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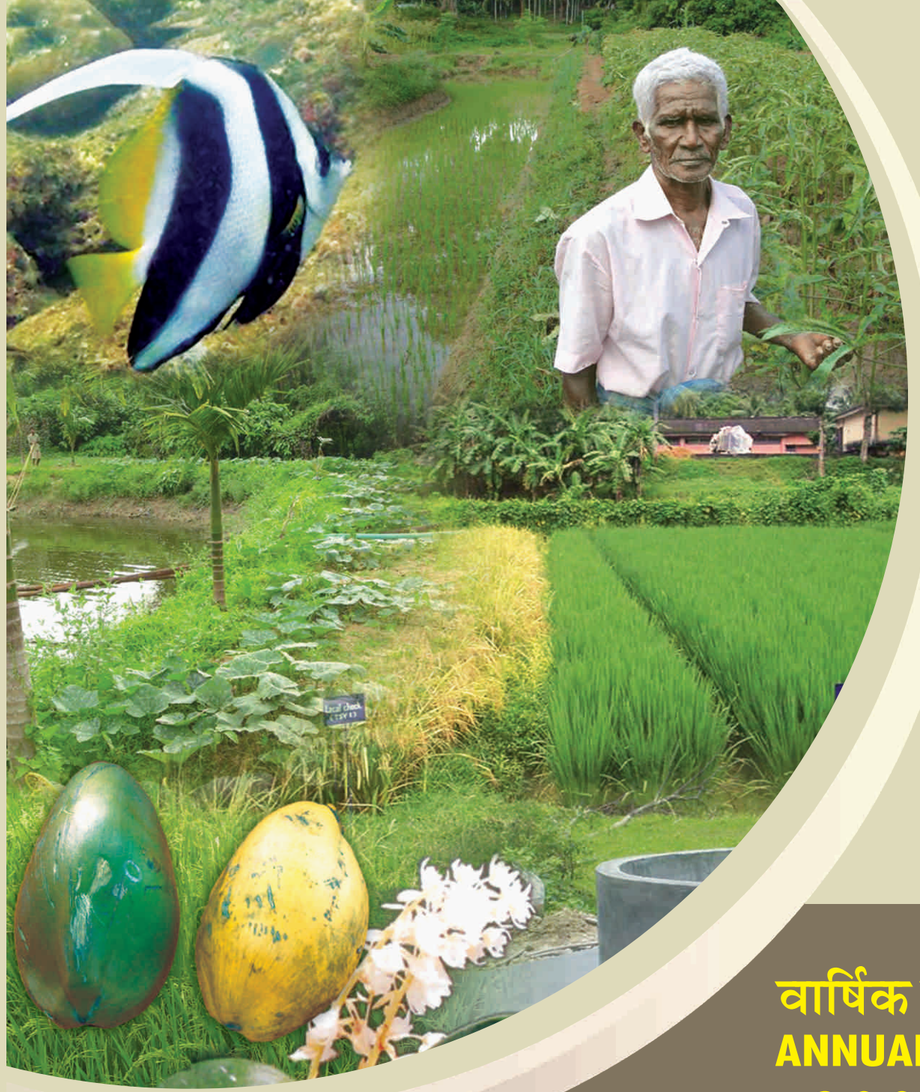
CARI ANNUAL REPORT 2007-2008



वार्षिक प्रतिवेदन
ANNUAL REPORT
2007-08

केन्द्रीय कृषि अनुसंधान संस्थान
पोर्ट ब्लेयर-७४४ १०१, अंण्डमान और निकोबार द्वीप
CENTRAL AGRICULTURAL RESEARCH INSTITUTE
Port Blair - 744 101, Andaman & Nicobar Islands

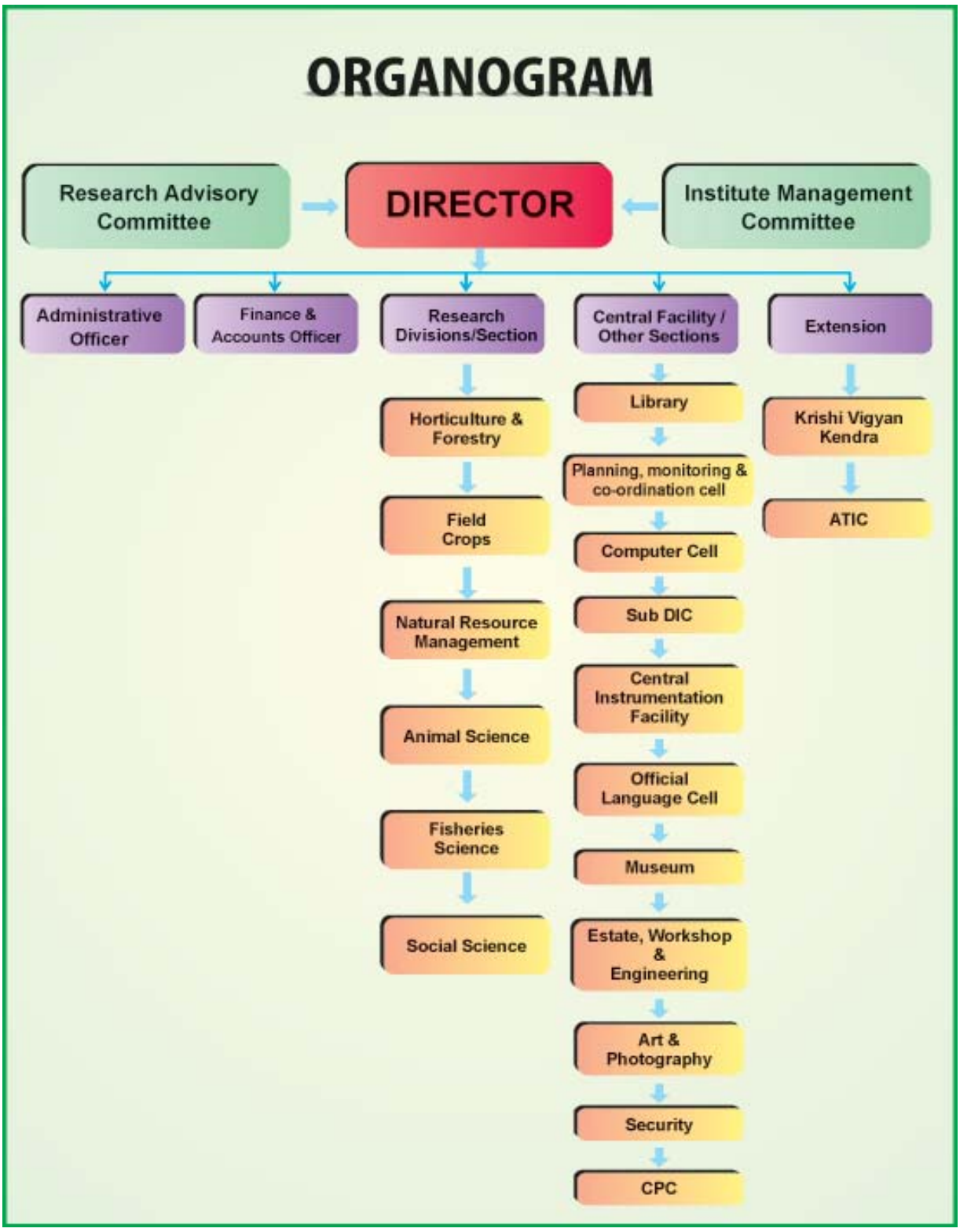
INTRODUCTION

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), Institute Research Council (IRC) 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 Social Science Section.


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
Planning, monitoring & co-ordination cell
Computer Cell
Sub DIC
Central Instrumentation Facility
Official Language Cell
Museum
Estate, Workshop & Engineering
Art & Photography
Security
CPC
Krishi Vigyan Kendra
ATIC

VISION

- Reorientation of agricultural production system to provide local level food security and to meet the demand of perishable products, viz. milk, egg, meat, fish, fruits, vegetables and flowers with specific reference to demand of booming tourism industry.
- Making the isolation as our strength, conversion of spices cultivation in an organic farming with a decoratively packaged Andaman brand organic spices being marketed.
- Preparation of disease map of livestock and poultry.
- Data base on disease monitoring and forecasting system.
- Development of suitable production to consumption level chain involving SHGs and retailers / armed forces / processors.
- Biodiversity richness of the island should be preserved and exploited for national benefit.
- The technologies should be eco-friendly and sustainable.
- Proper rain water management technology to create micro level water resources to increase irrigated area from present 1% to a significant level.
- Making CARI a model for NARS of other small island nations.

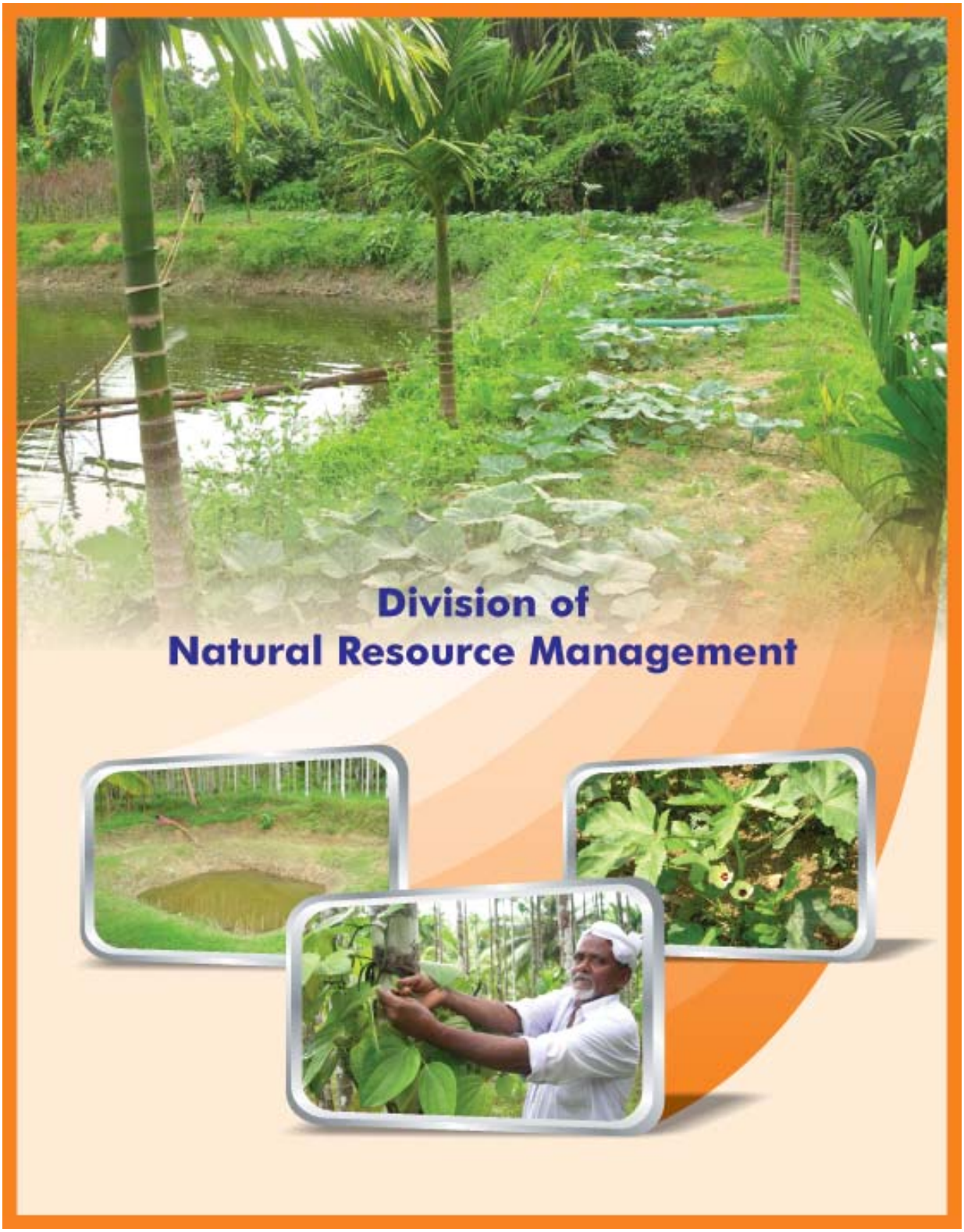
STAFF POSITION

Sl. No.	Category	Sanctioned	Filled
1.	Scientific	56+1	36
2.	Technical	43	37
3.	Administrative	30	26
4.	Supporting	84	77

BUDGET UTILIZATION DURING 2007-2008

Head of Account	Plan(In Lakhs)		Non-Plan (In Lakhs)	
Particulars	RE 2007-08	Expt. 2007-08	RE 2007-08	Expt. 2007-08
Establishment Charges	-	-	455.2	432.02
Travelling Allowances	14.00	13.99	12.00	11.73
Other charges including equipment	210.00	209.83	99.55	99.73
Maintenance of office building	-	-	17.20	17.08
Maintenance of residential building	-	-	8.00	8.05
Petty work	-	-	5.00	-
Major works	80.00	79.97	-	-
H.R.D.	8.00	7.96	-	-
Total	**312.00**	**311.75**	**597.00**	**568.61**

Research Achievements


Division of
Natural Resource Management

DEVELOPMENT OF FRESH AND BRACKISH WATER BASED INTEGRATED FARMING SYSTEM 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 (IFS) were conducted with an objective to identify, characterize and optimize the crop, animal, poultry and fish components for fresh and brackish water based farming.

Fresh water based IFS

Evaluation of crops: Among the vegetables evaluated on the embankments of pond during the year, okra, chilli, amaranthus, ridge gourd and bitter gourd performed better in terms of yield (Table 1 & 2). The water productivity of okra, amaranthus, french bean and bottle gourd are 1.1, 2.8, 1.2 and 5.6 kg/m^3, respectively (Table 3) (Plate 1). Other components of IFS *viz.*, poultry,

Plate 1. Vegetables on the embankment

Table 1. Performance of crops during wet season

Crop	No. of plants /Area(m^2)	Yield(kg)	Returns(Rs)
Okra	27.5 m^2	11.9	142.8
Amaranthus	32.7 m^2	14.0	98.0
Chilli	30.0 m^2	3.2	138.0
Ridge gourd	8 no's	11.5	138.0
Bottle gourd	9 no's	11.5	70.4
Bitter gourd	5 no's	0.9	10.8
Crossandra	As intercrop in vegetables	0.13	39.2
Areca nut + Blackpepper	25 no's	*	*
Papaya	59 no's	*	*
Total	-	53.0	637.2

* Crop not yet come to fruiting stage

Table 2. Performance of crops during dry season

Crop	No. of plants /Area(m^2)	Yield (kg)	Returns (Rs)
Okra	32.5 m^2	12.20	146.4
Cabbage	37.5 m^2	40.00*	-
Amaranthus	23 m^2	10.00	70.0
French bean	8 no's	1.25	15.0
Bottle gourd	5 no's	11.50	138.0
Areca nut + Blackpepper	25 no's	*	*
Papaya	59 no's	*	*
Total	-	34.95	369.4

Table 3. Water productivity of crops during dry season

Crop	No. of plants / Area (m^2)	Rainfall (mm)	Water applied (m^3)	Total water (m^3)	Water productivity	
					(kg/m^3)	(Rs/m^3)
Okra	32.5 m^2	63.8	9.36	11.43	1.07	12.80
Cabbage	37.5 m^2	44.2	3.13	4.79	8.36	-
Amaranthus	23 m^2	44.2	2.60	3.62	2.77	19.36
French bean	8 no's	44.2	0.95	1.05	1.20	14.35
Bottle gourd	5 no's	55.0	1.90	2.05	5.60	67.17
Papaya	59 no's	24.6	2.13	7.59	*	*
Total	-	-	20.07	30.53	-	-

* Crop not yet come to fruiting stage

duckery, fruit, plantation and aquaculture were also integrated.

Integration of poultry and duckery

Poultry and duckery: A small poultry-cum-duckery shed (3.3 m x 3.3 m) was constructed mainly with waste wooden plank. Side wall up to 1 m height was made of wooden plank and later height up to roof was enclosed with wire mesh for proper ventilation. Wooden floor was made in such a way that all the droppings may be washed into the pond. A small door (0.6 m) towards the pond side was made and fixed with sloping wooden plank so as the ducks may go into the pond during day time and shelter in the shed during night time. A provision for roof water harvesting was also made (Plate 2). Cleaning of floor with

Plate 2. Poultry shed with water harvesting system

pond water was done twice in a week. The effort of housing ducks and birds failed due to some problems and will be attempted again.

Evaluation of fresh water based IFS at farmers field

Plate 3. Fresh water based IFS components

The potential of fresh water fish farming was assessed in the Guptapara village. It was observed that the income from the scarce land area increased substantially leading to the overall improvement in the livelihood of the

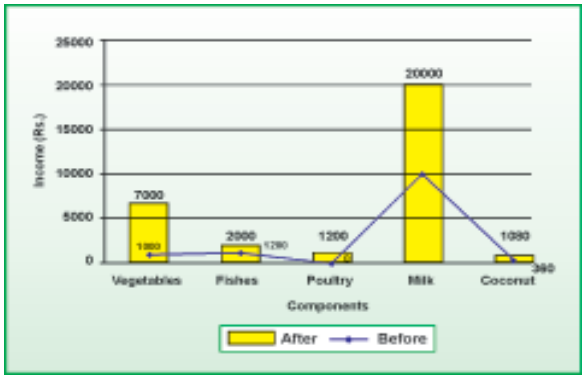


Fig.1. Pre and post intervention income from different components of fresh water pond based IFS at farmers fields

farmer. The income of the farmer increased from Rs. 12860/- to Rs. 31280/- in one year (Fig. 1, Plate 3). In addition, fodder on the embankments reduced the soil erosion from the sides during heavy downpour.

Brackish water Pond based IFS

Plate 4. Brackish water based IFS components

A pond was selected in the Manjery village for evaluating brackish water pond based IFS as an effective rehabilitation measure in the of post tsunami condition. An average height of the tide during high tide was observed 0.5 m above the ground level whereas it was 1 m above the ground level during highest tide.

The hydrographic parameters of brackish water pond are presented in Table 4. A stream was feeding fresh/rain water in the affected area making the confluence of fresh water and seawater as brackish water. An area of 65 m x 13 m size was found suitable for taking up prawn culture in initial stage and hence selected. The brackish water salinity was ranged between 10-30 ppt. The texture of the soil was sandy loam.

Table 4. Hydrographic parameters of brackish water pond

Place	Date	Time	pH(-)	Salinity (ppt)	DO (ppm)
Guptapara	25 June, 07	12.10	7.7	20	2.3
Guptapara	08 July, 07	-	7.6	25	-
Manjery	20 May, 07	13.10	8.2	11	9.7
Manjery	25 June, 07	10.38	6.8	11	4.8
Manjery	08 July, 07	-	7.0	15	-
Manjery	08 July, 07	-	7.6	0	-
New Manglutan	08 July, 07	-	7.3	10	-

Along the dyke, crops such as spinach and pumpkin were taken in the beds of size 1 m x 5 m x 0.1 m. Three rows of sweet potato were also taken along the slopes of the dykes (Plate4). Plantation and fruit crops like banana and morinda were taken. Fodder slips of hybrid napier and para grass were planted along the sides of the pond. The fodder that had come up naturally in the inner and outer slopes of the embankments was identified as a variety of buffalo grass, which has good palatability to the cattle and goats and thus recommended for their feed.

PLANNING, AUGMENTATION AND EFFICIENT UTILIZATION OF WATER RESOURCES IN KAJU NALLAH WATERSHED

S.K. Ambast, R.C. Srivastava, R. Raja, Babulal Meena and Subhash Chand

As rainwater is the only source of fresh water availability in A&N Islands, it's harvesting and management forms the most important strategy for intensive agriculture in these islands. Therefore, the project was initiated with the objectives viz., (i) to assess water resource potential and to plan its development using spatial information techniques for Kaju Nallah watershed, (ii) evaluate recharge structure-well system for augmenting water resources in the Garacharma farm (iii) to efficiently utilize developed water resources using micro-irrigation systems and (iv) to

functions (fitted at 1% level of significance except for 24, 36, and 45 weeks in wet season) is shown in Fig.2.

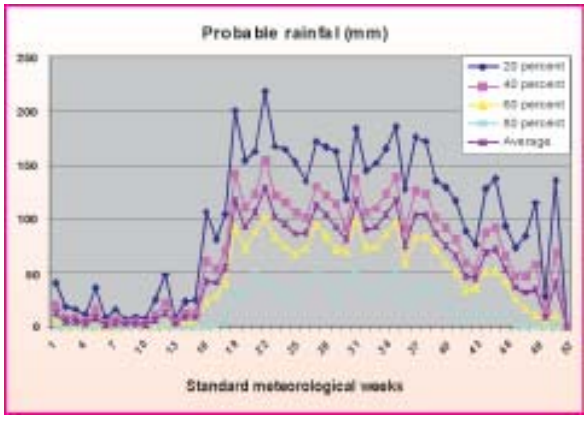


Fig.2. Weekly rainfall at different probability levels for Port Blair

evaluate economics of water resource development.

