leadership and to scientists and other doing the excellent work.*
Dr. A.L. Arora, Head, AG&B, Div. CSWRI, Avikanagar, Rajasthan on 21st Dec.,'06.	*I am impressed with the excellent work being done by scientists of this institute and that for in a remote area.*
Dr. Vineeta Agrawal, Professor & Head, EED. M.N.N.I.T., Allahabad on 22nd Dec., '06.	*Excellent work done by CARI scientists. We liked the museum very much.* *Appreciative work on various crops.*

Dr. P.N. Gururaja Rao, Principal Scientist, (Physiology) Sugarcane Breeding Institute, Coimbatore on 29th Dec.,'06.	*It was an excellent museum, well maintained and highly useful information was broughtout for all scientific communities.*
Dr.(Mrs.) S. Padmaja Rao, Principal Scientist (Physiology), Sugarcane Breeding Institute, Coimbatore on 29th Dec.,'06.	*Very impressive.*
Mr. P.R. Bhagwat, Addl. Private Secretary to Union Minister of Agriculture, New Delhi on 29th Dec., '06.	*Very informative and well-maintained hall. Variety of works are going on in the Institute.*
Dr. Alok Saxena, Conservator of Forests (Wildlife) on 05th Jan., '07.	*On my first visit to CARI at Port Blair, this has been an enriching and educative experience. The enthusiasm and dedication of the scientists and staff is very encouraging. The academic and particularly library is of outstanding quality. I was fortunate to see a programme in action of extension work in progress. All this and the multiple work being done will be of immense benefit to these islands. Under the able guidance of Dr. Srivastava, I wish them all success.*
Sh. Shamsher K. Sheriff, Chief Secretary, Andaman & Nicobar Islands on 12th Jan.,'07.	
Surg. Capt. V.K. Mohindra, Minnie Bay, Port Blair on 17th Jan.,'07.	*An excellent Institute which has developed path breaking agricultural technology which requires commercial exploitation.*
Col. J.S. Dharmadheeran, DDRVS, HQ ATNK & K Area, Chennai on 1st Feb., '07.	*A Institute is doing stellar work in conservation, extension and propagation of modern animal husbandry and agricultural practices in these remote islands.*

PERSONNEL

DIRECTOR	Dr. R.C. Srivastava
Head / Incharge Divisions / Section	
Head, Division of Field Crops	Dr. T.V.R.S. Sharma
Head, Division of Fish & Fishery Sciences	Dr. S. Dam Roy
Head, Division of Natural Resource Management	Dr. S.K. Ambast
Head i/c, Division of Horticulture & Forestry	Dr. C.B. Pandey
Head i/c, Division of Animal Science	Dr. A. Kundu
Incharge, Social Science Section	Dr. Subhash Chand
Incharge, Planning, Monitoring & Coordination Cell	Dr. B. Ganesh Kumar
Incharge, Computer Cell	Dr. M. Balakrishnan
Incharge, Library	Sh. P. Gangopadhyay
Incharge, Central Instrumentation Facility	Dr. Jai Sunder
Incharge,Legal Cell	Dr. S.K.Zamir Ahmed
Incharge, Garacharma Farm	Dr.T.V.R.S. Sharma
Incharge, Sippigaht Farm	Dr. C.B. Pandey
Incharge, Bloomsdale Farm	Dr. S. Ghoshal Chaudhuri
Incharge, Desk Officer Estate	Er.Arul Selvam
Incharge, Workshop	Er.S.L.Paik
Incharge, Guest House	Dr. V.B. Pandey
Administrative Officer	Shri. Abhishek Srivastava
Finance & Accounts Officer	Sh. Rajesh Sahay
Assistant Director, Official Language	Smt. Sulochana
Security Officer	Sh. N.K. Pushp
Incharge, Krishi Vigyan Kendra	Dr. M.S. Kundu

LIST OF SCIENTIFIC STAFF

DIVISION OF NATURAL RESOURCE MANAGEMENT

Dr. S.K. Ambast, Head

Dr. S. Ghoshal Chaudhuri, Senior Scientist (Soil Science: SP&WC)

Dr. M. Din, Senior Scientist (Farm Machinery & Power)

Dr. N. Ravisankar, Scientist Sr. Scale (Agronomy)