In order to assess water resource potential, historical daily weather data (1970-2003) for Port Blair were procured from India Meteorological Department (IMD), Pune. Historical daily rainfall for 34 years was analyzed using RAINSIM computer software to estimate the weekly probable rainfall. The weekly probable rainfall for normal probability distribution

Fig.3. (a) Garacharma farm and Kaju Nallah watershed

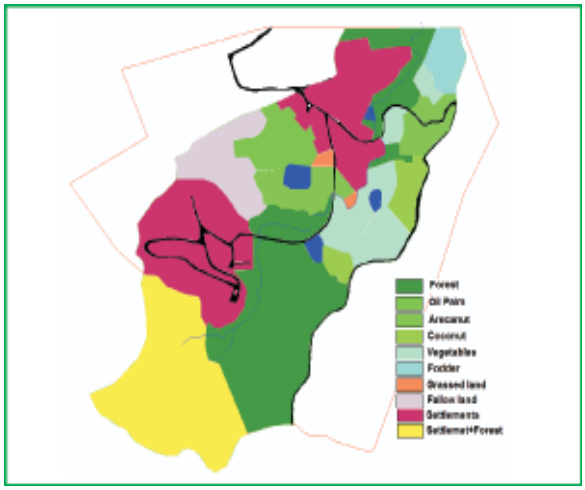


Fig.3 (b) landuse map of Kaju Nallah watershed

Further, to plan its development using spatial information techniques for Kaju Nallah watershed, necessary information of SOI toposheets, remote sensing data, layout plan of the Garacharma farm have been collected. Considering the topographic image, the

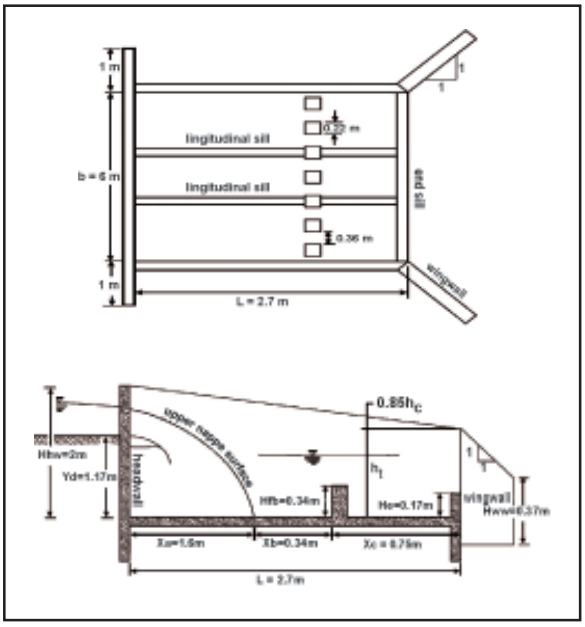


Fig.4. Design details of the proposed check dam on Kaju Nallah

watershed boundary of the Kaju Nallah was digitized (Fig.3a) and superimposed on remote sensing data for extraction of thematic information on land use (Fig. 3b). In order to harvest the rainwater from Nallah, design of a check dam as a recharge structure was prepared. The plan and elevation of the structure is shown in Fig. 4. Further to plan efficient utilization of created water resources in the Kaju Nallah watershed through recharge structure-cum-well system using drip irrigation, topographic survey was carried out for different blocks of the plantation crop in the Garacharma farm.

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, Babulal Meena and M. Balakrishnan

An extensive soil survey was carried out at periodical interval to monitor the changes in soil salinity of tsunami affected agricultural lands of Lalpahar, Craikabad, Chouldhari (Dhanikhari series) Guptapara (School line series), Mitha Khari, Loha Barrack and New Mangluton (Tushnabad series) villages of the South Andaman. The samples were collected from surface layer (0-15 cm) and subsurface layer (15-30 cm) using Edelman corer (7 cm Ø, 60 cm length) from ten selected locations 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 2007-March 2008 at three months interval. The dried and sieved soil samples (< 2 mm) were analyzed for different physico-chemical properties *viz.*, pH, EC, soluble cations (sodium, calcium and magnesium), soluble anions (CO_3^{-}, HCO_3^{-}, SO_4^{2-} and Cl^{-}) and organic carbon using standard methods. From the values of soluble sodium, calcium and magnesium, the Sodium Adsorption Ratio (SAR) and Exchangeable Sodium Percentage (ESP) were derived.

The pH of the surface soil layer of Dhanikari series under situation I varied between 5.1-6.2, 5.4.-6.0 and 5.4-6.3 in Lalpahar, Craikabad and Chouldhari over the period (Table 5 & 6). The same trend was observed in situation II also as the pH varied between 5.1-5.4, 5.2-6.1 and 5.7-6.6 for the same locations. In case of Tushnabad series of soil the trend of soil pH were 5.1-6.1, 5.7-6.9 and 5.1-5.5 for Mitha Khari, Loha Barrack and New Mangluton, respectively. Similar trend was observed under situation II for the same locations as the pH of these locations varied between 5.4-6.4, 6.0-6.8 and 5.2-5.8, respectively. For school line series of soil in Guptapara, the soil pH varied between 4.2-5.4 and 3.8-5.1 under situation I and II, respectively. The reason for

such variation in hydrogen ion concentration may be attributed to the high rainfall received after tsunami during 2005-07, 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, it is fact that after retreat of tsunami waves, most of the salts remained in the root zone raising soil salinity as high as 0.2-8.3 dSm^{-1} ECe under situation I and II, irrespective of the locations (Table 7 & 8). These high ECe values prevailed for some time after the flooding even after receiving one seasonal rainfall during the study period. In the study, the results revealed that the salinity level in the surface soil of situation I with a decreasing trend up to January 2008 and slight increase then after during March 2008. Similar trend was observed in subsurface soil as well. The decreasing trend in soil salinity from March 2007 to March 2008 may be attributed to the amount of rainfall received during the year and its distribution as well as creation of bunding to explore the efforts for protecting the sea water intrusion. This was reflected in the soluble cation and anion concentration in the soil solution over the period during March 2007-March 2008. With the same analogy of the last year study (2007) it has been observed during 2008 also that the variation of salinity might be due to the timing of the soil sampling. The September and November 2007 sampling have coincided with the rainy season where leaching of the excess soluble salts has occurred. However, during summer (January 2008 and March 2008), the higher evaporation rate might have induced the capillary rise of soluble salts from lower layer to surface layer and in turn there was little increase in the salinity level.

Table 5. Temporal and spatial variability of surface soil pH of tsunami affected soils of South Andaman

Situation	Location	Mar' 07	Jun' 07	Sep' 07	Nov' 07	Jan' 08	Mar' 08
I	Lalpahar	5.9	5.6	5.5	5.2	4.9	4.6
	Crikadabad	6.3	5.9	5.7	5.5	5.1	5.0
	Guptapara	5.1	4.2	3.9	3.8	3.7	3.4
	Mithakhari	5.9	5.6	5.5	5.1	5.1	4.7
	Loha Barrack	6.5	6.5	6.1	5.7	5.2	5.1
	New Manglutan	5.7	5.6	5.7	5.2	4.8	4.6
	Chouldari	6.4	6.0	5.2	5.1	5.0	4.7
II	Lalpahar	5.9	5.5	4.8	4.3	4.1	3.5
	Crikadabad	6.3	5.9	4.1	3.9	3.9	3.7
	Guptapara	5.1	4.9	4.7	4.6	4.4	4.2
	Mithakhari	6.1	6.0	5.8	5.8	5.7	5.5
	Loha Barrack	6.5	6.6	6.7	6.1	5.9	5.8
	New Manglutan	5.4	5.8	5.4	4.9	4.8	4.4
	Chouldari	6.6	6.7	6.2	6.1	6.1	5.7

Table 6. Temporal and spatial variability of sub surface soil pH of tsunami affected soils of South Andaman

Situation	Location	Mar' 07	Jun' 07	Sep' 07	Nov' 07	Jan' 08	Mar' 08
I	Lalpahar	6.2	5.4	5.1	5.2	5.2	5.8
	Crikadabad	6.0	6.0	5.7	5.6	5.4	5.8
	Guptapara	5.4	4.9	4.5	4.3	4.2	5.3
	Mithakhari	6.1	5.8	5.4	5.3	5.1	6.0
	Loha Barrack	6.6	6.3	6.1	5.9	5.7	6.9
	New Manglutan	5.5	5.5	5.3	5.2	5.1	5.5
	Chouldari	6.1	5.8	5.7	5.7	5.4	6.3
II	Lalpahar	5.2	5.4	5.4	5.3	5.1	5.4
	Crikadabad	6.1	5.7	5.6	5.3	5.2	6.0
	Guptapara	4.8	4.4	4.2	4.0	3.8	5.1
	Mithakhari	6.4	5.8	5.8	5.6	5.4	6.1
	Loha Barrack	6.4	6.8	6.4	6.3	6.0	6.4

Table 7. Temporal and spatial variability of surface soil ECe (dSm^{-1}) of tsunami affected soils of South Andaman

Situation	Location	Mar' 07	Jun' 07	Sep' 07	Nov' 07	Jan' 08	Mar' 08
I	Lalpahar	5.6	4.8	4.4	4.2	3.9	4.3
	Crikadabad	5.9	4.2	4.0	3.9	3.6	3.8
	Guptapara	0.6	0.4	0.5	0.6	0.3	0.5
	Mithakhari	5.2	4.4	4.0	3.7	3.9	4.2
	Loha Barrack	4.8	3.4	3.6	3.5	3.6	3.9
	New Manglutan	0.9	0.5	0.6	0.8	0.6	0.7
	Chouldari	4.3	3.7	3.6	3.7	3.6	3.9
II	Lalpahar	7.1	5.4	5.5	5.7	5.4	5.2
	Crikadabad	7.5	5.1	5.4	5.1	4.8	4.9
	Guptapara	4.7	3.3	3.1	2.9	3.0	3.3
	Mithakhari	8.3	6.6	6.2	5.9	5.4	5.7
	Loha Barrack	5.9	4.4	4.1	3.8	3.2	3.5
	New Manglutan	3.9	2.8	3.1	3.0	2.7	3.1
	Chouldari	5.7	4.9	4.4	4.1	3.6	3.9

Table 8. Temporal and spatial variability of sub surface soil ECe (dSm^{-1}) of tsunami affected soils of South Andaman

Situation	Location	Mar' 07	Jun' 07	Sep' 07	Nov' 07	Jan' 08	Mar' 08
I	Lalpahar	4.2	2.6	2.4	2.3	2.5	2.9
	Crikadabad	5.3	1.8	1.7	1.4	1.7	2.1
	Guptapara	0.4	0.3	0.3	0.2	0.6	1.1
	Mithakhari	4.4	1.1	1.0	2.8	3.1	3.6
	Loha Barrack	4.1	1.1	1.3	1.1	1.7	2.2
	New Manglutan	0.6	0.4	0.5	0.4	0.9	1.3
	Chouldari	4.1	2.2	1.8	1.8	2.5	2.9
II	Lalpahar	6.2	3.4	2.7	2.4	3.3	3.7
	Crikadabad	6.6	3.3	2.6	2.3	2.7	2.4
	Guptapara	4.4	2.3	2.0	2.0	2.1	1.9
	Mithakhari	7.6	2.9	2.3	2.1	2.7	2.8
	Loha Barrack	5.3	1.1	1.4	1.3	1.9	1.9
	New Manglutan	3.7	1.4	1.1	1.1	1.6	1.9
	Chouldari	5.2	2.7	1.6	1.0	1.7	1.6

EVALUATION OF SOIL MANAGEMENT TECHNIQUES IN PROBLEM SOILS OF SOUTH ANDAMAN

T.P. Swarnam, B.L. Meena, T. Damodaran, V. Jayakumar and R.C. Srivastava

The sea water intrusion into agricultural lands during tsunami resulted in the salinisation of coastal lands. The salt content has increased (ECe: 5-19 dSm^{-1}) in all the affected areas as compared to unaffected area (0.7-3.1 dSm^{-1}). In general, surface soils had more ECe than subsurface soils. Dhanikari recorded higher ECe at surface than other soils.

Impact of bunding on soil salinity in tsunami affected areas

To rehabilitate these lands, field bunds of 1 m height were constructed before monsoon season of 2007. In order to assess the impact of bunding, pre- and post monsoon soil samples were collected at three different depths (0-30, 30-60 **and 60-100 cm**) from bunded and unbunded fields of tsunami affected areas of Dhanikari soil series during 2007 and analyzed for pH and ECe. No significant difference in ECe values were observed between bunded and unbunded areas as ECe in surface layer (0-30

cm) reduced to less than 4.0 dSm^{-1} in both bunded and unbunded areas after the monsoon irrespective of their initial values. The heavy rainfall of 2250 mm in 2007 led to leaching of the salts even in the unbunded areas due to flat slope which led to water stagnation.

Evaluation of coconut husk as liming material in acid soils

Pot and field experiments were initiated for evaluating coconut husk as liming material. The soil samples were taken at three months interval and analysed for change in pH (Table 9). The soil pH has increased significantly under various treatments. The coconut husk along with compost significantly increased the pH after three months. After six months coconut husk, compost and coconut husk + compost were comparable in terms of increase in pH.

Table 9. Effect of incorporation of coconut husk on soil pH

Treatments	Soil pH	
	August, 2007	January, 2008
Control	5.9	6.0
Coconut husk	6.1	7.1
Compost	6.2	6.9
Coconut husk + Compost	6.5	7.0
Lime	7.9	8.3
SED	0.1	0.1
CD(P=0.05)	0.3	0.3

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

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

Nine treatments comprising of different nutrient management practices i.e. control, 100% NPK recommended dose of fertilizer (RDF), 75% NPK (25% N substituted by FYM), 75% NPK (25% N substituted by Green Manure, GM), 75% NPK (25% N substituted by compost), 75% NPK (25% N substituted by Poultry Manure, PM), 75% NPK (25% N substituted by Bio Fertilizer), 50% NPK (50% N Substituted by FYM) and fully organic (25% FYM + 25% PM + 25% compost + 25% GM) for rice-maize cropping system was laid out in randomized block design with 3 replications. The chemical compositions of different organic sources are given in Table 10. The RDF adopted for rice and maize in the experiment was 120, 60 and 40 kg N, P_2O_5 and K_2O ha^{-1}, respectively. Half of the fertilizers N and K, full dose of P were applied as basal. Remaining half of N and K was applied in two equal splits at the interval of 25 days in both crops. Organic

manures were applied at the final preparation of land as per treatment schedule.

Table 10: Nutrient composition of different organic sources

Organic source	Chemical composition (%)		
	N	P	K
FYM	0.50	0.25	0.50
Gliricidia	2.90	0.5	1.2
Coir pith compost	1.2	0.06	1.2
Poultry Manure	1.5	1.6	0.8

Soil sampling and analysis for rice and maize crop

Soil samples were collected from 0-15 and 15-30 cm depths from different experimental plots after harvesting of rice and analyzed for various physico-chemical properties. Among the INM treatments, higher rice grain yield of 4.2 t/ha was obtained from 75% NPK+25% nitrogen substitute by PM followed by 75% NPK+25% nitrogen substitute by FYM compared to 100% NPK (Table 11). Similar trend was observed in case of maize crop. Increase in grain yield with INM over 100% NPK might be due to the favorable soil condition and synchronized release of nutrients throughout the crop growth period. Thus the substitution of 25% chemical fertilizer with organic source viz., PM or FYM would provide an opportunity to harness the benefits of integrated nutrient management.

Significant variation was observed in the uptakes due to different nutrient management practices. The highest total N uptake and its assimilation was observed under 75% RDF+25% N substances by PM, closely followed by 75% RDF+25% N substances by FYM. Nitrogen uptake was more in all the INM practices than 100% RDF. In case of P, the maximum uptake was observed under 75% RDF+25% N substances by compost, closely followed by 75% RDF+25% FYM indicating better uptake of P compared to 100% RDF. The highest uptake of K was observed when soil fertilized with 75% RDF+25% N substances by PM. However, better assimilation of K was recorded in all the treatments with integrated nutrient management.

The nutrient status of soil after the harvest of rice crop was improved with combined source of inorganic and organic fertilizer in the first year (Table 12). The total N was observed highest under 75% NPK+25% FYM. On the other hand, the improvement in N and P status of soil was recorded highest under 75% NPK+25% PM. The higher K status was observed in the treatment with 75% NPK+25% compost compared to applications of inorganic fertilizer. Therefore, a considerable improvement in soil fertility status was observed when inorganic fertilizer was combined with organic nutrient sources. This will also reduce the 25% chemical fertilizer load. Among the INM treatments for maize, higher yields were observed in case of 75% NPK+25%N substituted by PM (6075 kg/ha) followed by 75% NPK+25% N substituted by FYM (5926 kg/ha) as compared to 100% NPK (Table 11).

Table 11. Effect of integrated nutrient management on yield of rice

Treatment	Rice grain yield (kg/ha)	Rice straw yield (kg/ha)	Maize grain yield (kg/ha)
Control	2420	2621	4126
100% NPK	3750	4062	5655
75 % NPK (25%N by FYM)	3910	4236	5926
75 % NPK (25% N by GM)	3820	4138	5722
75 % NPK (25% N by compost)	3370	3651	5272
75% NPK (25% N by PM)	4200	4550	6075
75 % NPK (25%N by BF)	3490	3781	5391
50 % NPK (50% N by FYM)	2980	3228	4972
Fully organic	2620	2838	4513
CD (P= 0.05)	267	303	292

Table 12. Soil fertility status under different integrated nutrient management treatments after rice harvesting

Treatment	Total N ( )	Available P( )	Available K( )
Control	1110(-72)	7.4(-3.76)	71.04(-8.96)
100% NPK	1137(-45)	9.19(-1.71)	75.68(-4.32)
75 % NPK (25% N FYM)	1201(+19)	12.09(+1.19)	82.63(+2.63)
75 %NPK (25% N by GM)	1207(+25)	12.73(+1.83)	87.56(+7.56)
75%NPK(25% N by Compost)	1995(+13)	11.44(+0.54)	82.97(+2.97)
75%NPK (25% N by PM)	1225(+43)	15.94(+5.04)	82.83(+2.83)
75%NPK (25% N by BF)	1186(+4)	11.85(+0.95)	81.97(+1.97)
50 %NPK (50% N by FYM)	1209(+27)	11.57(+0.67)	82.37(+2.37)
Fully organic	1191(+9)	11.57(+0.67)	80.65(+0.65)
CD (P= 0.05)	15.42	1.12	4.55

Figures given in the parenthesis are in %

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

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In order to assess the effect of *Gliricidia* prunings on physico-chemical properties of soil and yield of brinjal as intercrop, an experiment was conducted in Sippighat Research Farm. Analysis of the soil aggregates indicated highest value of particle under the particle size from 0.2 to 0.02 mm (Table 13). The aggregates smaller than 0.2 mm size blocks the larger pores and restrict the free flow of water and air. The rate of nitrogen mineralization under the plot of treatment increased significantly with decrease in the size of particle after 15, 25, 45 and 60 days of application of fresh *Gliricidia* leaves (Table 14). The effect of *Gliricidia* leaves on yield of brinjal indicated the highest yield of 11.9 t/ha when *Gliricidia* leaves applied @8 t/ha which is observed at par with *Gliricidia* leaves when applied @5 t/ha (Table 15).

Table 13. Soil aggregate analysis after application of 5 t/ha Gliricidia

Particle size (mm)	Particle diameter (> mm)	Value ± SE (Particles)	OC (%)	Total N (%)	Total P (%)
5.0-2.0	2.0	25.49 ± 1.00	0.34^{a}	0.01^{a}	0.001^{a}
1.0-0.5	1.0	71.28 ± 1.63	0.51^{b}	0.02^{b}	0.001^{a}
0.5-0.25	0.5	2.17 ± 0.06	0.68^{c}	0.06^{c}	0.002^{b}
0.25-0.10	0.1	1.05 ± 0.05	1.02^{d}	0.08^{d}	0.004^{c}

Table 14. Nitrogen mineralization rate of Gliricidia leaves @5t/ha under different aggregates size

Particle size (mm)	Particle diameter (>mm)	Control 15 days	Application of Gliricidia leaves @ 5t/ha			
			30 days	45 da	ys	60 days
5.0-2.0	2.0	0.20	0.22^{a}	0.25^{a}	0.20^{a}	0.18^{a}
1.0-0.5	1.0	0.26	0.31^{b}	0.57^{b}	0.41^{b}	0.27^{b}
0.5-0.25	0.5	0.37	0.43^{c}	0.87^{c}	0.57^{c}	0.34^{c}
0.25-0.10	0.1	0.52	0.67^{d}	1.02^{d}	0.89^{d}	0.48^{d}

Data in a column with different superscript are significant at P<0.05

Table 15. Effect of *Gliricidia* pruned leaves on yield of brinjal (var.PB-64)

Treatments	Yield (t/ha)
Control	10.0
3 t of *Gliricidia* leaves /ha	10.9
5 t of *Gliricidia* leaves /ha	11.6
8 t of *Gliricidia* leaves /ha	11.9
CD (P=0.05)	0.4

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

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During the year, study on analysis of expenditure pattern of farm family and role of women in integrated farming system (IFS) were taken. Critical analysis of expenditure pattern of different farm families engaged in IFS under different micro farming situations illustrated 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 around the pond only, expenditure on agriculture was lowest (only 5%), whereas expenditure 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.

Plate 5. Making of MAT nursery

Plate 6. Sowing of sugarcane

Plate 7. Making of garland

The share of work by women in agriculture and allied activities were found to be 40% in paddy (sowing, transplanting, weeding, harvesting, threshing, winnowing, drying and packing), 50% in vegetable (sowing, irrigation, weeding, harvesting and retail selling), 40% in sugarcane (set preparation and treatment, sowing, fertilizer application, removing of trash, propping and harvesting), 70% in floriculture (sowing, irrigating, manure application, harvesting, making of gajra/ mala, and selling), 50% in coconut (dehusking and copra drying), 50% in arecanut (dehusking, drying and packing), 30% in spices (seed preparation, harvesting, drying, packing), 30% in fodder (sowing, harvesting, chopping), 40% in cattle (cleaning of shed and animal, feeding, milking, selling milk), 70% in poultry including duck (cleaning of shed, feeding, egg collection, setting of egg for hatching, selling of egg and chick), 70% in goat (feeding, caring kids and selling), 20% in fish (feeding, netting/ harvesting, selling of fish) and 40% in compost making (dung collection, dumping in pits, addition of green manure, periodical mixing) (Plate 5 to 7). The total share of work by farm women in integrated farming system works out to 46%, which is quite significant.

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

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

Six cropping systems *viz*. French bean-radish, sweet potato-cabbage-amaranthus, coriander-tomato-okra, okra-knolkhol, cowpea-amaranthus-cauliflower-amaranthus, and okra-amaranthus-chilli in the beds and four (Plate 8 -12) systems *viz*., Rice-rice (azolla + tilapia fish), rice-rice (azolla + tilapia fish), rice-rice ratoon (Azolla + fish (singhi + magur) and rice-rice (azolla + singhi + magur fish) were evaluated in the furrows in BBF system during the period at experimental farm. In the beds, tomato crop failed due to high incidence of wilt at early stage of crop. In furrows also, vegetables like cucumber, pumpkin and bottle gourd were planted and could not be harvested as a result of water logging in furrows due to continuous rain during January to March.

Among the crops evaluated on the beds, chilli, radish, okra, cowpea, knolkohl,

Plate 8. Okra in bed of BBF

Plate 9. Radish in bed & paddy in furrow

Plate 10. Chilli on bed of BBF

cauliflower, amaranthus and sweet potato performed better compared to tomato and french beans during the monsoon and post-monsoon seasons. Among the six cropping systems, okra-amaranthus-chilli recorded higher net return of Rs. 127558 with B:C ratio of 4.3 (Table 16) followed by coriander-okra registering net return of Rs. 48028 with B:C ratio of 2.9. The cropping intensity ranged between 200-400 % for different cropping systems. Cultivated land utilization index (CLUI) was higher under okra-amaranthus-chilli (0.90) indicating efficient utilization of land. Sweet poatato-cabbage-amaranthus also recorded CLUI of 0.82. Among the three cole crops evaluated, knolkohl registered the

Plate 11. Knolkohl on BBF

highest yield of 2184 kg from 4000 m^2 area of BBF followed by cauliflower (1058 kg). The returns from knolkohl and cauliflower was Rs. 26200 and 12700, respectively.

In furrows, double cropping of paddy with singhi and magur resulted in maximum returns. Among the combination of fish and rice evaluated, it was found that rice-rice (azolla + singhi + magur) resulted in production of 2.23 t of rice and 73 kg of fish from 6000 m^2 area (Table 17), whereas combination rice-rice (azolla + tilapia) led to

reduced rice yield of 1.43 t and 25 kg of fish from 6000 m^2 clearly indicating the unsuitability of tilapia culture with paddy. In terms of net returns also, rice-rice (azolla + singhi + magur) led to Rs. 11000 compared to rice-rice (azolla + tilapia). The cropping intensity and CLUI was 200% and 0.66 for all the systems except ratoon crop.

Plate 12. Harvested Knolkohl

In terms of residue production, Sweet potato-cabbage-amaranthus recorded 14933 kg followed by okra-amaranthus-chillies (8200 kg) in the beds (Table 18). Cabbage could not be harvested for economical yield due to delay in planting which was the reason for higher residue yield in the system. Cabbage alone produced 4700 kg of residues which was used for composting. Residue production from furrow ranged from 1625 to 1855 kg. Hence, in one ha of BBF system, on an average, net return of Rs. 138500 can be obtained by practicing okra-amaranthus-chillies system on the beds and rice-rice (azolla + singhi + magur) in furrows.

At Indiranagar, as per the farmers choice, two crop sequences *viz.*, okra-cowpea, okra-amaranthus-okra (Plate 13) were evaluated in the beds with brinjal, moringa and banana as border crops and rice + fish + azolla in furrows in BBF system. All the crops performed better on the beds during monsoon season. Among the cropping system, okra-amaranthus-okra recorded maximum net return of Rs. 1,06,134 from 4000 m^2 area of beds in one ha (Table 19) and Rs. 10840 obtained from furrows. Further, by adoption of okra-amaranthus-okra in beds, brinjal + moringa + banana in border areas and rice + azolla + fish in furrows in one ha of BBF, Rs. 117532 can be obtained.

Plate 13. BBF system at Indiranagar

Table 16. Yield, cropping intensity and economics of beds (4000 m^2)

Cropping Sequence	Yield (Rs)	Cropping (%) Intensity	CLUI (kg)	Gross returns (Rs)	Net returns (Rs)	B:C ratio
CS 1						
French bean Radish	274 5733	200	0.60	43414	26822	1.61
CS 2						
Sweet potato	1600	300	0.82	14500	4700	1.01

Cabbage	-					
Amaranthus	700					
CS 3						
Coriander	17	300	0.71	64458	48028	2.92
Tomato	-					
Okra	5288					
CS 4						
Okra	1557	200	0.58	44881	22539	1.01
Knolkohl	2184					
CS 5						
Cowpea	3450	400	0.75	66873	47099	1.28
Amaranthus	1208					
Cauliflower	1058					
Amaranthus	616					
CS 6						
Okra	1750	300	0.90	157258	127558	4.29

Table 17. Yield, cropping intensity and economics of furrows (6000 m²)

Cropping Sequence	Yield (kg)	Cropping Intensity (%)	CLUI	Gross returns (Rs)	Net returns (Rs)	B:C ratio
CS 1						
Rice	1000	200	0.66	11121	5721	1.06
Rice	430					
Fish: tilapia	25*					
CS 2						
Rice	966	200	0.66	9927	4527	0.83
Rice	133					
Fish: tilapia	45*					
CS 3						
Rice	1000	200	0.55	16681	11281	2.09
Rice ratoon	84					
Fish: singhi + magur	78*					
CS 4						
Rice	1000	200	0.66	16781	11381	2.11
Rice	1230					
Fish: singhi + magur	73*					

*Yield calculated on the basis of 10 furrows from one ha of BBF

Table 18. Residue production from cropping system from beds (4000 m²) and furrows (6000 m²) for recycling in BBF System

CS	Cropping Sequence (Beds)	Residues yield (kg)	Cropping sequence	Residue syield(kg) (furrows)
CS 1	French bean-radish	967	Rice-rice	1855
CS 2	Sweet potato-cabbage-amaranthus	14933	Rice-rice	1733
CS 3	Coariander-tomato-okra	6833	Rice-rice ratoon	1625
CS 4	Okra-knolkohl	5125	Rice-rice	1670
CS 5	Cowpea-amaranthus-cauliflower -amaranthus	1400	-	-
CS 6	Okra-amaranthus-chilli	8200	-	-

Table 19. Crop yield and return in beds (4000 m²), furrows (6000 m²) and border area of BBF in the farmers field at Indiranagar

CS	Crops	Yield (kg)	Gross return (Rs)	Net return (Rs)	B:C ratio
Beds					
CS1	Okra	2411	21699	6499	1.4
	Cow pea	4851	48510	35710	3.8
	Total	-	70209	42209	2.5
CS2	Okra	2744	39928	24728	2.6
	Amaranthus	5543	49887	45387	11.0
	Okra	5691	51219	36019	3.4
	Total	-	141034	10613	4.0
Border areas	Brinjal	2	18	18	-
	Moringa	5	40	40	-
	Banana	50	500	500	-
	Total	-	558	558	-
Furrows	Rice + azolla	2418	12090	7590	2.60
	Fish (prawns, catla, rohu, and mrigal)	75	3750	3250	6.50
	Total	-	15840	10840	2.17
1 ha BBF (4000 m² bed + 6000 m² furrows + border areas)	Okra-amaranthus-okra in beds + rice + fish in furrows + brinjal, moringa and banana in border areas	-	157432	117532	2.95

STANDARDIZATION OF PACKAGE OF PRACTICES FOR TABLE PURPOSE GROUNDNUT IN ANDAMANS

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In order to standardize the package of practices for hand picked selected (HPS) table purpose groundnut, field experiments were conducted during dry season at Bloomsdale Research Farm. The soil of the farm is sandy loam with pH 6.7, 0.85% OC, medium in available N, P and K. Treatments were laid out in split plot design with three replications. Two methods of sowing *viz.*, manual line sowing and manual dibbling were assigned to main plot and three dates of sowing *viz.*, 24 December 2007, 7 January 2008 and 22 January 2008 along with two varieties, namely, SG-99 and ICGS-76 were assigned to sub plots.

Yield parameters

The results indicated that the pod parameters *viz.*, pod weight and shell weight per plant were influenced significantly by different methods of sowing. Manual dibbling led to significantly higher pod weight (77 g/plant) and shell weight (41 g/plant) compared to manual line sowing. However, the number of pods per plant and 100 pods weight were not influenced significantly by sowing methods. Similarly, different sowing dates influenced significantly on number of pods, pod weight and shell weight per plant.

Plate 14. Pod of single plant

Sowing in second fortnight of December led to higher number of pods (40/plant) and pod weight (80 g/plant) which is on par with sowing in first fortnight of January. Sowing in second fortnight of January registered significantly lesser number of pods and pod weight per plant. Higher shell weight (41 g/plant) was recorded with sowing in first fortnight of January. However, different sowing dates did not influence 100 pods weight significantly. Although, varieties did not show influence on number of pods and pod weight per plant, but perceptible influence was observed on 100 pods weight and shell weight. ICGS-76 recorded significantly higher 100 pods weight (224 g) and shell weight (39 g/plant) than SG-99.

Number of kernels and kernel weight per plant were influenced significantly by different method of sowing. Manual dibbling registered significantly higher number of kernels (56/plant) and kernel weight (47 g/plant) than manual line sowing (Table 20). 100

Plate 15. Kernal of SG 99 variety

Plate 16. Harvested wet pods

kernels weight and shelling percentage was not affected due to method of sowing. Though sowing in second fortnight of December recorded numerically higher number of kernels (62) and kernel weight (53g/plant), it was observed on par with sowing in first fortnight of January. Sowing in second fortnight of January had significantly lesser number of kernels and kernel weight per plant. Similar trend was observed in shelling percentage also. 100 kernels weight was not affected by date of sowing. No significant difference was observed between SG-99 and ICGS-76 varieties in kernel parameters and shelling percentage (Plate 14-16).

Yield

Different sowing methods did not influence dry pod yield, wet haulm yield and harvest index significantly, whereas time of sowing significantly influenced the yield of pod and haulm and thereby harvest index. Sowing on 24 Dec 2007 resulted in higher pod (3881 kg/ha) and wet haulm (28737 kg/ha) yields (Table 21) which is on par with sowing in January first week. Late sowing (22 Jan 2008) led to reduction in pod yield to the tune of 8%. Both SG-99 and ICGS-76 registered yield of 3737 and 3741 kg/ha revealing on par performance (Plate 17). The harvest index also exhibited similar trend.

Economics

The cost of cultivation of manual line sowing and manual dibbling was estimated Rs. 20450 and 21750 /ha indicating requirement of additional 10 man days for sowing by dibbling method. Hence, there is no significant difference in net returns and B:C

Plate 17. Haulms of HPS groundnut

ration due to sowing methods. Sowing on 24 December 2007 led to higher net returns (Rs 41815/ha) and B:C ratio (2.0) which is on par with sowing in January first week (Table 22). Sowing in 22 January 2008 led to reduction of net returns to the tune of Rs. 5542/ha. As there was no significant difference in yield of both the varieties, the difference in net returns was also not significant.

Energetics

The input energy required to produce HPS groundnut under manual line sowing and manual dibbling is estimated to be 12809 and 12935 MJ/ha, which is mainly due to additional 10 man days required for sowing under dibbling method. In terms of output energy, energy ratio and specific energy (energy required to produce one kg of economic yield) for both the sowing methods was estimated equal. The energy ratio and specific energy was better in case of early sowing (24 December 2007). On an average, HPS groundnut requires 3.5 MJ of energy to produce one kg of pods. No significant difference between SG-99 and ICGS-76 in terms of output energy, energy ratio and specific energy.

Pattern of soil moisture during crop growth period

As 78.4 mm of rainfall occurred during 45-47 standard week, soil condition was found unsuitable for sowing up to 51st week. Sowing was done when soil attained moisture content between 11-13 % (Fig 5). Soil samples were collected during the crop growth period at 0-20 and 20-40 cm depths for studying the soil moisture pattern. Soil moisture was observed in the range of 12-20 % throughout the crop growth cycle.

Relationship between rainfall and yield

In 2006-07, irrigation was given during life, flowering, pegging and pod formation stages @3 cm/irrigation with the available water (12 cm) as no rain has occurred during the entire crop growth period. This has resulted in pod yield of 1612 kg/ha. However, in 2007-08, 187.3, 171.7 and 360.1 mm of rainfall was recorded for crop growth periods for first, second and third date of sowing to harvest, respectively. During effective growth phases, almost 11 rainy days occurred in all the sowing dates. The dry pod yield was recorded 3881, 3765 and 3571 kg/ha for first, second and third date of sowing, respectively (Fig 6). All the practices like sowing time, mulching and varieties were same in both the years. This indicated an increase in 132% yield over the previous year, mainly due to 11 rainy days that supplemented about 6 cm water coinciding with critical growth stages and improved micro-climatic condition for crop growth.

Based on the above findings, it is concluded that manual line sowing before first week of January for SG-99 and ICGS-76 varieties can be recommended for Andaman conditions considering the availability of labour, probable rainfall and marketing potential for HPS groundnut.

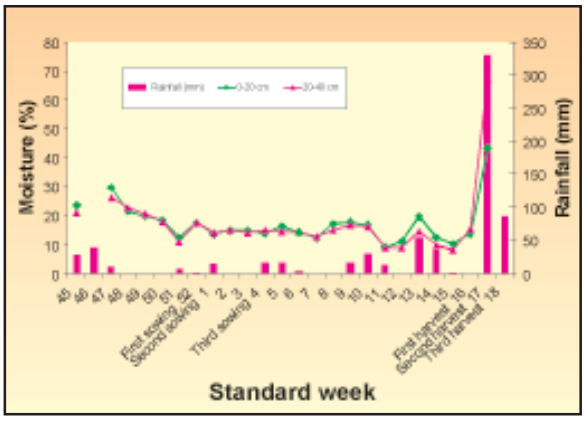


Fig 5: Rainfall and soil moisture pattern during crop growth period.

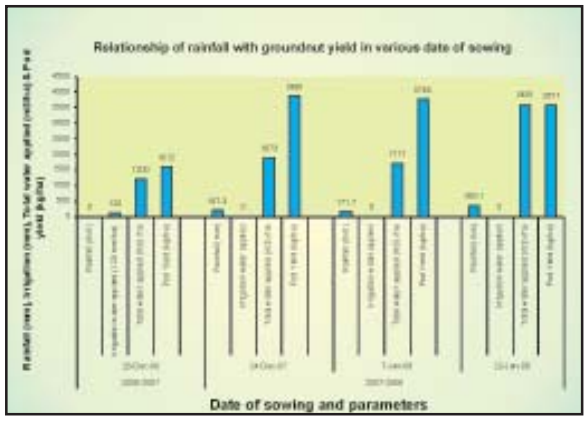


Fig 6. Relationship of rainfall with groundnut yield in various date of sowing

Table 20. Influence of method, date of sowing and varieties on kernel parameters of HPS groundnut

Treatments	No. of kernels/plant	Kernel weight (g/plant)	100 kernel weight(g)	Shelling(%)
Method of sowing				
Manual line sowing	44.3	36.5	85.3	58.1
Manual dibbling	56.0	46.8	92.7	60.3
SEd	0.1	0.3	4.4	1.5
CD *(P=0.05)*	0.3	1.4	NS	NS
Date of sowing				
24 Dec 2007	62.1	53.0	88.3	66.1
07 Jan 2008	58.0	45.1	89.0	60.0
22 Jan 2008	30.3	27.1	90.0	52.1
SEd	6.1	4.3	6.0	2.5
CD *(P=0.05)*	12.8	9.0	NS	5.1
Varieties				
SG 99	46.7	39.0	91.8	60.0
ICGS 76	53.5	44.4	86.1	58.2
SEd	5.0	3.5	4.8	2.0
CD *(P=0.05)*	NS	NS	NS	NS
CV (%)	28.5	24.3	16.0	10.3

Table 21. Influence of method, date of sowing and varieties on yield of HPS groundnut

Treatments	Dry pod yield (kg/ha)	Wet haulm yield (kg/ha)	Harvest index
Method of sowing			
Manual line sowing	3612	22112	0.15
Manual dibbling	3866	23369	0.15
SEd	138	1653	0.001
CD *(P=0.05)*	NS	NS	NS
Date of sowing			
24 Dec 2007	3881	28737	0.12
07 Jan 2008	3765	24273	0.14
22 Jan 2008	3571	15212	0.20
SEd	120	2119	0.01
CD *(P=0.05)*	250	4420	0.02
Varieties			
SG 99	3741	23369	0.14
ICGS 76	3737	22112	0.16
SEd	180	1730	0.01
CD *(P=0.05)*	NS	NS	NS
CV (%)	14.1	22.7	15.6

Table 22. Influence of method, date of sowing and varieties on economics and energetics of HPS groundnut

Treatments	Net returns (Rs/ha)	B:C ratio	Energy ratio	Specific energy (MJ/kg)
Method of sowing				
Manual line sowing	39103	2.0	24.3	3.6
Manual dibbling	41374	1.8	25.5	3.4
SEd	3722	0.2	1.5	0.2
CD *(P=0.05)*	NS	NS	NS	NS
Date of sowing				
24 Dec 2007	42627	2.0	30.0	3.4
07 Jan 2008	41815	2.0	26.0	3.5
22 Jan 2008	36273	1.7	18.8	3.6
SEd	2816	0.1	2.0	0.2
CD *(P=0.05)*	5874	NS	4.0	NS
Varieties				
SG 99	39204	1.8	25.4	3.5

ICGS 76	41273	2.0	24.4	3.6
SEd	2585	0.1	1.6	0.2
CD *(P=0.05)*	NS	NS	NS	NS
CV (%)	20.2	20.2	18.7	16.0

* Cost of cultivation: Manual Line sowing: Rs. 20450/ha & Manual dibbling : Rs 21750/ha, ** Dry pods : Rs 15/kg and wet haulm for fodder : Rs. 0.25 /kg , *** Input energy: Manual Line sowing: 12809 MJ/ha & Manual dibbling : 12935 MJ/ha, **** Energy value : Dry pods : 25 MJ /kg and wet haulm for fodder : 10 MJ /kg

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, Babulal Meena, M. Din, Subhash Chand, S.K. Ambast, S.K. Zamir Ahmed and S.K. Verma

Productivity enhancement of rice through use of long duration varieties and adoption of improved management practices during monsoon season (June-November)

Long duration rice varieties with high yield potential were evaluated to utilize the available growing period to the maximum extent under island ecosystem. The improved, high yielding long duration varieties *viz*., Gayatri (160 days), Savitri (145 days), Ranjit (155-160 days) and Varshadhan (160 days) from Central Rice Research Institute, Cuttack were evaluated along with Taichung Sen Yu and C 14-8 as local check at research farm and farmers field during wet season 2007.

Long duration varieties performed better than medium duration Taichung Sen Yu (3.86 t/ha) at research farm. Among the long duration varieties, Ranjit recorded highest grain yield (5.1 t/ha) followed by Savitri (4.7 t/ha), Varshadhan (4.3 t/ha) and Gayatri (4.2 t/ha). The higher yield of long duration varieties could be attributed to its better growth and yield attributes over medium duration local check (Table 23). In farmers field also, long duration varieties produced significantly higher grain yields (Ranjit - 3.0 t/ha; Savitri - 2.6 t/ha; Varshadhan - 2.5 t/ha and Gayatri - 2.4 t/ha) than long duration C 14-8 (2.0 t/ha) in spite of minimal management practices adopted by the farmer during the crop growth period (Table 24). The increased yield of long duration varieties over the local checks under on-station and on-farm conditions has resulted in increased gross and net income and in turn resulted in higher output:input ratio (Plate 18-19).