Dr. R. Raja, Scientist (Agronomy)

Shri. Deshmukh Prashant, Scientist (Farm Machinery & Power)

Dr. T.P. Swarnam, Scientist (Soil Science : Soil Chemistry/ Fertility/ Microbiology)

Shri Babulal Meena, Scientist (Soil Science : SP&WC)

DIVISION OF FIELD CROPS

Dr. T.V.R.S. Sharma, Head

Dr. Krishna Kumar, Senior Scientist (Plant Pathology)

Sh. Someshwar Bhagat, Scientist (Plant Pathology) on study leave

Dr. V. Jayakumar, Scientist (Plant Pathology)

DIVISION OF HORTICULTURE AND FORESTRY

Dr. C.B. Pandey, Senior Scientist (Forestry) & I/c Head

Dr. D.R. Singh, Senior Scientist (Horticulture)

Dr. T. Damodaran, Scientist Sr. Scale (Horticulture)

DIVISION OF FISHERIES SCIENCE

Dr. S. Dam Roy, Head

Dr. Chandra Shekhar Chaturvedi, Senior Scientist (Fish & Fisheries)

Dr. Kamal Sarma, Senior Scientist (Fish & Fisheries)

Shri.P. Krishnan, Scientist (Fish & Fishery) on study leave

Shri. Grinson George, Scientist (Fish & Fishery Science)

Dr. Satyanarayan Sethi, Scientist (Fish & Fishery Science)

DIVISION OF ANIMAL SCIENCE

Dr. A. Kundu, Senior Scientist (Livestock Production & Management) & I/c Head

Dr. Madhu Sudan Kundu, Sr. Scientist (Animal Nutrition)

Dr. Simmi Tomar, Senior Scientist (Poultry Science)

Dr. Satyapal Yadav, Scientist (Animal Biotechnology)

Dr. S. Jeyakumar, Scientist Sr. Scale (Animal Reproduction)

Dr. Jaisunder, Scientist Sr. Scale (Veterinary Microbiology)

Dr. S.K. Verma, Scientist Sr. Scale (Animal Nutrition)

Dr. T. Sujatha, Scientist (Poultry Science)

SOCIAL SCIENCE SECTION

Dr. Subhash Chand, Sr. Scientist, (Agriculture

Economics) & Incharge.

Dr. M. Balakrishnan, Scientist (Computer Applications)

KRISHI VIGYAN KENDRA

Dr. M.S. Kundu, In-charge

Sh. Nagesh Ram, Subject Matter Specialist (Fisheries) – on study leave

Dr. S.K. Zamir Ahmed, Subject Matter Specialist (Agronomy / Extension)

Dr. Kanak Lata, Subject Matter Specialist (Home Science)

Dr.Abhay Kumar Singh, (T6) Subject Matter Specialist (Animal Science)

Sh. L. Brojendra Singh, Subject Matter Specialist (Horticulture)

Sh. N.C. Choudhury, Progamme Assistant (Animal Science)

VARIOUS COMMITTEES OF THE INSTITUTE

OFFICIAL LANGUAGE IMPLEMENTATION COMMITTEE

Dr. R.C. Srivastava	Chairman
Dr. C.B. Pandey	Member
Dr. N. Ravisankar	Member
Dr. Jaisunder	Member
Dr.(Mrs.) Kanaklata	Member
Shri A.K. Tripathi	Member
Shri P. Gangopadhaya	Member
Smt. Sulochana	Member Secretary

INSTITUTE JOINT STAFF COUNCIL

Staff Side

Technical Staff

Shri Norman David

Shri K. Babu Rao

Administrative Staff

Shri S.K. Biswas

Shri Prasanta Kr. Das

Supporting Staff

Shri B. Mahadevaiah

Shri A. Dorairaj

Official Side (Nominated by Director)

Administrative Officer

Finance & Accounts Officer

Dr. N. Ravisankar

Er. P.S. Deshmukh

Dr. Jai Sunder

INSTITUTE MANAGEMENT COMMITTEE

Dr. R.C. Srivastava	Chairman
Shri M.A. Salam	Member
Dr. B. Murali Manohar	Member
Shri Ashok Kumar Dubey	Member
Smt. R.S. Uma Bharti	Member
Dr. R.P. Medhi	Member
Dr. Arulraj	Member
Dr. Ram Kishan	Member
Dr. S. Dam Roy	Member
Administrative Officer	Member Secretary