Table 23. Growth, yield attributes, yield and economics of rice varieties in Bloomsdale Research Farm

Varieties	Height (cm) hill)	Leaf area (cm^2/ (kg/ha)	DMP at harvest tillers/hill (Rs)	Ear bearing grains/hill (Rs)	No. of filled weight (g)	1000 grain	Grain yield (kg/ha)	Straw yield (kg/ha)	Gross Income	Net Income	Output : Input Ratio
Ranjit	160	2452	13010	14	953	20.0	5083	5638	48844	34104	3.31
Savitri	138	2092	12800	16	804	22.0	4719	5285	34827	20087	2.36
Varshadhan	194	2416	13950	13	675	24.0	4321	6385	30344	15604	2.06
Gayatri	129	2183	12067	12	774	20.4	4211	6043	29751	15011	2.02
TSY	116	1234	10667	8	435	21.2	3860	4825	27985	13445	1.92
SEd	*11.0*	*228.4*	*469.0*	*0.6*	*38.9*	*0.75*	*260.9*	*373.1*	-	-	-
CD (P=0.05)	*25.2*	*526.7*	*1081.5*	*1.3*	*89.8*	*1.74*	*601.7*	*860.3*	-	-	-
CV (%)	*9.1*	*13.5*	*11.9*	*8.3*	*9.6*	*6.30*	*12.2%*	*8.1*	-	-	-

Table 24. Growth, yield attributes, yield and economics of rice varieties in Farmer's field (Lalpahar)

Varieties	Height (cm)	Leaf area (cm^2/hill)	DMP at harvest (kg/ha)	Ear bearing tillers/ hill	No. of filled grains/ hill	1000 grain weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Gross Income (Rs)	Net Income (Rs)	Output : Input Ratio
Ranjit	95	933	9267	7	509	20.0	3043	3773	29639	16199	2.21
Savitri	102	946	8411	9	405	22.0	2625	3248	25561	12121	1.90
Varshadhan	111	863	7133	6	395	24.0	2455	4026	24894	11454	1.85
Gayatri	83	794	7600	11	364	20.4	2386	3531	23812	10372	1.77
C 14-8	130	830	8004	7	368	25.2	2028	4259	21497	8057	1.60
SEd	*8.2*	*57.6*	*241.3*	*0.4*	*27.3*	*1.5*	*184.2*	*205.8*	-	-	-
CD (P=0.05)	*18.9*	*132.8*	*556.5*	*1.0*	*63*	*3.5*	*424.9*	*474.5*	-	-	-
CV (%)	*9.6*	*9.0*	*7.7*	*6.4*	*12.1*	*8.4*	*11.4*	*13.0*	-	-	-

Plate 18. Medium duration variety (Taichang Sen Yu) at maturity and long duration variety (Savitri) at vegetative stage in Bloomsdale Research Farm

Plate 19. Ranjit and Varshadhan at Maturity in Farmer's field (Lalpahar)

Raising post monsoon crop with supplemental irrigation (December 2007-April 2008)

In order to optimize the supplemental irrigation (SI) schedule for different crops for getting maximum profit during dry season (December-April), field trial was conducted during 2007-08 in the rice fallows of Bloomsdale research farm. The details of supplemental irrigation (5 cm irrigation depth per irrigation) given at critical crop growth stages were given in Table 25.

The SI had a significant effect on the yield of post monsoon crops (Table 26). The reason for improved crop yield during the season vis-à-vis 2006-07 season might be due to the rainfall received (186.7 mm for maize and chilli, 95.3 mm for green gram and sesamum and 149.7 mm for okra, respectively) during the crop growth period. In maize, providing four supplemental irrigations has resulted in at par yield with that of I_5 (5787 kg/ha). Providing three supplemental irrigations has resulted in significantly higher yield (5182 kg/ha) than no irrigation, I_0 (3906 kg/ha) and at par yield with that of I_4. The percent yield increase over I_0 due to SI was 19, 20, 33, 37 and 48 % in I_1, I_2, I_3, I_4 and I_5, respectively.

With respect to green gram, SI at flowering has resulted in on par yield (609 kg/ha) with that of I_5 (670 kg/ha), I_4 (651 kg/ha) and I_3 (705 kg/ha) and I_2 (633 kg/ha), and higher yield than that of I_0 (584 kg/ha). In case of sesamum, SI at 4-5 leaf stage, flowering and pod setting has registered at par yield (1643 kg/ha) with that of I_5 (1792 kg/ha) and I_4 (1736 kg/ha) and significantly higher yield than I_2 (1569 kg/ha), I_1 (1028 kg/ha) and I_0 (833 kg/ha). Providing two supplemental irrigations (I_2) has also produced significantly higher yield over I_0.

In case of vegetables, SI has significantly increased the yield levels and economic returns. The maximum yield was achieved

under I_5 in both ladies finger (6433 kg/ha) and chilli (2415 kg/ha). However, providing three supplemental irrigations in ladies finger has resulted in on par yield with that of I_5 and in chilli it has resulted in next best yield (vis-à-vis I_5) and significantly higher yield than I_0. The yield increase due to SI is in the tune of 6 (I_1), 20 (I_2), 44 (I_3) and 48 (I_4) percent in okra and 19 (I_1), 27 (I_2), 69 (I_3) and 88 (I_4) percent in chilli over I_0 (No irrigation).

The results revealed that SI could increase the crop yield with lesser irrigation water usage and in turn increase the profitability (Table 27) and water productivity (Table 28), an important consideration for raising dry season crops in the rice fallows from harvested rainwater of rainy season under Island conditions (Plate 20 & 21).

Table 25. Details of supplemental irrigation provided at different crop growth stages

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

Table 26. Effect of supplemental irrigation on yield of post monsoon crops

Irrigation level	Yield (kg/ha)*				
	Maize	Green gram	Sesamum	Okra	Chilli
I_0	3906	584	833	9610	4192
I_1	4635	609	1028	10170	4985
I_2	4688	633	1569	11530	5310
I_3	5182	705	1643	13780	7068
I_4	5365	651	1736	14190	7892
I_5	5787	670	1792	14330	10387
SEd	***208.2***	***50.5***	***97.4***	***728.1***	***468.9***
CD (P=0.05)	*463.8*	*112.5*	*217.0*	*1622.4*	*1044.6*
CV (%)	*11.91*	*14.2*	*8.3*	*9.3*	*12.8*

* Average yield of maize, green gram and sesamum are reported at 10% moisture level while the yield of okra and chilli are reported as weight of the fresh harvested produce

Table 27. Economics of supplemental irrigation

Irrigation levels	Net returns (Rs/ha)					
	I_0	I_1	I_2	I_3	I_4	I_5
Maize	30,791	35,416	35,287	39,585	40,888	43,682
	(4.72)	(4.24)	(4.05)	(4.23)	(4.20)	(4.08)
Green gram	8,370	7,525	7,735	9,015	7,275	7,750
	(2.34)	(1.98)	(1.96)	(2.05)	(1.81)	(1.86)
Sesamum	15,132	18,960	32,095	33,295	35,100	35,590
	(3.66)	(3.81)	(5.50)	(5.28)	(5.23)	(4.86)
Okra	82,720	74,760	90,040	1,16,780	1,21,440	1,22,080
	(3.54)	(2.58)	(2.86)	(3.40)	(3.49)	(3.45)
Chilli	65,454	67,950	74,060	1,11,826	1,29,044	1,81,594
	(3.45)	(2.63)	(2.73)	(3.56)	(3.89)	(4.87)

The data in the parenthesis indicates output: input ratio

Table 28. Water productivity of different post monsoon crops under different supplemental irrigation levels

Irrigation level	Maize		Green gram		Sesamum		Okra		Chilli	
	TWP*	GIWP**	TWP	GIWP	TWP	GIWP	TWP	GIWP	TWP	GIWP
I_1	1.96	1.46	0.42	0.05	0.71	0.39	5.09	1.12	2.11	1.59
I_2	1.63	0.78	0.32	0.05	0.80	0.74	4.62	1.92	1.85	1.12
I_3	1.54	0.85	0.29	0.08	0.67	0.54	4.60	2.78	2.10	1.92
I_4	1.39	0.73	0.22	0.03	0.59	0.45	4.06	2.29	2.04	1.85
I_5	0.99	0.47	0.23	0.04	0.45	0.32	2.61	1.18	1.77	1.55

* TWP (kg/m^3) is taken as the ratio of irrigated yield to total water supply (rainfall (*186.7 mm for maize and chilli, 95.3 mm for Green gram and Sesamum and 149.7 mm for Okra, respectively*) + SI)
** GIWP (kg/m^3) is taken as the ratio of increase in yield (over control) to the gross depth of SI applied

Plate 20. Overview of the supplemental irrigation experimental plots

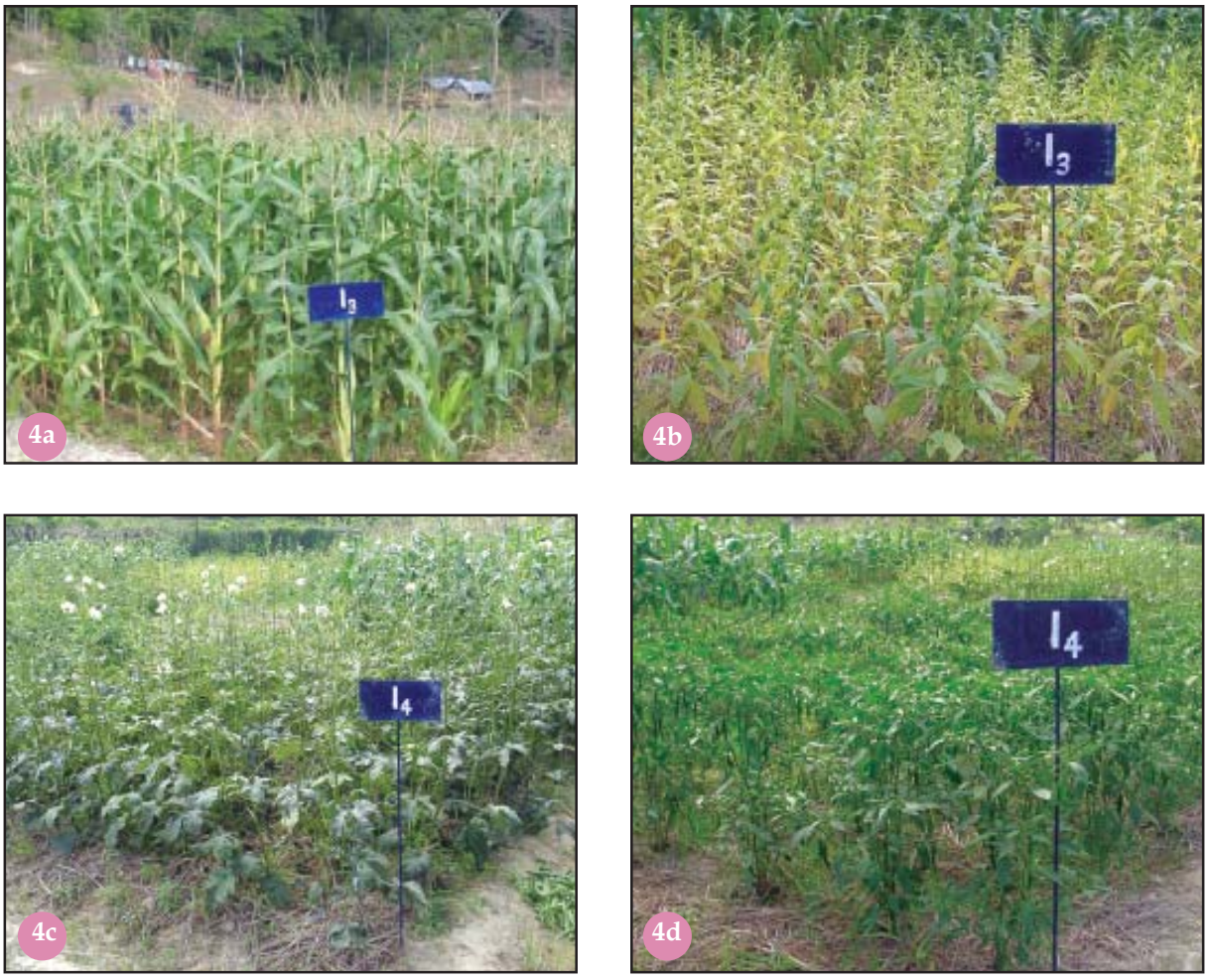


Plate 21. View of a) I_3 Maize b) I_3 Sesamum c) I_4 Okra and d) I_4 Chilli

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 Subash Chand

Cultivation of vegetable crops in A&N Islands during wet season is constrained due to heavy rains whereas during dry season is limited due to water shortages. Protected cultivation helps in minimizing the adverse effect of climate and gives higher productivity. As closed type greenhouse maintain higher temperature and humidity inside than the ambient conditions mainly due to poor air exchange in absence of ventilator facility, a natural venti-

lated, two span saw tooth shaped greenhouse (25 m x 10 m) was constructed at Garacharma farm to evaluate micro-climatic and crop performance of high value tomato (cherry type), capsicum, broccoli and coriander under protected structure. The frame was constructed with galvanized iron pipes and it was covered with 200 micron ultraviolet stabilized LDPE sheet. The gutter and centre heights were 2 m and 3.5 m, respectively. Aluminium flats were fixed over the sheet to with GI pipes to avoid fluttering due to wind. Ridge ventilation (1 m x 25 m size) and side ventilation (1.67 m x 25 m size) were provided for proper air exchange. The side walls and the ventilation openings were covered with 40 mesh insect-proof net. A provision was made to cover insect proof nets at ridge and side walls with rollable flaps of 200 micron ultraviolet stabilized LDPE sheet. The flap can be opened through mechanically rolling system. In this greenhouse 2.30 % ridge ventilation area and 11.95% side ventilation area was provided based on total volume of greenhouse (656.8 m^3). A slope of 2% along the length of inter span gutter was provided to harvest rainwater from the roof. Arrangement for misting has been made to control the microclimate inside the greenhouse. In this model (ridge and side ventilators covered with LDPE sheet i.e. closed type) wet-dry bulb temperature, solar radiation and lux were recorded at no load at load. In the month of March, air temperature and humidity inside the greenhouse varied from 32-48 °C and 80-85%, respectively whereas outside temperature ranged between 22-35 °C. Misting was operated when temperature reached to 35 °C. It was observed that a misting for 140 seconds required 117 litre of water to reduce temperature inside greenhouse by 1 °C.

Plate 22. Poly house

Plate 23. Nursery of vegetable

The effect of ventilation on the micro-climate was evaluated. The temperature inside the greenhouse varied between 31.5-41.5 °C when ventilation was allowed up to 11.95 % of volume of greenhouse. However, the inside greenhouse temperature was observed more than the optimum and ambient conditions indicating need to increase the ventilation

area. The solar radiation was observed between 100-1000 W/m^2 with average radiation of 548 W/m^2 on 18 March, 2008. The growth of seedlings raised in the greenhouse was found better as compared to open field that showed better air exchange rate and internal micro-climate in the greenhouse (Plate 22-23).

The observations on temperature and humidity were monitored for even span shape and fully open (from top and side walls) greenhouse. In this structure pumpkin, bottle gourd, okra and cabbage were cultivated during January-March, 2008 and the yield of pumpkin, bottle gourd, okra and cauliflower were recorded 3.2 t/ha, 9.2 t/ha, 6.6 t/ha and 14.1 t/ha, respectively. The ambient temperature varied between 27.3-31.1 ^{o}C and humidity ranged between 52-74 % whereas solar radiation varied between 150-952 W/m^2.

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, M. Balakrishnan and R. Sudha

Availability of renewable energy in Bay Islands was assessed from available weather data with the aim to utilize renewable energy sources efficiently for drying of agricultural produce. The variations in temperature, relative humidity, solar radiation and solar energy in November/December 2007 are shown in Figs. 7-9. The ambient temperature, relative humidity, solar radiation and solar energy varied between 18.2-30.2 ^{o}C, 51-97 %, 7-1006 W/m^2 and 0.60-78.17 Langley, respectively during the months of November-December 2007. These data were also analyzed during the months of January-May, 2008.

Performance of solar dryer

The performance of CARI solar dryer was evaluated for coconut and compared with natural sun drying. The average initial moisture content of copra was 50% that reduced to 5.7% after the drying process. The time required for drying by solar dryer was 32 hours against 40 hours in case of open sun drying and thus saved 20% time. The moisture removal rate from the coconut was high during the initial stage of drying because of high moisture migration rate from the surface layers and then reduced with the time.

Plate 24. Solar copra dryer

Performance of biomass fired dryer

Earlier, drying of 1000 coconuts was evaluated under biomass fired dryer. It was observed that 16 hrs and 50 kg coconut shells as fuel are required to dry 1000 coconuts

Plate 25. Biomass fired dryer

from an initial 50% to final 5.7% moisture content to obtain edible quality of copra. In order to maintain the optimum furnace temperature (60-65 °C), 4 kg/hr and 6.0 kg/hr feeding rate of coconut shells as fuel was evaluated. The temperature of drying chamber was observed 43 °C and 62-65 °C when feeding rate was 4 kg/hr and 6.0 kg/hr, respectively. For higher feeding rate than 6.0 kg/hr, the dried copra was observed much harder than desired. The quality of the dried copra was graded as 70% white copra, 20% brown copra and 10% dusty copra.

The drying of fish required about 14 hours to reduce the initial moisture content of 75% to safe storage moisture content of 8.5% (w.b.) as compared to 32 hrs for fish dried under open sun. The microbial analysis of the dried fish by solar dryer and biomass fired dryer indicated bacterial load of 8 x 10^3 /ml and 24 x 103 /ml, respectively that indicated 3 times less bacterial load in case of solar dryer as compared to biomass fired dryer. However, the microbial loads in both the cases were observed in the safe limit. The dried fish were good in appearance, texture and quality in solar and biomass fired dryer as compared to open sun drying.

Performance Evaluation of coconut dehusker :

The performance of CARI designed pedal and hand operated dehusker, and local tool 'sabbal' was evaluated with different sizes of nuts at 12.5% moisture content. A total of 600 nuts were tested per tool by ten unskilled persons. The dehusking capacity was observed 125, 72 and 180 nuts/hr for pedal operated, hand operated dehusker and local tool 'sabbal', respectively. The operators experience in terms of qualitative traits indicated higher bending stress in case of 'sabbal' fol-

Plate 26. Dehusking by women

lowed by hand operated and pedal operated dehusker. As height of the dehusker can be adjusted, dehusking can be done in a straight standing posture. In general, bending cycle stress/pain was experienced after dehusking of 80-90 nuts by 'sabbal', 120-130 nuts by hand operated and 150-160 nuts by pedal operated dehusker due to picking up of nuts at ground. The operators felt more comfort in operating pedal operated dehusker as compared to 'sabbal' as risk and drudgery involved was less. The training and demonstration on dehusker was arranged to farmers and farm women at Bedanabad village and CARI campus. Most of the farmers liked pedal operated coconut dehusker whereas farm women showed more interest to operate the hand operated dehusker. The traditional local tool 'sabbal' can be operated by skilled person only and thus the common farmer and farm women finds it difficult to use 'sabbal' as it involves risk to stomach due to pointed sharp edge. Operators will not feel stress in chest, abdominal part and waist when CARI designed dehuskers were operated in standing posture (Plate 24-26).

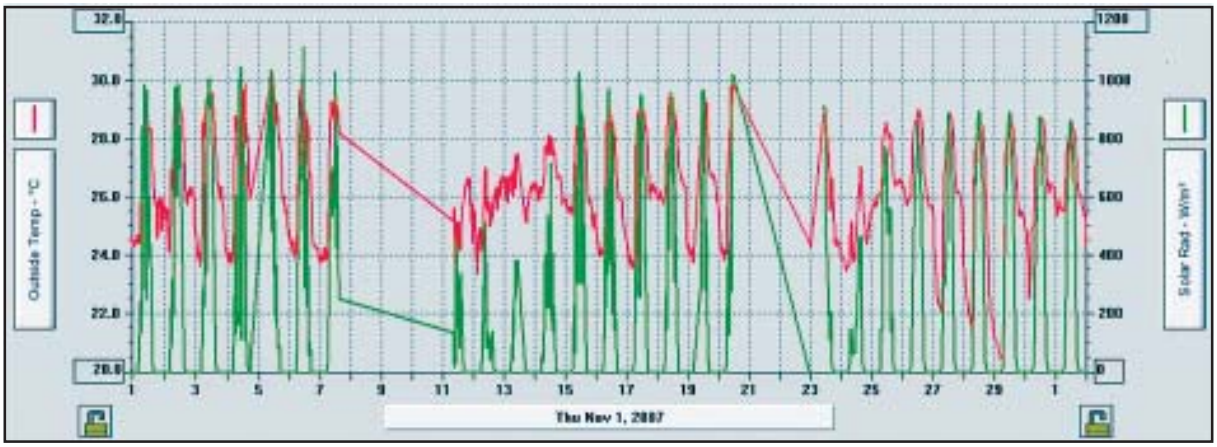


Fig. 7. Variation of temperature and solar radiation for the month of November 2007

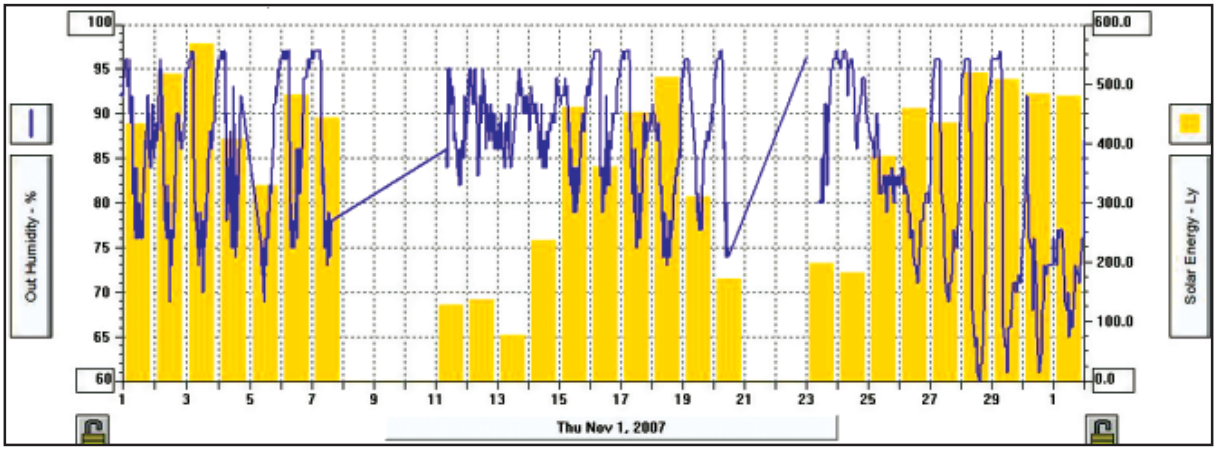


Fig. 8 Variation in relative humidity and solar energy (Langley) for the month of November 2007

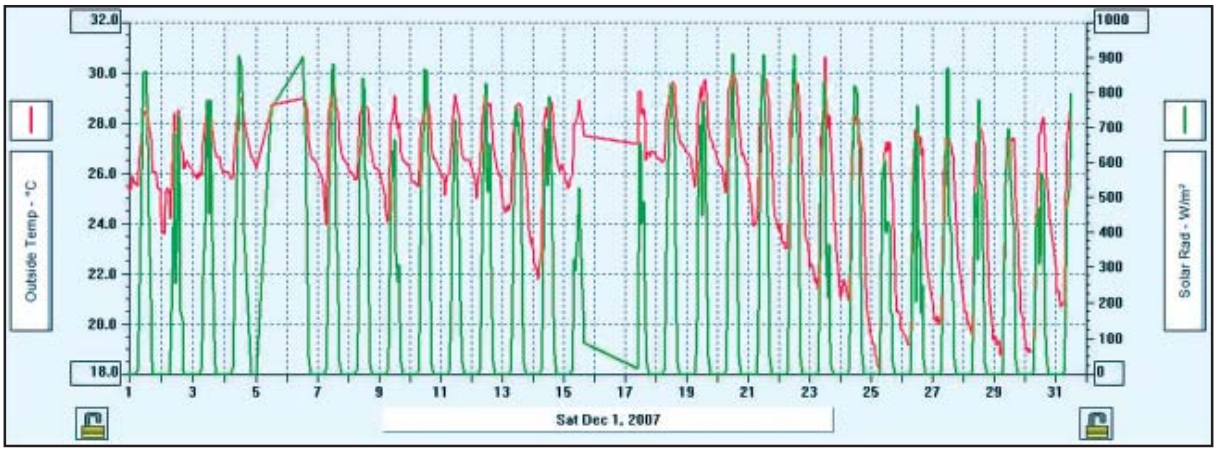


Fig. 9. Variation of temperature and solar radiation for the month of December 2007

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

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

Power tiller with different cage wheels namely lugged, angle iron and Chinese peg type was operated in different soils to evaluate their performance. The fuel consumption of the power tiller with lugged, angle iron and Chinese peg type cage wheels were observed at 2.6, 3.1 and 2.9 l/hr, respectively whereas the mean puddling efficiency were estimated at 72, 81 and 76%, respectively. The infiltration rate in the fields puddled with lugged, angle iron and Chinese peg type cage wheel were observed at 3.9, 3.8 and 4.0 mm/day, respectively. In swampy soil, performance of angle iron cage wheel was found better than lugged cage wheel. The lugged cage wheel sunk during puddling in the wet coastal fields due to scooping of the soil by lugs in less water. Further, it was observed that reversing of power tiller causes the cutting of swampy soil and thus clogging of the lugs. In sandy soil, lugged cage wheel was found more effective as it required less time to puddle. Chinese design worked better in reversing of power tiller and at the corners of the field.

Effect of age of seedling and type of cage wheel on rice yield

The effect of different cage wheels i.e. lugged, angle iron and Chinese peg type and age of seedlings i.e. 16, 19 and 22 days on rice yield was studied in a split plot designed experiment with four replications. The soil of the experiment plot was sandy clay. The CIAE transplanter was used for transplanting of rice, whereas weeding was performed by conoweeder at an interval of 11 days up to 45 days after transplanting. Rice yield of variety

Taichung-sen-yu varies between 2650-3220 kg/ha. The result of the experiment is given in Table 29. The yield of rice was observed significantly higher in the field puddle with angled cage than lugged and peg type cage wheels. The performance of the CIAE transplanter with 16 days old seedlings was observed better than 19 and 22 days old seedlings.

Table 29. Rice yield as influenced by type of cage wheels and age of seedlings

Treatment	Yield(kg/ha)
Cage wheel types	
Chinese peg cage wheel	2649
Angled cage wheel	3226
Lugged cage wheel	3037
SEd	20.40
CD (5%)	49.93
Age of seedling at transplanting	
Seeding age 22 days	2859
Seedling age 19 days	2832
Seedling age 16 days	3220
SEd	22.91
CD (5%)	48.14

Testing of CIAE 3-row animal drawn seed cum fertilizer drill

In 2007-08, CIAE 3-row animal drawn seed cum fertilizer drill was tested for sowing of green gram (var. Meha) and black gram (var. Samrat). The field performance of the drill is presented in Table 30. The field capacity (0.12-0.19 ha/h) and field efficiency (66.9%) of the machine were found satisfactory for the adoption, but the observed seed rates were far more than the recommended. Although the seed metering lever was kept at the lowest seed rate position with non crush

Table 30. Performance of CIAE 3-row animal drawn seed cum fertilizer drill

Parameter	Recommended value	Observed value
Field capacity (ha/hr)	0.10-0.28	0.12-0.19
Field efficiency (%)	65-70	66.9
Seed rate (kg/ha)		
Green gram	20-25	32.73
Black gram	15-20	35.76

of seed but the inherent fabrication problem resulted in higher seed rate. This can be overcome by rectification in seed metering mechanism. The sowing operation was easier to the operator as well as animal compared to the traditional system.

Testing of hoe

The CIAE single wheel hoe was tested in the field for okra and bottlegourd during dry season. The field capacity and weeding efficiency of the hoe was found 0.007 ha/hr and 86%. The labour requirement was less than half (125 hr/ha) compared to traditional weeding with hand hoe (260 hr/ha). Further, the operator felt easiness in handling the tool as it provide more comfort with high work output.

STUDIES ON EFFECTIVE STORAGE OF WATER IN PONDS

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

Water balance study during 2007-08 was carried out in all the treatments i.e. (i) lining with IITD material (ii) lining with IITD material with cement concrete tiles (iii) lining with 250 LDPE film with cement concrete tiles (iv) lining with 200 gsm Silpaulin (v) lining with 200 gsm Silpaulin with cement concrete tiles and (vi) unlined dug out pond as control. The water level, rainfall and open pan evaporation was recorded on daily basis to estimate the seepage losses (Table 31). The negative loss indicates that the water added to the pond is more than the loss during the period of observation. Moreover the rainwater added over the overflow level of the pond is lost. Hence the amount could be deducted from the overflow level. The water balance analysis indicated more available water in Silpaulin lined pond followed by IITD material and thus less losses. These observations were recorded for short period and thus required to be continued.

Plate 27. Lined ponds

Table 31. Water balance analysis of the lining treatments

Treatment	Rainfall(1) (cm)	Evaporation (cm)(2)	Loss (cm)(3)	Water balance (cm)(1-2-3)
From 1.11.07 to 22.6.08				
IITD material	196.95	47.3	2.2	147.45
Silpaulin	196.95	47.3	-9.7	159.35
Control	196.95	47.3	27.7	121.95
From 13.3.08 to 22.6.08				
IITD material with tiles	136.79	19.8	-15.5	132.51
From 3.6.08 to 22.6.08				
LDPE with tiles	22.65	3.8	-2	20.85
Silpaulin with tiles	22.65	3.8	-13.5	32.35

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 order to assess the impact of the farm mechanization inputs on the profitability, productivity, drudgery reduction and time saving, a survey was conducted during 2006-08 in South Andaman villages. Out of 90 farmers surveyed, who were provided farm implements under rehabilitation program, 60% of the farmers were more than 50 years in age, 67% literate and 57% belong to small and marginal category. 25% farmers had 1-2 ha hilly land whereas 66% farmers had submerged land up to 1.0 ha.

The analysis revealed that 24 farmers were benefited with power tillers. Of that, 13 farmers were familiar with the driving of the power tiller. 43% farmers were satisfied by the training given by dealer. However, farmers desired that 10-15 days practical training would have enhanced their operational skill. 88% farmers were satisfied with the quality of the power tiller. Only 11% farmers have skill for minor repair. 83% farmers do not have easy availability of spare parts for repair and maintenance. 78% farmers were paid for frequent repair during peak paddy season. Most of the farmers were unfamiliar with versatile use of power tiller. However, they wanted trolley to maximize the use of power tiller. The annual use of power tiller was 200-250 hrs in the South Andaman which is far less than the recommended annual use of 800 hrs.

The study revealed that 32 farmers used diesel engine pump set for irrigation that has increased productivity of arecanut. 19 farmers were using the pump set for other purposes like rice huller and aquaculture.

The average availability of spade, pickaxe, dao, sabbal (crowbar), plough, handhoe, sickle, hatchet, sprayer and pumpset was 1.44, 1.04, 1.47, 0.47, 0.44, 0.93, 2.58, 0.88, 0.24 and 0.16, respectively prior to tsunami. This had increased to 1.72, 1.77, 1.86, 1.8, 0.89, 0.89, 0.86 0.74 and 0.92 spade, pickaxe, dao, sabbal (crowbar), handhoe, sickles, forkspade, power tiller and pumpset, respectively during post-tsunami period as these implements were distributed by the A&N Administration.

Impact of Mechanization

i. Cropping intensity and time saving

The analysis of the farmers who received power tiller found it very useful as they were able to cultivate hilly land and perform timely tillage operations. Due to timely tillage operations after harvesting of paddy, farmers were able to utilize residual soil moisture to grow pulses and vegetables. This increased cropping intensity from 130% (pre-tsunami) to 155% (post tsunami) (Table 32). Further, the analysis indicated that 9-11 hrs/ha was required for one pass of puddling by power tiller with cage wheel as against 40-45 hr/ha in traditional method by animal with wooden

plough. Further, 3 passes of rotary tiller in place of 4 passes in traditional method were required for proper puddling. 69% farmers reported saving of 125 hrs/ha time in puddling by power tiller indicating its utility in the Bay islands. Thus, use of power tiller resulted in saving of 80-87 % time required in traditional ploughing by animals. Moreover, farmers reported higher yield of paddy and pulses.

Table 32. Cropping intensity and time saving by use of power tiller

Crops	Animal power (pre-tsunami)		Power tiller (post-tsunami)		Time saving (%)
	Area (ha)	Time Taken(hrs)	Area (ha)	Time Taken (hrs)	
Paddy	2.0	312 (4 ploughing)	2.0	60.0	80.8
Vegetable (post paddy)	0.3	52.5 (3 ploughing)	0.5	11.3	87.1
Pulses (post paddy)	0.3	52.5 (3 ploughing)	0.6	13.5	87.1
Cropping intensity (%)	130		155		

ii. Gross Farm Income & Net Return

Survey revealed that farms with power tiller compared to farms with animal power generated more income per hectare. As farmers have increased their gross cultivated area from 2.6 to 3.1 ha due to cultivation of pulses and vegetables (Table 32) due to availability of power tiller, their gross income raised considerably. Some farmers have raised their income through renting of power tiller for tillage and treading operations. The renting has resulted in additional earning in the range of Rs. 1500-6750 to the farmers. Farmers of South Andaman belonging to Stewartganj and Colinpur have earned an amount of Rs. 15000-20000 in three months by giving the power tiller on lease.

iii. Availability of mechanical power

In order to meet out the shortage of labour and rapid recovery of agriculture from the damages of tsunami, the mechanical inputs were integrated in the farming of A&N Islands. The survey revealed that the availability of mechanical power was 0.18 kW/ha in 2004 which increased to 0.55 kW/ha in 2006 indicating an increase by 205.6% over pre-tsunami period.

iv. Employment of Youth

Survey revealed that youths showed more interest towards power tiller than bullock power. This was mainly due to reduction in drudgery and increased comfort because of

seating arrangement for operator. Thus mechanization may help in attracting youths to employ in farming.

Constraints perceived by the farmers on use of farm mechanization inputs

In order to promote farm mechanization, costly inputs like power tiller and pump set were integrated to the agricultural farms. However, some farmers reported relatively less use of power tillers and pump sets. Further, a machine is economical when operated for optimum hours annually. In contrast, farmers used 100-150 hrs/annum of power tiller against the optimum use of 800 hrs/annum as it was preferred only for arduous farm operations like puddling and preparatory tillage due to hilly and fragmented land. In case of pump set, the annual use was less than 100 hrs, which is much below the optimum. Inadequate skill to operate power tiller (8% farmers), skill to minor repair (26% farmers) and non-availability of spare parts (18% farmers) were the main constraints reported by the farmers. Non-matching implements, pump set without pond/well, non-availability of plant protection equipments and lack of proper training were the other constraints in farm mechanization.

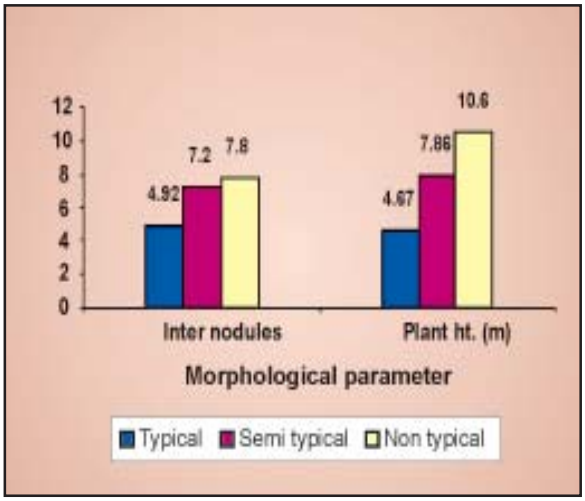
Division of Horticulture & Forestry

IMPROVEMENT OF COCONUT AND ARECANUT

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

Evaluation and Variability analysis of coconut

CARI- C-1 is a variant of Niu-lekha collections from Fiji Islands. It is a dwarf palm with large size nuts, produces an average yield of about 55 nuts/tree/year, high copra content (245 g/nut) and copra out turn of 12.49kg/palm. The important characteristics of this selection is that it is dwarf to semi-tall and has shown high productivity under rain fed conditions. Two types of variability were identified in the CARI-C-1, one is typical semi tall with an average yield of 73 nuts/tree and the other one is tall with an average yield of 43 nuts/tree. Significant variability also existed in the important morphological characters like plant height, number of scars and length of longest leaflet (Fig 1).



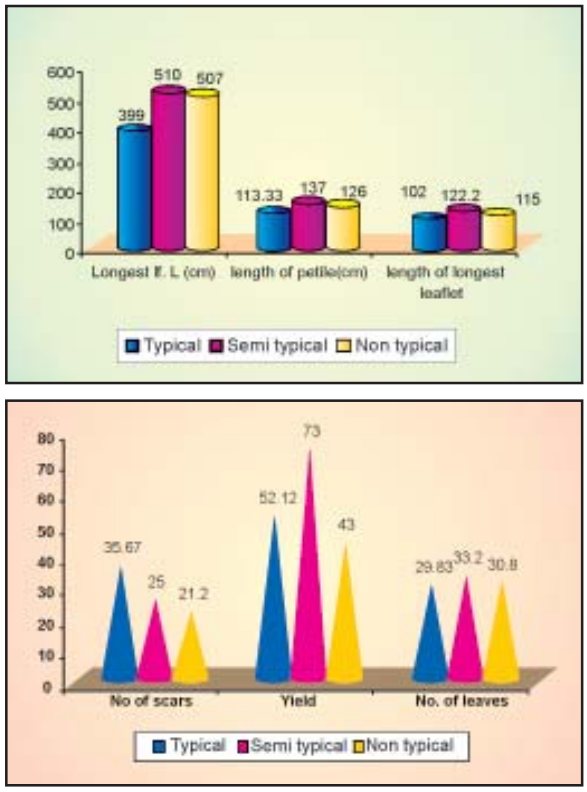


Fig. 1 Variability of CARI-C-1, for morphological characters

Estimates of variability in 15 accessions of CARI-C-1

The variability data of 15 genotypes of coconut indicated that there was close relationship between GCV and PCV for the character of plant height, number of leaves, leaf length and yield revealing very little influence of environment for their expression (Table 1). Moreover, the estimate of heritability for the character yield, leaflet length, number of leaflets, leaf length and number of bunches was more than 80 percent, which indicated that there is good scope of selection in this crop on the basis of traits mentioned.

Plate 1

Table 1. Estimates of variability in 15 accessions of CARI-C-1

	GCV	PCV	ECV	HERT	GA %
Girth	6.02	9.03	3.01	47.49	8.84
No of scars	23.96	27.49	3.47	75.98	43.02
internodal distance	20.71	29.97	9.66	47.75	29.48
No of leaves	9.87	11.92	2.68	68.53	16.83
Plant ht.	34.84	39.71	5.07	76.94	62.95
No of bunches	23.36	25.33	2.78	85.10	44.40
Leaf length	16.21	20.96	4.99	91.33	31.91
Length of petiole	13.78	17.23	4.34	63.94	22.70
No of leaflets	7.08	10.09	3.00	84.79	13.44
leaflet length	12.24	14.52	2.64	95.55	24.64
leaflet breadth	9.87	15.75	12.27	39.26	12.74
Yield	37.03	38.54	10.70	92.29	73.28

GCV= Genotypic co- efficient of variation, PCV= Phenotypic co-efficient of variation, ECV= environmental co- efficient of variation, HERT= Heritability, GA= Genetic advance

Molecular characterization of the variability in CARI-C-1

The main aim of the study was to use the ISSR markers to identify the genetic diversity present within the accessions of CARI-C1 and its relationship with the existing Andaman Tall and Dwarf coconut genotypes. A total of 65 primers were tested for amplification in the initial screening, 20 ISSR primers were found to amplify scorable and reproducible banding profiles (Fig. 2). The PCR by 20 ISSR primers yielded a total of 80 scorable bands. Among the 80 bands obtained 38 bands were polymorphic. The maximum number of polymorphic

bands was present in the primer (GA) 8 of UBC12. The PCR products ranged in size from 1000 bp to 5000 bp. Interestingly, the bands (alleles) 2000 bp were observed uniformly in all the accessions of typical CARI-C1 while 5000bp was observed in semi typical in the primer UBC-12. UPGMA analysis resulted in the phenotype dendrogram that separated the accessions in three groups viz. typical, semi typical and non typical. Each group is related among themselves more closely than with the other group (Fig 3).

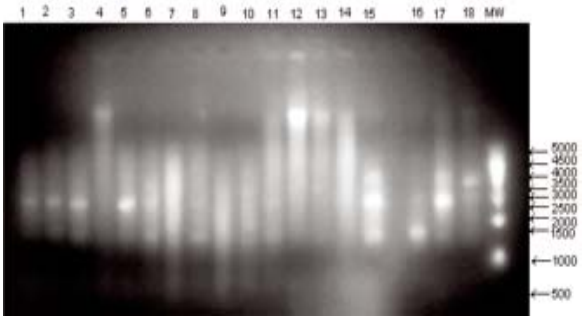


Fig 2. PCR amplified patterns of UBC- 12, Lanes 1&4 – Non typical; 5-8 – Typical; 11-14 Semi typical; 15- Hari Papua; 16- Green dwarf; 17- Orange dwarf, 18- Andaman Tall

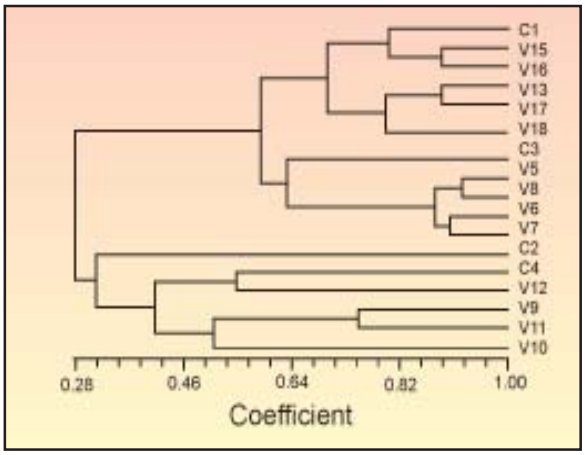


Fig 3. UPGMA Dendrogram showing genetic relationships with in variable types of CARI-C-1 selections

Evaluation of variability in New Oma, Hari Papua and Nikkorae collections

The variability was identified in the New Oma genotype, they are CARI-C-7 and its tall variant. The nuts range from oval to round shape and its height varies from 5.5 to 8.4 m. The average yield of the CARI-C-7 is 136 nuts/tree. The nuts are being promoted for ornamental purpose and tender coconut. Similarly, variability was assessed in the genotypes of Hari Papua and Nikkorae, which resulted in the varietal out put of the varieties CARI-C-6, CARI-C-4 and CARI-C-5 respectively. The average yield of the varieties is 114, 70 and 53 nuts/tree, respectively (Fig. 4 and 5, Table 2). Due to the typical shape and colour of these accessions they are considered as a potential for ornamental and tender nut purpose. In all the dwarf selections of Hari Papua, New oman and Nikkorae, there was variability in plant height and nut characters which could be used as an important morphological marker in selection procedure.