NEW ENTRANTS

Dr. R.C.SRIVASTAVA, DIRECTOR, CARI

PROFILE

Born on 1st July 1956, at Allahabad (U.P), **Dr. Ramesh Chandra Srivastava** obtained his bachelor's degree in Agricultural Engineering from Allahabad Agricultural Institute, Allahabad in 1975, M.Tech. and Ph.D. in 1978 and 1993 respectively from Indian Institute of Technology, Kharagpur. He joined the Agricultural Research service in 1978 at Almora (Uttaranchal). Before joining as **Director, CARI on 10th July, 2006**, he was working as Principal Scientist and Programme Leader, Rainwater Management Programme at Water Technology Centre for Eastern Region, Bhubaneshwar. Dr. Srivastava has worked on rain water management in hills, plateau and coastal areas. He has developed several technologies for water resource development utilizing rain water and its efficient management for cultivation of crops, fruit, fodder trees and vegetables during dry season. He has developed design of gravity fed drip irrigation system for crops on hill slope using gravity force. A major contribution of his is pond centered integrated farming system.

In recognition of his work on rain water management, Dr. Srivastava has been bestowed with the highest honour of Indian Council of Agricultural Research, the Rafi Ahmed Kidwai Award. He is also a recipient of Vasant Rao Naik Award, ASPEE Award and Commendation Medal of India Society of Agricultural Engineers. Recently, he has been elected as Fellow of Indian Association of Soil & Water Conservationists. He has also visited several countries namely, Philipines, USA, Peru and Australia as part of official delegation.

The CARI family extends a warm welcome to Dr. Srivastava and looks forward to grow further under his dynamic leadership.

- Dr. Krishna Kumar joined on 28.07.2006 as Sr. Scientist in Division of Field Crops.
- Dr. Subhash Chand joined on 31.07.2006 as Sr. Scientist in Social Science Section.
- Dr. Madhu Sudan Kundu joined on 10.08.2006 as Sr. Scientist in Division of Animal Science.
- Dr. C.S. Chaturvedi, joined on 16.08.2006 as Sr. Scientist in Division of Fisheries Science.
- Dr. Simmi Tomar joined on 02.09.2006 on selection as Sr. Scientist in Division of Animal Science.
- Dr. S.K. Verma, joined as Scientist Sr.Scale on 02.09.2006 in Division of Animal Science.

- Shri Abhishek Srivastava joined on 15.12.2006 as Administrative Officer
- Dr. Kamal Sarma, joined on 16.12.2006 as Sr. Scientist in Division of Fisheries Science.
- Dr. S.K. Ambast, joined on 30.03.2007 as Head of Department in Division of Natural Resource Management.

TRANSFER

- Dr. R.C. Upadhyay, Director was transferred to NRC for Orchids, Pakyong, Sikkim on 09.07.2006.
- Dr. R.B. Rai, Head, Division of Animal Science was transferred to IVRI, Izatnagar, Bareilly on 07.08.2006.
- Dr. A. Venkatesh, Scientist transferred to NRC for Agroforestry at Jhansi on his selection to the post of Sr. Scientist.
- Shri Vivek Purwar, Administrative Officer of this Institute transferred to IISR, Lucknow on his selection as Sr. Administrative Officer.
- Dr. R. Elanchezhian, Scientist transferred to ICAR Research Complex for Eastern Region at Patna on his selection to the post of Senior Scientist.

PROMOTION

- Shri Subhash Chatterjee, Sr.Clerk promoted as Assistant w.e.f. 24.11.2006.
- Shri Karupayya, Jr.Clerk promoted as Sr.Clerk w.e.f. 01.03.2007.
- Shri Sridham Kumar Biswas, Jr.Clerk promoted as Sr.Clerk w.e.f. 01.03.2007.
- Shri B. Dhanraju, Jr.Clerk promoted as Sr.Clerk w.e.f. 01.03.2007.
- Shri Emil Lakra, S.S.Gr III promoted as S.S.Gr IV w.e.f. 01.03.2007.
- Shri Rathia Kullu, S.S. Gr III promoted as S.S.Gr IV w.e.f. 01.03.2007.
- Shri K.Dakshina Murthy, S.S. Gr II promoted as S.S.Gr III w.e.f. 01.03.2007.
- Shri MSRC Murthy, S.S.Gr II promoted as S.S.Gr III w.e.f. 01.03.2007.
- Shri Devanus, S.S.Gr II promoted as S.S.Gr III w.e.f. 01.03.2007.