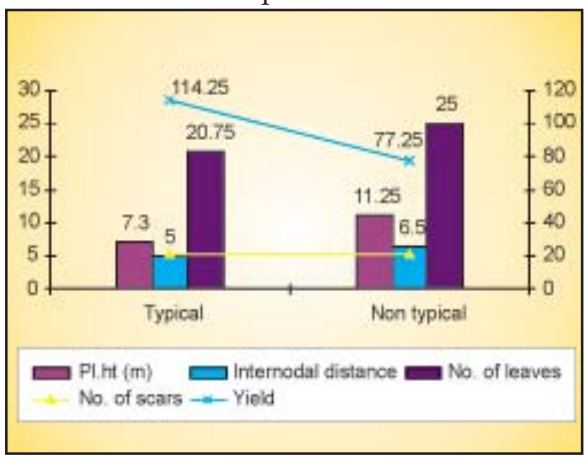


Fig 4. Performance of Hari Papua selections

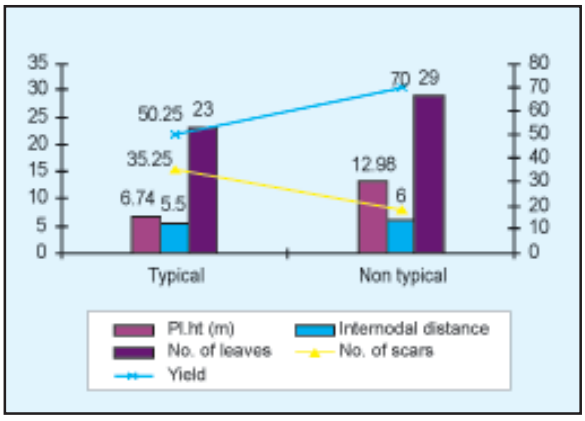


Fig 5. Average performance of the accessions on Nikkore selections

Plate 3. Hari Papua Selections

Plate 2. New Oma Selections

Plate 4. Nikkorae Selections

Table 2. Performance of selections of New Oma selections and its variants

Acc. No	Pl.ht (m)	Pl. girth (cm)	No. of scars	Inter-nodal distance	No. of leaves	No. of bunches	No. of nuts	Leaf length (m)	Length of petiole (cm)	No of leaflets	Length of leaflet (cm)	Width of leaflet (cm)
New Oma typical												
8/45	5.50	67	34	5	20	11	106	416	100	90	115	4
8/7	5.85	68	31	5	22	13	170	370	80	83	115	5
8/8	5.34	66	32	4	23	15	132	390	90	85	110	5
Non typical												
88/44	8.68	80	20	7	35	15	85	470	110	95	110	5
8/17	8.20	90	18	7	24	2	37	480	110	108	120	5
8/16	8.33	86	29	7	30	11	56	480	120	98	130	5
CD at 5%	2.37	3.09	0.87	1.50	2.74	2.45	13.09	32.30	14.51	3.56	9.23	0.82
SEd	1.17	1.50	0.40	0.63	1.34	1.20	6.01	14.82	6.66	1.63	4.24	0.37

COLLECTION, CONSERVATION AND MOLECULAR CHARACTERIZATION OF EARLY FLOWERING OPEN POLLINATED AND WILD MANGO CLONES OF BAY ISLANDS

T. Damodaran, R. Sudha, D.R. Singh, Satyapal Yadav and V. Jayakumar

Molecular Characterization of the Mangifera Sp. of Bay Islands Using RAPD and SSR Markers

These islands are distinguished for the native wild mangoes, which are potentially valuable in breeding programmes. Out of reported seven species, M. andamanica, M. camptosperma, M. griffithi, M. nicobarica and M. indica have been found to exist in Andaman and Nicobar islands. The species M. andamanica has been reported in 6 locations; however there happened to be another variant of this which was identified as Bouea oppositifolia (Rox), a related genera of mango. The tree of Bouea oppositifolia is evergreen and can grow up to 27m tall, with light brown,

Plate 5. Mangifera andamanica

Plate 6. Bouea oppositifolia

fissured bark. Branches are often smooth, hanging and angular or flattened. Under the Andaman conditions the tree flowers during October - November and bears fruits from February - March. Since the new genus resembled with M. andamanica morphologically excepting for the variability in leaf arrangement and cotyledon colour between them, characterization of the variation at genomic DNA level is essential to establish its individual species status. The accessions were collected from Chouldhari (M1), Chidiyatapu (M2), Shoal Bay (M3), Naya shar (B1), Chidiyatapu 1 (B2), Chidiyatapu 2 (B3) which represent the stretch of South Andaman. Out of the six accessions collected, three were found morphologically similar under the classification using IPGRI mango descriptors. However the other three [Naya shar (B1), Chidiyatapu 1 (B2), Chidiyatapu 2 (B3)] showed variations in their leaf arrangement

and cotyledon colour. These were later identified as Bouea oppositifolia (Rox.) a highly endangered related genera of Mangifera. This is the first report on the presence of this species in the Indian sub continent. The PCR products generated from SSR analysis were used to determine the genetic distances between the six accessions of the M. andamanica and its related genera Bouea oppositifolia. A total of 45 primers were tested for amplification in the initial screening and 15 SSR primers were found to amplify scorable and reproducible banding profiles (Figure 6). The other primers were discarded as they did not produce bands or there was a smear in the PCR products. The PCR by 15 SSR primers yielded a total of 61 scorable bands. Among the 61 bands obtained, 29 bands were polymorphic. The maximum number of polymorphic bands was present in the primer (AG) 8T of UBC 7, (GA) 8YT of UBC 40 and (GGGTG)3 of UBC 881(Table 2). The PCR products ranged in size from 400 bp to 1358 bp. The GC content of the primers also varied from 33.33 to 78.57. A higher level of polymorphism was earlier explained using the SSR primers (GAA)6 of UBC-86818 and (GGAT)418. Interestingly, the bands (alleles) 1317, 1050 and 834 bp was observed uniformly in all the three Bouea oppositifolia accessions only with the primer (GGGTG)3 of UBC-881. This delegate an identity that can be used in the development of molecular ID for the Bouea oppositifolia Rox. The dendrogram (Figure 7) based on SI separated the accessions collected from 6 locations in to two major groups X and Y, having 48 % similarity. Among the two major clusters, the accessions belonging to the cluster X were collected from Chouldhari (M1), Chidiyatapu (M2), Shoal Bay (M3) while the accessions belonging to the Y cluster were collected from Naya shar (B1), Chidiyatapu 1 (B2), Chidiyatapu 2 (B3) respectively. Here all the accessions of the M. andamanica are grouped in the cluster X, while that of Bouea oppositifolia are grouped in cluster, and while that of Bouea oppositifolia was grouped in cluster Y.

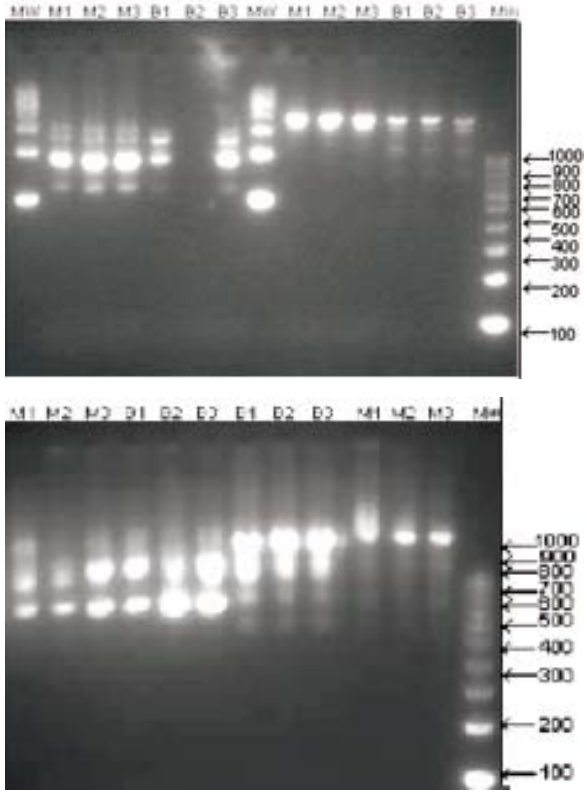


Fig 6. PCR amplified patterns of UBC- 36, 881 and 835, 40. Lanes 1&8(500 bp DNA ladder), 16 & 29 (100bp DNA ladder), M1- M. andamanica (Chouldari), M2- M. andamanica (Chidiyatapu), M3- M. andamanica (Shoal bay), B1- B.oppositifolia (Naya shar), B2- B.oppositifolia (Chidiyatapu 1), B3- B.oppositifolia (Chidiyatapu 2).

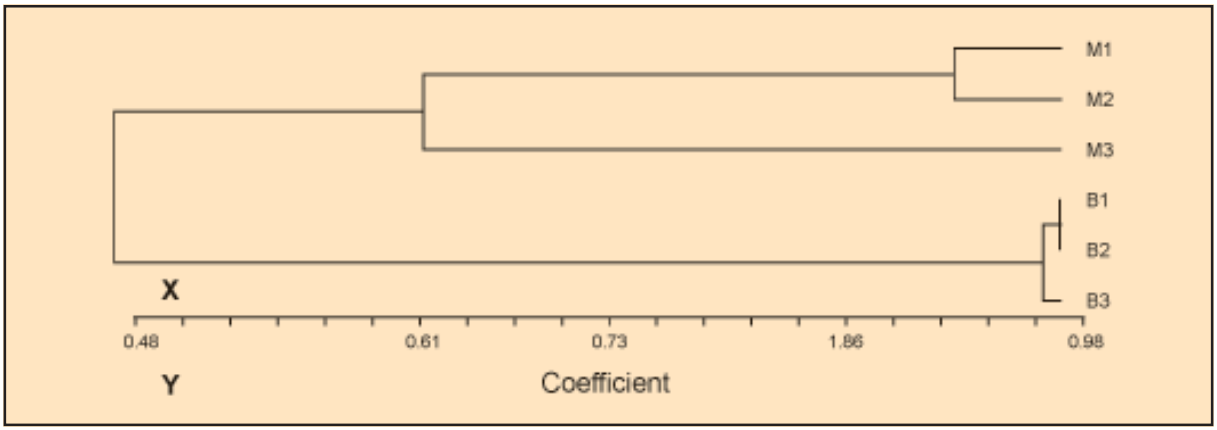


Fig 7. UPGMA Dendrogram showing genetic relationships with in the accessions of *Mangifera andamanica* L.and *Bouea oppositifolia* Rox..

STUDIES ON EFFECT OF PLANT GROWTH PROMOTING BIO CONTROL AGENTS ON GROWTH AND YIELD OF PAPAYA (VAR. LOCAL)

R. Sudha, T. Damodaran, D.R. Singh and Krishna Kumar

An experiment was conducted to study the effect of plant growth promoting microorganisms and utilize the positive effects of microorganisms on growth and yield of papaya. Seedlings were treated with Pseudomonas, Trichoderma and fytolon solutions and planted at a distance of 2x2m. The seedling treatment followed by spraying of Pseudomonas, Trichoderma and Dithane M45 and their combinations were carried out at 30 day interval. Recommended fertilizer schedule and cultural practices were followed for all the treatmental plots. The study revealed that seedling treatment with Pseudomonas + spraying of Pseudomonas@0.2% and soil ap-

Plate 7. Combined application of *Pseudomonas* and *Trichoderma* on papaya

plication of Trichoderma @ 2.5kg / ha at 30 days interval (T3) was found to be significantly influenced the growth parameters viz., leaf area (3179.50 cm2), leaf area per plant (58178.75 cm2), no. of leaves (18.50), leaf area index (3.92), length of petiole at first flowering (73.50 cm), chlorophyll content (4.43mg/g of tissue) and soluble protein content (230.36 mg/100gm) (Table 3) followed by seedling treatment with Pseudomonas + spraying of Pseudomonas @ 0.2% at 30 day interval (T1) and seedling treatment with Trichoderma + soil application of Trichoderma @ 2.5 kg/ha at 30 days interval (T2). Maximum microbial load and no incidence of root rot disease were recorded in combined application of Pseudomonas and Trichoderma at 30 day interval. In control plot, 25% root rot disease incidence was observed. Early flowering (103 days) and minimum days to harvest (307.67 days) were observed in Trichoderma and Pseudomonas treated plants, respectively.

The 6th petiole from the apex was selected for leaf N, P and K analysis. Maximum N (2.16 %) and P (0.32%) contents were observed in combined application of Pseudomonas and

Table 3. Effect of bio control agents on growth parameters of papaya var. Local

Treatments	Plant height (cm)	Plant girth (cm)	No.of leaves	Leaf area (cm2)	Leaf area Index	Soluble protein content (mg/100gm)	Root rot in cidence (%)
T1- Seedling treatment with *Pseudomonas* + spraying @0.2% at 30 days interval	195.65	27.25	18.25	2683.62	3.44	191.70	6.25
T2-Seedling treatment with *Trichoderma* + soil application @2.5 kg/ha at 30 days interval	175.00	30.12	18.15	2917.31	3.83	220.70	18.75
T3-seedling treatment with *Pseudomonas*+ spraying @0.2% *Pseudomonas* and soil application of *Trichoderma* @2.5kg/ha at 30 days interval	169.65	26.75	18.50	3179.50	3.92	230.36	0.00
T4-Seedling treatment with Fytolon + spraying of diathane M45 at 30 days interval	88.75	19.12	18.13	2172.62	3.52	211.33	12.50
T5-seedling treatment with *Pseudomonas* + spraying @0.2% *Pseudomonas*, soil application of *Trichoderma* @2.5kg/ha and spraying of diathane M45 at 30 days interval	158.25	25.62	14.25	2571.40	3.16	185.25	0.00
T6-Control	158.75	25.62	14.00	1748.12	3.32	209.62	25.00

Trichoderma treatment, and maximum K (3.73%) content was observed in Pseudomonas treated plants. The mechanisms of plant growth promotion by non-pathogenic, plant-associated bacteria and fungi have not been completely clarified, but the important mechanisms are direct phytohormonal action, enhancement of plant nutrient availability, plant disease suppression and enhancement of other beneficial microorganisms.

IMPROVEMENT AND AGROTECHNIQUES OF VEGETABLE CROPS

D.R. Singh and V.B. Pandey

VARIETAL EVALUATION

Cowpea

Out of six varieties of cowpea varieties tested, the variety VRCP-5 recorded the highest yield of 54.2 q/ha followed by VRCP-6 (36.8q/ha) (Table 4).

Plate 8.

French Bean

Out of thirteen varieties of French bean tested, the variety Arka Anoop was found to be superior to all other entries with the yield of 102.73 q/ha , maximum number of pods per plant (30.1 no) and highest weight of ten pods (104.4 gm) followed by Swarna Lata (91.22q/ha) (Table 5).

Plate 9. French bean varieties

Plate 10. French bean varieties

Dolichos Lablab

Out of eighteen varieties tested, the variety Ankur goldy was early in flowering with 41.5 days for 50% flowering. However, the variety Gomachi green recorded the highest yield of 64.6q/ha followed by VRDB-1 (56.6q/ha) (Table 6).

Table 4. Performance of cowpea varieties.

Varieties	Plant growth habit	Plant height	Days to 50% flowering	Colour of pods	Pod length	Pod diameter	Pod weight	No of Seeds /pod	No of Pod /plant	Pod yield/ha
	cm	cm	cm	cm		cm	gm			Qt
Arka Garima	Pole	191.66	40	Light Green	20.4	0.78	10	11.4	5.5	24.3
Shewetha	Pole	225.00	37	Light Green	30.4	0.60	12.08	16.4	6.6	30.55
VRCP-5	Bush	53.33	38	Green	28.0	0.68	15.63	15.4	7.7	54.20
VRCP-6	Bush	68.33	39	Green	30.0	0.62	10.33	9.2	5.0	36.8
Swarna Harit	Pole	198.33	38	Dark Green	28.4	0.62	12.00	13.0	6.0	13.33
Ankur Gomati	Pole	226.66	41	Light Green	17.0	0.44	5.50	18.2	4.0	10.41
CD (0.05)		NS	2.17		2.85	0.08	1.12	1.38	0.69	2.19
CV (%)			3.70		7.46	9.13	6.82	6.56	7.87	5.13

Table 5. Performance of French bean varieties.

Entries	Plant growth habit	Plant height	Plant spread	Days to 50% flowering	No. of pods /plant	Weight of 10 pods	Length of pod	Diameter of pods	Pod yield/ha
		cm	cm			gm	cm	cm	Qt
VLFB-2003	Bush	50	40.8	31.0	21	79.5	13.6	1.02	69.46
VLFB-130	Bush	45	43.8	30	16.1	54.9	14.2	1.04	49.73
Arka Anoop	Bush	52.5	51.2	30.5	30.1	104.4	15.2	1.05	102.73
Contender	Bush	48.4	44.2	30.3	17.7	32.6	14.1	0.93	56.53
DWD-FB-1	Bush	49.4	52.1	29.8	18.3	99.4	16.0	1.11	72.53
DWD-FB-57	Bush	34.2	39.8	30	12.5	89.6	14	1.03	21.12
DWD-FB-53	Bush	22.6	26.6	31	7.4	59.9	11.3	0.92	20.96
Kentuky Wonder	Pole	236.2	21.9	41.5	14.3	58.4	12.1	1.04	37.43
HAPB-3	Pole	251.8	29.9	42.5	15.6	54.9	9.4	0.85	53.13
HAFB-3	Bush	48.7	22.9	30.3	12.7	40.9	13.1	1.12	33.91
Swarna LAta	Pole	255.5	43.8	43.3	26.7	62.9	11.0	0.96	91.22
HAPB-4	Pole	254.9	36.0	40.8	20.7	64	11.6	1.00	62.62
HAFB-4	Bush	51.1	45.0	32.8	8.6	45.3	10.1	1.01	25.54
CD (0.05)		15.44	7.39	12.67	2.92	9.55	1.68	0.20	7.68
CV (%)		9.99	13.38	27.68	11.93	10.13	9.19	13.77	9.99

Table 6. Performance of Dolichos Lablab varieties.

S. No.	Entries	Plant growth habit	Pod colour	Pod shape	Parchment layer	Plant height	Days to 50% flowering	Pod length	No. of seeds /pod	Pod yield /ha
						cm		cm		Qt/ha
1	IS-2	Pole	Green	Flat	Absent	201.9	114.7	10.95	4	14.5
2	IS-1	Pole	Light Green	Flat	Absent	268.4	92.8	12.65	4.5	9.6
3	IIVR Sem-186	Pole	Dark Green	Curved	Absent	190.1	71.7	12.55	6.5	43.6
4	TRC Dolichus3	Pole	Light Green	Flat	Absent	229.3	93.7	12.10	4.5	22.9
5	IIVR SEM-8	Pole	Dark Green	Curved	Absent	181.8	93.2	10.33	5	49.0
6	KUB 415	Pole	Dark Green	Curved	Absent	167.9	92.5	9.20	4.8	8.2
7	TRCDolichus 1	Pole	Green	Flat	Absent	176.8	139.5	7.30	4.3	15.5
8	Swran Utkrist	Pole	Green	Curved	Absent	160.6	73.5	7.07	4.3	47.3
9	JDM-79-1	Pole	White	Flat	Absent	154.4	89.0	8.95	3.8	16.7
10	Gomuchi Green	Pole	Green	Curved	Present	144.9	71.3	8.47	5.3	64.6
11	JIB(V)-16	Pole	Green	Flat	Absent	131.7	121.5	7.03	4.3	31.8
12	DCDB-1	Pole	Green	Flat	Absent	116.7	96.8	7.65	4.5	19.5
13	IIVR SEM-11	Pole	Green	Flat	Present	128.6	78.5	11.17	3.8	48.4
14	Ankur goldy	Bush	Light Green	Intermediate	Absent	48.8	41.5	10.93	4.0	26.1
15	VRDB-1	Pole	Dark Green	Curved	Absent	116.9	86.0	9.83	4.5	56.6
16	KDB 413	Pole	Dark Green	Curved	Absent	126.8	74.3	8.20	3.8	36.9
17	HADB 4	Pole	Purple	Flat	Absent	130.9	134.8	6.77	4.0	10.5
18	HADB 3	Pole	Purple	Curved	Absent	106.2	167.0	8.07	3.8	9.8
	CD (0.05)					13.71	5.46	1.28	0.94	5.90
	CV (%)					6.25	4.00	9.63	15.04	14.09

EXPLORATORY TRIAL OF POTATO VARIETY- KUFRI SURYA UNDER NORTH ANDAMAN CONDITION AT DIGLIPUR

D.R. Singh and V. B. Pandey

Four farmers were selected at Diglipur in North Andaman and 5 quintals of potato seed tubers of variety Kufri Surya along with fertilizers and plant protection chemicals were distributed to the selected farmers. The farmers were given training on potato cultivation and farmers had practiced the recommended cultural operations. The vegetative growth parameters of potato (var. Kufri surya) is presented in Table 7.

With regards to yield parameters, the highest yield of 14.58 t ha^{-1} was recorded at Krishnapuri village followed by 14.13 t ha^{-1} at Lakshmipur village. Due to heavy rain in the Sitanagar and Desh Bandhugram harvesting was done at 60 days after sowing itself, hence recorded low yield 2.75 t ha^{-1} and 5.6 t ha^{-1}, respectively (Table 8). Average tuber weight, length and diameter were recorded 208.5 g, 11.1 cm and 6.5 cm, respectively .

Table 7. Growth parameters of potato variety Kufri Surya under North Andaman conditions.

S.No	Name of the village	Plant height (cm)		Plant spread (cm)		No. of branches	
		30 days after sowing	60 days after sowing	sowing after 30 days	sowing after 60 days	sowing after 30 days	sowing after 60 days
1.	Desh Bandhugram	35.2	58.00	38.95	47.85	3.1	3.7
2.	Lakshmipur	32.9	62.80	37.95	58.85	3.0	3.0
3.	Krishnapuri	38.0	57.00	35.15	51.35	3.7	3.9
4.	Sitanagar	24.5	50.80	29.00	54.15	3.3	4.2

Plate 11. Potato seed tuber

Plate 12. Harvested potato (Kufri surya) at Diglipur

Plate 13

Plate 14

Table 8. Yield parameters of potato variety Kufri Surya under North Andaman Conditions

S.No	Name of the village	Area cultivated (m^2)	Total yield (q/ha)
1.	Desh Bandhugram	230	56.4
2.	Lakshmipur	298	141.28
3.	Krishnapuri	192	145.8
4.	Sitanagar	400	27.45

STANDARDIZATION OF AGROTECHNIQUE FOR ORGANIC BLACK PEPPER CULTIVATION IN ANDAMAN AND NICOBAR ISLANDS

C. B. Pandey, Krishna Kumar and B. L. Meena

To standardize the agro-techniques for organic cultivation of black pepper, about 364 black pepper cuttings (2 yr old) (Panniyur 1) were planted on the standards of Gliricidia as an intercrop of coconut at Sipighat farm. Spacing of coconut is 7.5 x 7.5m, and either clove or nutmeg is planted the centre of four coconut trees at 7.5 x 7.5 m spacing. Black pepper is planted and trained on Gliricidia standards between rows of coconut trees. These way two models: coconut- clove- black pepper and coconut- nutmeg- black pepper are (Fig.8, Plate 15&16) in progress.