RETIREMENT

- Shri Shanmugam, S.S.Gr.IV retired on 30.06.2006
- Shri A.K.Samanta, T-8, CARI voluntary retired on 01.10.2006.

LEFT TO HEAVENLY ABODE

- Late N. Veeran Kutty , T-3, on 07.01.2007
- Late Silvanus Soreng, S.S.Gr. III, on 23.04.2006

INSTITUTE ACTIVITIES

ANNUAL SPORTS

The Annual Games and Sports meet for the year 2006-2007 of the institute was held on 9th March, 2007. During the sports meet various indoor, outdoor, tract and field events were conducted for staff and their family members. All the players were divided randomly into four houses viz., Bhabha House, Menon House, Kurien House and Bose house. The players from different houses participated in all the track and field events including the indoor events in large number. Based on the overall championship points earned by different houses, the kurien house was adjudged as the overall champion for the year 2006-07. Shri Babu Swamy from Kurien house was declared as the Best athlete for the year 2006-07. The Institute also participated in Annual Games and Sports meet conducted by the Central Government Employee Welfare Co-ordination Committee (CGEWCC). For the second year in succession the championship trophy was won by our institute amongst all the Central Government Institution. Multi gym facilities have been developed alongwith TT, Carrom and treadmill for the staff of the institute.

INDEPENDENCE DAY

Independence Day was celebrated in the institute with gaiety at Garacharma research complex. On this occasion, Dr. R.C. Srivastava, Director lauded the efforts of the Scientists, Technical, Administrative and Supporting staff of the Institute in fulfilling the research mandates and expressed his desire to keep up the same for the overall development of the Institute.

RAJBHASHA EXHIBITION

The institute participated in the exhibition on "Rajbhasha Pradarshini" organized by Rashtriya Hindi Academy, Rupambara, Kolkata at Peerless Beach Resort, Port Blair during 2nd to 4th October, 2006.The institute was given 1st prize by Union Minister of Power & Energy Shri Sushil Kumar Shinde for excellent work display of the activities in the Pradarshini.

VIGILANCE WEEK

The Vigilance Awareness Week was organized by this institute w.e.f. 06th to 10th November, 2006.

BHARAT NIRMAN PUBLIC INFORMATION CAMPAIGN

The Institute participated in the exhibition on "Bharat Nirman Public Information Campaign" organized by Press Information Bureau, Port Blair on behalf of UT

Administration at Wimberlygunj, South Andaman during 3rd to 7th December, 2006. A total of 25 video films were shown to the visitors on different agricultural technologies. A large number of people (more than 800 per day) visited and appreciated the stall for the technological information displayed.

HINDI FORTNIGHT

During "Hindi Fortnight" from 14th to 28th September, 2006, various programmes like extempore, quiz, noting and drafting, essay, poetry and recitation competitions for scientist, staff, ladies and children were organized to give awareness about the importance of increasing use of Hindi as official language. On this occasion, Deputy Commissioner of Andaman & Nicobar Administration, Shri Krishna Sharan Singh, IAS was the chief guest and Director, Dr. R.C. Srivastava presided over the function.

INTERFACE WITH MEDIA

Dr. R.C. Srivastava, Director, CARI, in his public interface during September 2006 said that his dream was to make the islands rich in organic farming specially due to its distant location from the mainland-India. He also highlighted the possibilities of successful commercialization of *Morinda*, popularly known as NONI. He said his institute would put thrust on development of Integrated farming system on various land, keeping in mind the water resource scenario and post-tsunami effect, so that the requirement of visiting tourists in terms of fresh fruits, milk, egg, meat, fish vegetables and flowers were fulfilled.

Dr. Srivastava concluded, by saying that "CARI will strive hard in its endeavor to serve the farmers of this island especially those who were affected by the tsunami in particular and all other farmers in general to enable them to raise their living standards without threatening the fragile ecosystem and develop technologies for economic prosperity of farmers while maintaining natural beauty of these islands".