It was found that a uni-model leaf fall pattern occurred in coconut (Fig. 9). On an average one frond fell every month from May to January. This occurred probably due to availability of soil- moisture/ rainfall and inherent character of the tree. However, the leaf fall was more than one time during dry months i.e. February, March, and April. Nutmeg also followed the uni-model pattern as

Plate 15. Black pepper on *Gliricidia* standards: close

Plate 16. Black pepper on *Gliricidia* standards: general view

found in coconut and shed maximum leaves in the month of February similar to that of evergreen species (Fig.10). Unlike the coconut and nutmeg, clove showed a bi- model pattern in leaf fall and represented semi-evergreen character (Fig.11).

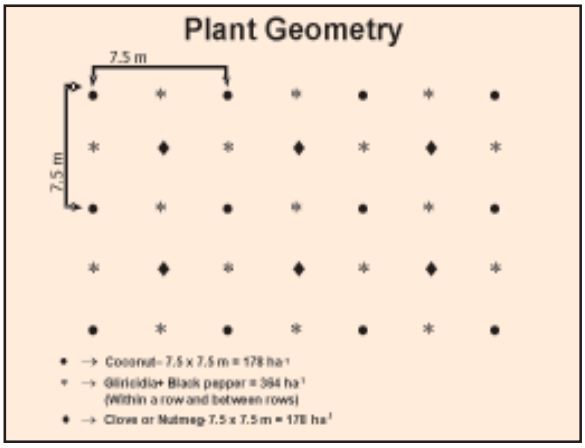


Fig 8. Plant geometry in coconut- clove- black pepper and coconut- nutmeg black pepper models

Fine roots, known as a hidden half, provide substrate to soil N mineralization. Therefore, dynamics of fine roots, both live and dead, was studied for the coconut, nutmeg and

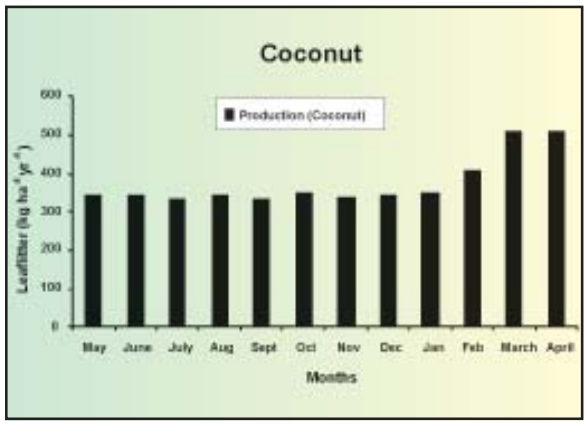


Fig 9. Litter fall pattern in coconut tree

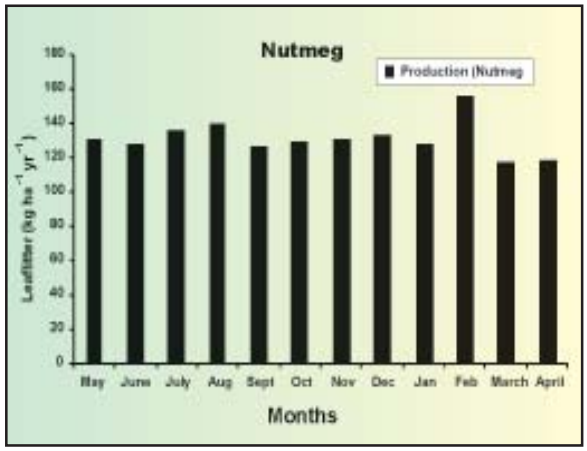


Fig 10. Litter fall pattern in Nutmeg tree

Fig 11. Litter fall pattern in Clove tree

clove. In all the trees, dead fine roots were found the highest during the dry months which declined during wet months (Fig.12 a, b, c). Coconut produced 2.24 t ha^{-1} yr^{-1}, Clove 1.05 t ha^{-1} yr^{-1} and Nutmeg 1.18 t ha^{-1} yr^{-1} fine root biomass which together contained 17.7kg t ha^{-1} yr^{-1} N, 0.45kg t ha^{-1} yr^{-1} P and 14.64kg ha^{-1} yr^{-1} K (Table 9). Root biomass serves as a buffer stock of organic matter and sustains fertility built up by leaf litter.

Table 9. Root production and mineral content in home garden trees

Component	Production (t ha^{-1} yr^{-1})	Nitrogen (kg ha^{-1} yr^{-1})	Phosphorus (kg ha^{-1} yr^{-1})	Potassium (kg ha^{-1} yr^{-1})
Coconut	2.24	8.06(0.36)	0.11(0.005)	6.50(0.29)
Clove	1.05	7.98(0.76)	0.09(0.008)	1.89(0.18)
Nutmeg	1.18	1.65(0.14)	0.25(0.021)	6.25(0.53)
Total	4.47	17.69	0.45	14.64

Data in bracket are concentrations

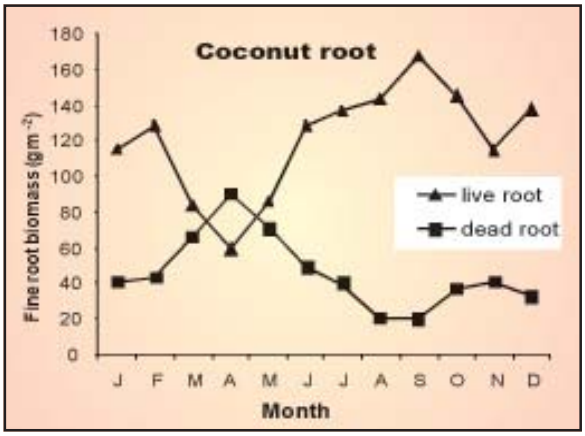


Fig 12(a). Seasonal variation in line and dead roots in coconut tree

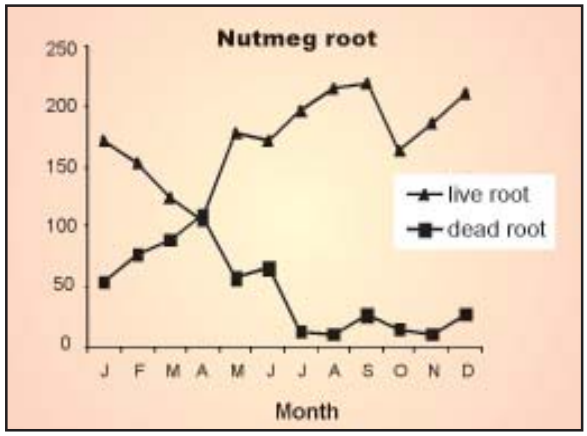


Fig 12(b). Seasonal variation in live and dead roots in Nutmeg tree

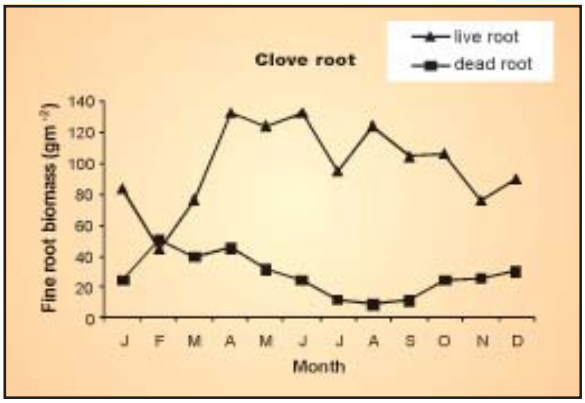


Fig 12(c). Seasonal variation in line and dead roots in Clove tree

It was found that three year old Gliricidia standards produced 8 t ha^{-1} pruning biomass, which produced 3.7 t Gliricidia compost during the report year. Concentrations of N, P and K in the compost were 3.6%, 0.29% and 3.4%.

Table 10 shows litter and pruning biomass production and concentrations of N, P and K in them in coconut- clove -black pepper model. Litter was found to produce 151kg N $ha^{-1}yr^{-1}$, 12kg $ha^{-1}yr^{-1}$ P and 156kg $ha^{-1}yr^{-1}$ potassium. However, the trees in this model requires an additional 39kg $ha^{-1}yr^{-1}$ N, 116kg $ha^{-1}yr^{-1}$P and 209kg $ha^{-1}yr^{-1}$ K which can be made by 94 t $ha^{-1}yr^{-1}$ cow dung (Table 4).

Table 10. Litter production and mineral content in a coconut- Clove-Black pepper plantation (Litter data are oven dry matter)

Component	No. of tree	Litter (t ha^{-1} yr^{-1})	Nitrogen (kg ha^{-1} yr^{-1})	Phosphorus (kg ha^{-1} yr^{-1})	Potassium (kg ha^{-1} yr^{-1})
Coconut (MC)	178	4.52	11.3 (0.25)	0.59 (0.013)	18.98 (0.42)
Clove (IC)	178	2.53	6.83(0.27)	0.28(0.011)	11.64(0.46)
Gliricidia (IC)	364	3.69	133.0(3.6)	10.70(0.29)	125.46(3.4)
Total	711	10.74	151.13	11.57	156.08

Table 11. N, P, and K requirement of above crops in a Coconut- Clove- Black pepper plantation

Component	No. of tree	N (kg ha^{-1} yr^{-1})	P (kg ha^{-1} yr^{-1})	K (kg ha^{-1} yr^{-1})
Coconut (MC)	178	89.0 (0.5)	57.0 (0.32)	213.6 (1.2)
Clove (IC)	178	53.4 (0.30)	46.28 (0.26)	135.28 (0.76)
Black pepper (IC)	364	48.05 (0.132)	24.02 (0.66)	16.38 (0.045)
Total	711	190.45	127.30	365.26
Additional requirement		39.32	115.73	209.18
* Cow dung required (dry) (kg ha^{-1})	40207.7	(293.51) (0.73)	128.67 (0.32)	209.04 (0.52)

MC = main crop, IC = Inter crop,* Fresh cow dung = 93684.64 kg ha^{-1}

Similarly, leaf litter and Gliricidia pruning biomass together was found to produce 151kg $ha^{-1}yr^{-1}$ N, 11kg $ha^{-1}yr^{-1}$ P and 158kg $ha^{-1}yr^{-1}$ K in coconut- nutmeg- black pepper model (Table 12). However, requirement of the trees was: 226 kg $ha^{-1}yr^{-1}$ N, 129kg $ha^{-1}yr^{-1}$ P and 408kg $ha^{-1}yr^{-1}$ K (Table 13). Additional requirement (75kg ha-1 N, 117kg ha-1 P and 251kg ha-1 K) of the trees might be met out by 112 t $ha^{-1}yr^{-1}$ cow dung. But, this value may change during subsequent years. Therefore, real production of Gliricidia pruning biomass in both the models could be obtained only when growth in black pepper vines and berry production are stabilized. Therefore, a long term study is required to suggest package of practice of organic black pepper cultivation under a coconut plantation.

Table 12. Litter production and mineral content in a Coconut - Nutmeg- Black pepper plantation.

Component	No. of tree	Litter (t ha^{-1} yr^{-1})	Nitrogen (kg ha^{-1} yr^{-1})	Phosphorus (kg ha^{-1} yr^{-1})	Potassium (kg ha^{-1} yr^{-1})
Coconut (MC)	178	4.52	11.3(0.25)	0.59(0.013)	18.98(0.42)
Nutmeg (IC)	178	1.69	6.59(0.39)	0.07(0.004)	13.01(0.77)
Gliricidia (IC)	364	3.69	133.0(3.6)	10.70(0.29)	125.46(3.4)
Total	711	9.90	150.89	11.36	157.45

Table 13. N, P and K requirement of above crops in a Coconut– Nutmeg– Black pepper plantation

Component	No. of tree	N (kg ha^{-1} yr^{-1})	P(kg ha^{-1} yr^{-1})	K(kg ha^{-1} yr^{-1})
Coconut (MC)	178	89.0(0.5)	57.0(0.32)	213.6(1.2)
Nutmeg (IC)	178	89.0(0.50)	48.06(0.27)	178.0(1.0)
Black pepper (IC)	364	48.05(0.132)	24.02(0.66)	16.38(1.0)
Total	711	226.05	129.08	407.98
Additional requirement		75.16	117.72	250.53
* Cow dung (dry) needed (kg ha^{-1})	48179.0	351.71(0.73)	154.17(0.32)	250.53(0.52)

SILVIPASTURE SYSTEM: EFFECT OF FERTILIZER AND CUTTING ON NET PRIMARY PRODUCTION (HERBAGE PRODUCTION) IN HUMID TROPICAL CLIMATE OF BAY ISLANDS

C. B. Pandey, S. K. Verma and B. L. Meena

Establishment of coconut based silvipasture system started in late part of 2006. The root slips and rhizomes from the existing grasses are being used for bringing greater area of coconut plantation (>25yr old) under the grasses at Sipighat farm. Three grasses: hybrid napier *(Panicum purpurium), para (Brachiaria mutica) and guinea grasses (Panicum maximum)* were grown under coconut trees. Spacing of the grasses was 50 x 50cm. Coconut trees were planted at 7.5 x 7.5 m distance . Population of the grasses could not be maintained homogeneously during the reporting year in plots because rhizome of the grasses in the plots was used to bring more area of the coconut plantation under the grasses. Therefore, it is not feasible to estimate potential of the grasses under the palm tree.

Plate 17. Establishment of coconut based silvispasture agroforestry model at Sipighat farm

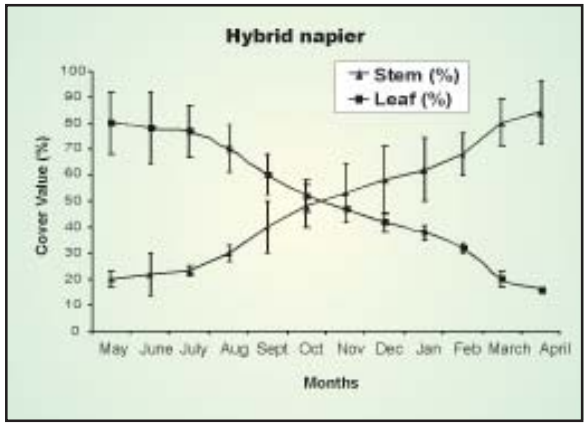


Fig 13(a) Proportion of stem and leaf cover in hybrid napier under coconut

Pattern of seasonal changes in the proportion of stem and leaf of the grasses provides information on quality of the grasses which is pertinent from the herbage use and storage view points. Percent cover of leaves was the high-

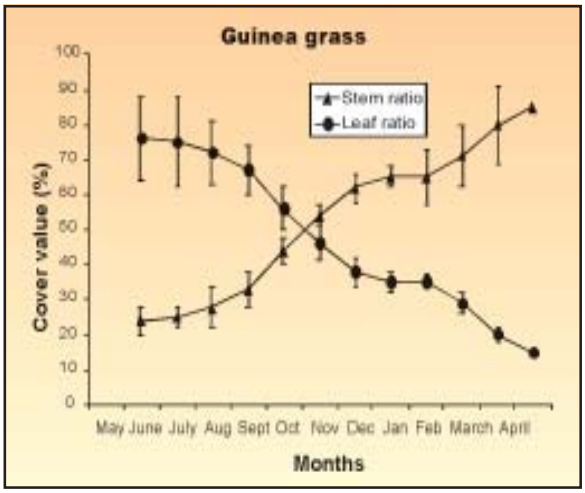


Fig. 13(b). Proportion of stem and leaf cover in para grass under coconut

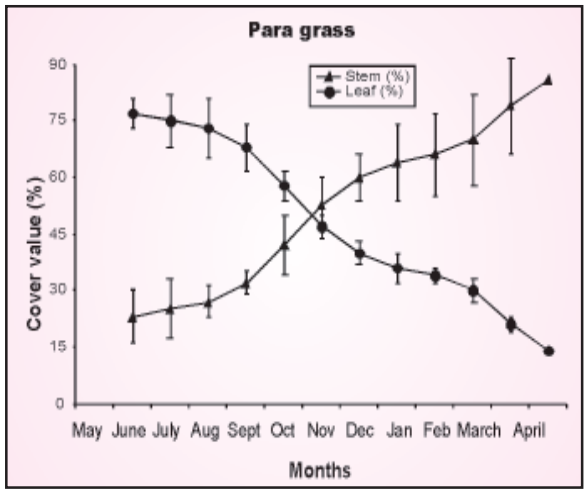


Fig. 13(c). Proportion of stem and leaf cover in guinea grass under coconut

est in the month of May and declined with time. On the contrary, cover of the stem was the lowest in the month of May and increased with time in all the grasses (Fig. 13. a, b, c). Stem/ leaf ratio was the lowest in the month of May and increased with time (Fig. 14. a, b, c). Moreover, the increase was slow and almost linear with time. But, after January, the increase was exponential. This suggests that these grasses are suitable for storage up to January.

These grasses were fertilized with different doses of nitrogen: 20kg ha^{-1}, 40kg ha^{-1} and 60kg ha^{-1} at three locations: under the tree canopy, between the tree canopy and open (without tree) Table 14.

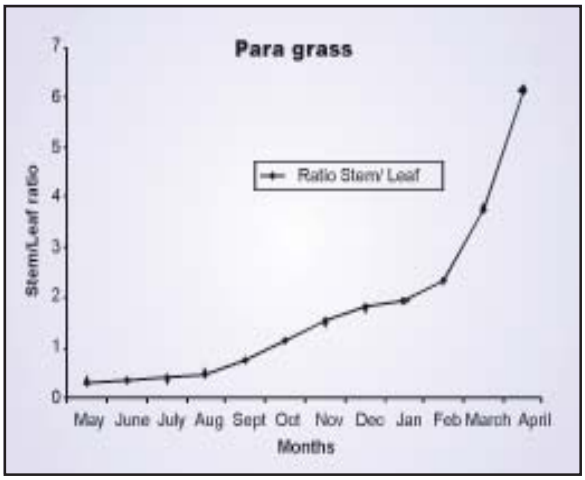


Fig 14(a). Stem/ leaf cover ratio in hybrid napier under coconut trees under coconut

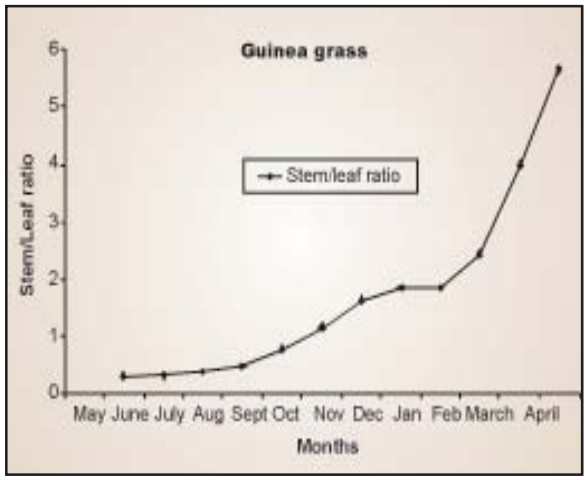


Fig 14(b). Stem/ leaf cover ratio in para grass under coconut trees under coconut

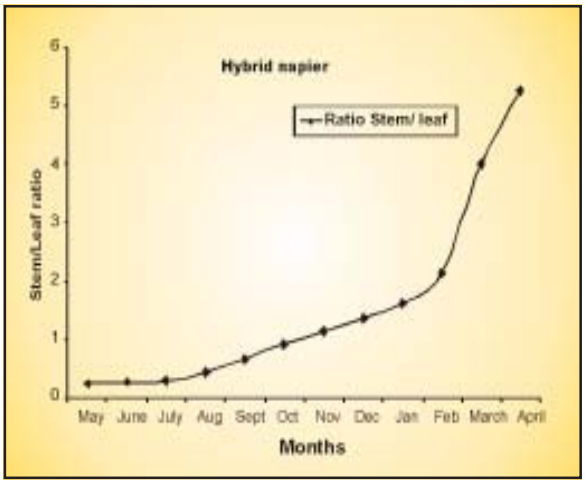


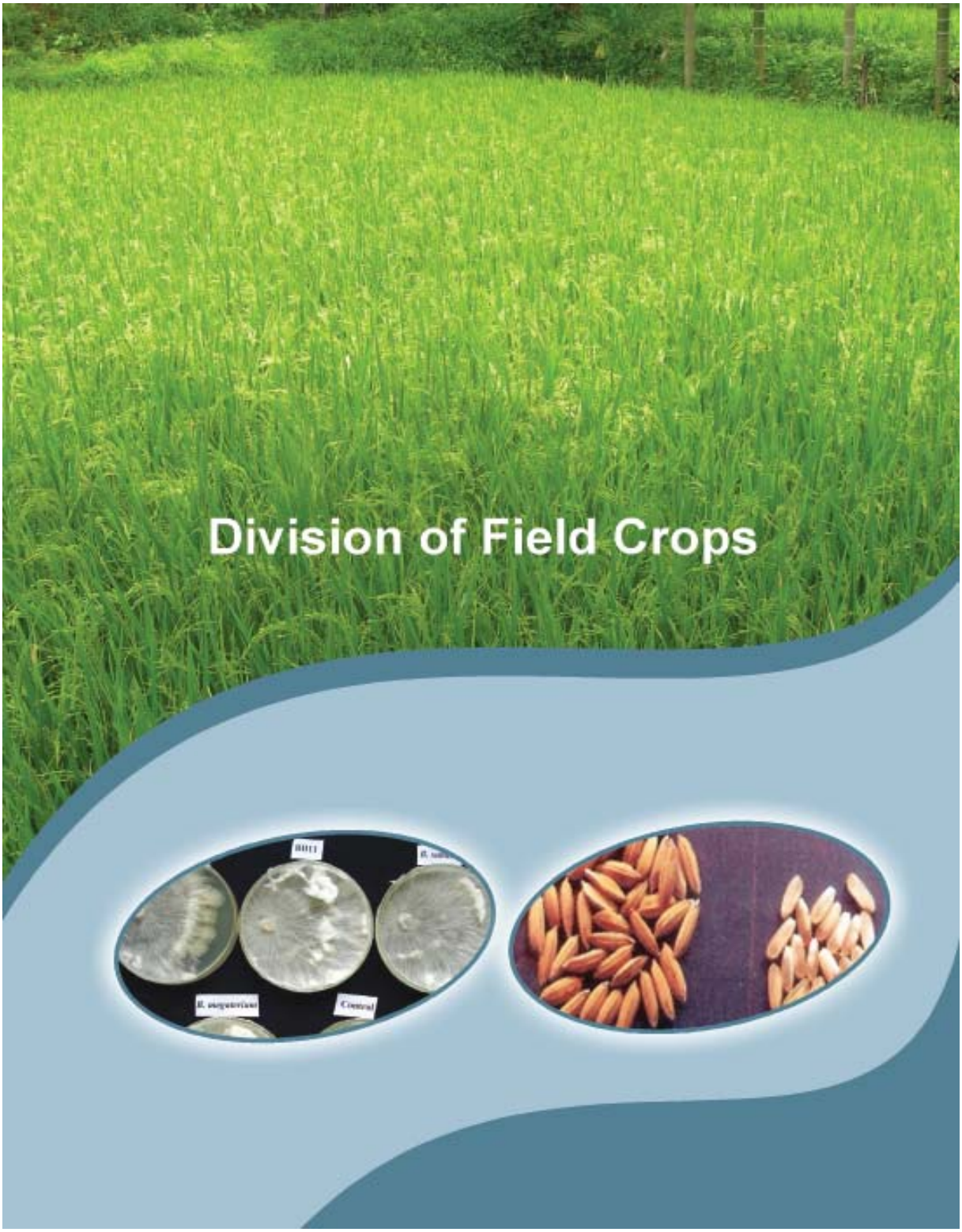
Fig 14(c). Stem/ leaf cover ratio in guinea grass under coconut trees under coconut

Light available under the locations under canopy lux = 18000 360, between canopy lux = 33000 810 and Control conditions lux = 49000 1100. Phosphorus and potassium were applied at 80 kg ha $^{-1}$ and 120kg ha^{-1}, respectively. Since, area under the grasses was limited; therefore the treatments could not be replicated. Therefore, statistical analysis of the data is not performed. These data provided preliminary information for further study.

Herbage production in all the grasses declined at both the canopy positions as compared to open (Table 14). But, these grasses responded to nitrogen application between canopy than at under the canopy position. Moreover, they responded the nitrogen application linearly at between canopy position, and yielded maximum herbage at 60 kg ha^{-1}. However, the herbage yields were lower in all the nitrogen doses under both the canopy positions compared to control. Real response of the grasses under the tree may be realized only after population of the grasses is homogenously established.

Table 14. Herbage production (t ha^{-1}) the coconut trees and between the coconut trees

Grass	Under canopy Nitrogen (kg ha $^{-1}$)			Between canopy Nitrogen (kg ha $^{-1}$)			Control Nitrogen (kg ha $^{-1}$)		
	20	40	60	20	40	60	20	40	60
Hybrid napier	20	24	24	23	28	34	26	48	65
Para grass	18	27	28	22	26	31	28	40	60
Guinea grass	17	26	27	20	25	31	24	39	57


Division of Field Crops

IMPROVING THE PRODUCTIVITY OF RICE AND RICE BASED CROPPING SYSTEM

T.V.R.S. Sharma, Krishna Kumar and N. Ravisankar

Rice is the only cereal crop grown in about 12000 ha before tsunami and 7550 ha after tsunami. Generally this crop is grown as single, double and triple crop sequences. However, wherever traditional varieties cultivated as single crops the yield is 2 t/ha and only in the HYV average yield recorded up to is 3-3.4 t/ha. The best combination will be 2 rice crop followed by a pulse crop of short duration like black gram and green gram. In this combination best results can be obtained with the available moisture with life saving irrigation. To find out suitable varieties for above mentioned combinations, (164 varieties and 23 hybrids) were evaluated in 2007-2008 and IET-1007 with potential of 5t/ha followed by previously selected variety IR31851-6-6-6-3-3-1 (145) with 4t/ha MLT-M5 (PA6444) MLt-M7 (JK RH 2000) IET-18666, IET-18726, IET-18727 with yield range of 3.06 to 3.8 t/ha and Taiching Sen-Yu MLT E-2 (PSD-3) MLT-M6 (Suruchi), Jaya have also performed superiorly to other lines and selected for further trials. In 2007-08, 3 varietal trials were conducted along with suitable checks and promising lines have been identified.

Among the hybrid rice lines, all the hybrids tested were superior to the best check. Promising among them are PA6444, JKRH2000, PSD3 and Suruchi. Among the saline tolerant lines CST-7-1 was found to be promising. The previous year's promising lines were put as check also and 5 new varieties/lines were found to be better then the check.

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

In continuation of previous three years work on survey, isolation and evaluation of native bioagents for their biocontrol ability against major fungal pathogens of vegetable crops, the five fungal antagonists selected by in vitro screening viz., Thr1, Thr5, Tv3, Tv5 and Thm1 were evaluated in field trial to screen against diseases of chilli. The details of field trial are given below.

Field screening of Trichoderma spp

The treatment schedule followed was similar as previous year and compared with chemical treatment and a control. The chilli crop was observed for disease incidence and yield was recorded treatment wise. The result on field efficacy of each treatment is presented in Table 1.

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

Treatment	Disease Incidence						Yield (t/ha)
	Damping off (%)	Root (%)	Wilt (%)	Leaf pot (PDI)	Anthracnose on leaf (PDI)	Anthracnose on fruit (PDI)	
T1	23.3 (28.81)^{a}	1.57 (7.12)^{bc}	13.53 (21.57)^{b}	9.13 (17.58)^{a}	5.33 (13.35)^{a}	19.83 (26.40)^{a}	11.86^{b}
T2	41.6 (40.16)^{e}	2.87 (9.39)^{c}	13.70 (21.72)^{b}	16.33 (23.84)^{d}	8.70 (17.13)^{c}	29.03 (32.59)^{bcd}	7.65^{d}
T3	30.5 (33.52)^{c}	0 (0.57)^{a}	7.63 (16.02)^{a}	11.93 (20.16)^{bc}	6.70 (14.98)^{b}	30.63 (35.63)^{ef}	10.13^{c}
T4	33.7 (35.48)^{d}	0 (0.57)^{a}	18.40 (25.40)^{c}	12.97 (21.10)^{c}	5.70 (13.81)^{ab}	33.70 (37.48)^{f}	6.90^{d}
T5	24.4 (29.55)^{ab}	0 (0.57)^{a}	9.33 (17.78)^{a}	9.33 (17.78)^{a}	6.43 (14.69)^{ab}	26.83 (31.18)^{bc}	13.56^{a}
T6	31.8 (34.30)^{cd}	1.4 (5.74)^{b}	19.03 (25.86)^{cd}	12.17 (20.36)^{bc}	10.13 (18.85)^{d}	32.13 (34.52)^{de}	6.50^{d}
T7	26.0 (30.56)^{b}	2.93 (9.79)^{cd}	12.17 (20.39)^{b}	10.53 (18.94)^{ab}	5.30 (13.31)^{a}	24.97 (29.97)^{b}	10.34^{c}
T8	39.8 (39.11)^{e}	5.3 (13.29)^{d}	21.3 (27.48)^{d}	12.83 (20.97)^{bc}	9.17 (17.62)^{cd}	31.50 (34.14)^{cde}	6.75^{d}
CD (5%)	1.47	3.64	1.97	2.06	1.44	2.95	1.23

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

It was observed that the treatments T1 and T5 (T. harzianum1 and T. hamatum 1) consistently performed well in the earlier trials as well as in the present field trial and reduced incidence of all diseases. The two treatments (T1 and T5) were better than chemical control in controlling the soil borne diseases of solanaceous vegetable crops. The chemical control (T7) using fungicide was effective on fungal diseases but not against bacterial wilt, so its yield was reduced significantly than T1 and T5. It may be concluded that the field treatments with T. harzianum1 and T. hamatum 1 are consistently effective in controlling the soil borne diseases of solanaceous vegetable crops. These two antagonists will be tested in multi-location trials to confirm their efficacy.

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

V. Jayakumar and Krishna Kumar

The in vitro screened isolates viz., PfH1, PfCN1, C26, C27, C28 and C29 (Pseudomonas spp) and BG1, BB2 (Bacillus spp) were screened for functional properties and then tested in field trial for their plant growth promoting as well as antagonistic properties.

Functional properties of PGPRs

The eight antagonists were tested for phosphorous solubilization, siderophore production, IAA production and HCN production.

(i) Phosphate solubilization

The isolates were spot inoculated on a Pikovaskaya's medium (Pikovaskaya 1948) containing tri-calcium phosphate [Ca3 (PO4)2] and incubated at 28°C ± 2°C for 7 days. The development of a clear zone at inoculation site on the culture plates was noticed as an index of phosphate solubilization.

(ii) Siderophore production

Siderophore production of the endophytic isolates was determined using the Chrome azurol S (CAS) method developed by Schwyn and Nielands (1987). The nutrient agar medium was amended with CAS dye and plated. The cultures were spot inoculated on the plates and incubated for 24-48 h at 28°C ± 2°C. Formation of an orange halo zone indicated the Siderophore production.

(iii) Production of IAA

Production of Indole acetic acid (IAA) was investigated using the method developed by Sawar and Kremer (1995). Luria broth amended with tryptophan was used for the test. The isolates were inoculated and incubated for 48 h. After the incubation, cells were removed by centrifugation and the culture filtrate was taken. To this filtrate added 4ml of Salkowski's reagent and the samples were incubated for 30 min. The optical density of the samples was determined spectrophotometrically at 530nm and the readings were plotted against a standard curve of IAA.

(iv) HCN Production

HCN production by the isolates was detected by following the method of Bakker and Schipper (1987). The isolates were streaked on plates containing King's B medium amended with glycine and the lid of each Petri plate contained Whatman No 1 filter paper soaked in picric acid. The plates were then sealed with parafilm and incubated at 28 ±2°C for 4 days. Change of color from yellow to orange and then to dark brown in the filter paper indicated as positive reaction and the absence as negative reaction. The result of functional properties of PGPRs is given in Table 2.

Table 2. Functional properties of PGPR

S. No	Isolate Name	IAA production (µg/ml)	Phosphate solubilization	HCN production	Siderophore production
1	C26	18.5	-	+	-
2	C27	26.2	-	-	-
3	C28	17.0	-	+	-
4	C29	25.0	++	-	-
5	PfH1	5.0	-	-	-
6	PfCN1	50.0	-	-	-
7	BG1	18.5	+	-	+
8	BB2	80.0	++	-	++

+ indicates positive reaction; - indicates negative reaction

The results showed that BB2 possess both antagonistic property and plant growth promoting property. The isolate PfCN1 was potent plant growth promoter and C28 and C26 were capable of producing broad spectrum antibiotic compound HCN.

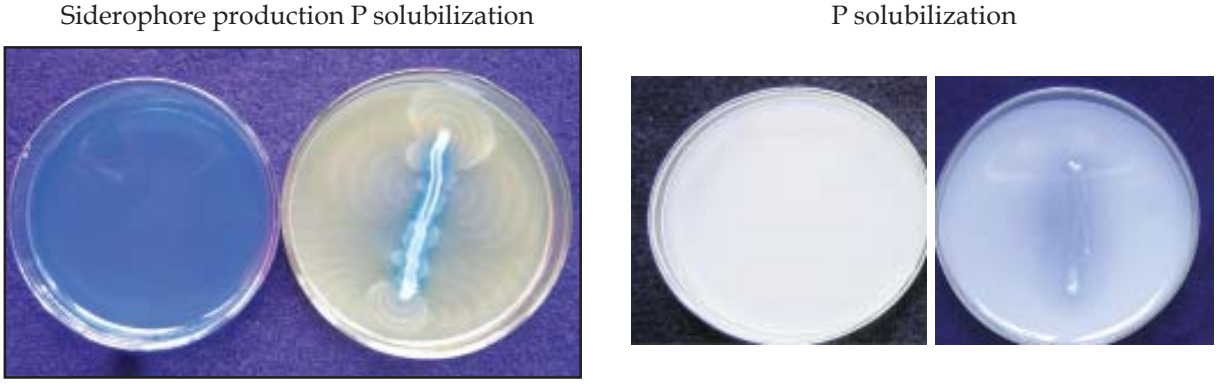


Plate 1. Functional properties of PGPRs

Field evaluation of PGPRs

The 8 promising bacterial antagonists selected by in vitro screening were mass multiplied for field trials and treatment schedule was followed same as previous trial and screened against diseases of chilly and tomato. The results of field trials on chilli and tomato are presented in Table 3 and 4, respectively.

Table 3. Field evaluation of PGPRs against diseases of Chilli

Treatment	Disease Incidence						
	Damping off (%)	Root rot (%)	Leaf spot (PDI)	Anthracnose on leaf (PDI)	Anthracnose on fruit (PDI)	Wilt (%)	Leaf curl (%)
T1	7.3^{c}	2.1	12.27^{a}	9.77^{a}	18.30^{ab}	12.5^{ab}	13.9^{c}
T2	9.8^{e}	4.0	19.40^{abc}	13.73^{bc}	31.17^{c}	30.2^{e}	15.9^{def}
T3	6.3^{b}	1.0	22.10^{bc}	18.40^{d}	25.60^{bc}	15.8^{abc}	16.3^{ef}
T4	13.6^{f}	3.2	21.67^{bc}	13.97^{bc}	31.30^{c}	28.3^{de}	16.7^{f}
T5	9.8^{e}	0.4	23.37^{bc}	16.53^{cd}	32.40^{c}	23.3^{cde}	13.5^{bc}
T6	8.3^{d}	0	18.17^{abc}	15.80^{cd}	31.10^{c}	18.3^{abcd}	13.1^{b}
T7	5.6^{a}	1.1	16.90^{ab}	11.97^{ab}	25.70^{bc}	11.2^{a}	15.3^{d}
T8	8.4^{d}	5.6	22.30^{bc}	15.10^{bcd}	13.50^{a}	21.5^{bcde}	11.1^{a}
T9	13.1^{f}	3.7	26.17^{c}	13.17^{abc}	26.60^{bc}	27.4^{de}	15.4^{d}
T10	5.4^{a}	4.2	17.53^{ab}	12.53^{abc}	33.60^{c}	15.4^{abc}	15.6^{de}
T11	13.9^{f}	5.5	26.50^{c}	9.27^{d}	37.40^{c}	29.4^{bcde}	18.7^{g}
CD (5%)	1.01	14.3	3.21	3.21	7.72	7.07	0.65

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

Table 4. Field evaluation of PGPRs against diseases of Tomato

Treatment	Disease Incidence				Yield
	Damping off (%)	Root rot (%)	Leaf spot (PDI)	Wilt (%)	(t/ha)
T1	12.3 (20.53)^{c}	6.47 (14.36)^{a}	10.97 (19.32)^{a}	28.3 (23.76)^{a}	15.3^{a}
T2	18.4 (25.40)^{f}	15.57 (23.13)^{bcd}	18.60 (25.45)^{bc}	34.2 (31.62)^{bcd}	9.8^{d}
T3	21.0 (27.27)^{h}	10.63 (18.86)^{abc}	17.03 (24.36)^{bc}	35.7 (30.37)^{abcd}	14.6^{ab}
T4	19.1 (25.91)^{g}	11.13 (19.13)^{abcd}	17.03 (24.36)^{bc}	31.2 (29.50)^{abc}	10.1^{d}
T5	14.4 (22.30)^{e}	13.13 (20.90)^{bcd}	20.30 (26.73)^{d}	37.7 (31.49)^{bcd}	10.3^{d}
T6	13.1 (21.21)^{d}	32.57 (36.81)^{e}	15.30 (23.04)^{b}	42.4 (34.69)^{cd}	12.9^{c}
T7	8.9 (17.36)^{a}	16.27 (23.69)^{cd}	15.53 (23.20)^{b}	30.1 (26.14)^{ab}	14.8^{a}
T8	9.4 (17.85)^{b}	8.93 (17.05)^{ab}	18.97 (25.8)^{bc}	29.1 (26.77)^{ab}	13.5^{bc}
T9	23.3 (28.86)^{i}	18.43 (25.39)^{d}	15.07 (22.79)^{b}	36.2 (31.64)^{bcd}	9.8^{d}
T10	9.1 (17.56)^{ab}	35.53 (36.57)^{e}	15.20 (22.90)^{b}	29.3 (29.98)^{abc}	14.9^{a}
T11	26.3 (30.85)^{j}	31.20 (33.85)^{e}	21.60 (27.63)^{d}	44.5 (37.33)^{d}	10.2^{d}
CD (5%)	0.49	6.32	3.42	7.41	1.16

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

The results of field trials on chilli and tomato showed that the treatments T1 and T7 (i.e., isolates C26 and BB1) were effective in controlling almost all the diseases as much as chemical control. The treatments T6 and T8 (isolates PfCN1 and BB2) were significantly effective against the bacterial wilt and leaf curl virus disease, which may be due to its ability to induce systemic resistance in host. The isolate BB2 produced higher Siderophore in vitro but failed to significantly reduce the soil borne pathogens, which might be due to variation of siderophore production in natural ecosystem as reported earlier. However, the isolate BB2 showed plant growth promoting property both under in vitro and in vivo, there by increased the yield of crop in spite of its only moderate effect on diseases of chilli and tomato crops. The earlier reports suggest that few rhizobacteria may survive in the plant as endophyte that may be the reason for varied performance of isolate BB2.

In total the isolates C26, BB1 and BB2 showed their individual antagonistic and plant growth promoting ability both in vitro and in vivo and these isolates can be formulated in consortium mode to achieve their combined effect.

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

V. Jayakumar

Survey and isolation of microorganisms

A survey was conducted in 61 villages in South Andaman and 20 villages in Middle Andaman in the reporting period and collected infected plant samples and rhizosphere soil samples from vegetable and spice crops (Table 5). From the initiation of the project a total of 86 villages were surveyed for collection of samples.

Table 5. Geographical locations surveyed for collection of samples

Name of the district	Total no. of villages surveyed		
	2006-07	2007-08	Total
South Andaman	35	26	61
Middle & North Andaman	-	20	20
Nicobar	5	-	5
Total	40	46	86

Isolation of plant pathogens

Bacterial pathogens

The symptoms associated with brinjal, chilli and tomato plants in Andaman & Nicobar Islands are typical bacterial wilt. The plants showing wilt symptoms were collected from the surveyed areas and the pathogen was isolated on Tetrazolium chloride (TZC) medium (Kelman, 1954) from the bacterial ooze. The typical mucoid, creamy white colonies with

pink centre (after 48 hrs of incubation) were isolated and purified. Eight such bacterial wilt pathogens were isolated so far in the reported period.

Fungal pathogens

The pathogens associated with root rot, wilt and other leaf infections were isolated from infected leaf and root samples of vegetable and spice crops. Each isolate was purified by adopting single hyphal tip method and maintained on PDA slants for further studies. In 2007-08 a total of 13 fungal pathogens were isolated and maintained at CARI, Port Blair.

Pathogenicity test

The pathogenicity test of 23 bacterial pathogens was completed by following the pot culture screening procedure of Haware and Nene (1982). They were subjected to pathogenicity test on three different solanaceous crops viz., tomato, brinjal and chilli and the symptom production was observed. From 33 fungal pathogens isolated 10 pathogens associated with anthracnose symptoms were tested for their pathogenicity in their respective host plants. Both the bacterial and fungal pathogens producing typical symptoms were selected for further studies.

Isolation of Antagonistic microorganisms

From the samples collected from South & Middle Andaman the plant pathogens and antagonistic microorganisms were isolated in selective as well as common media. A total of 284 microorganisms were isolated in the reported period and the pure cultures are maintained at Central Agricultural Research Institute for further studies. From the initiation of project a total of 543 Agriculturally Important Microorganisms (AIMs) were isolated from the plants and rhizosphere of vegetable and spice crops. The detailed list of microorganism isolated and maintained at CARI, Port Blair is given in Table 6.

Table 6. Microorganisms isolated from vegetable and spice crops

Isolate	Year		Total
	2006-07	2007-08	
Fungal pathogens	20	13	33
Bacterial pathogens	23	8	31
Bacterial antagonist (isolated on KB)	104	100	204
Bacterial antagonist (Isolated on NA)	90	105	195
Mycoparasitic fungi (Isolated on TSM)	22	58	80
Total	**259**	**284**	**543**

Characterization of microorganisms

Morphological and biochemical characterization

Isolated bacteria and fungi were characterized for cultural and morphological traits which includes microscopy and then by biochemical characterization according to the requirement as per the organisms.

Plant pathogens

Among the 31 bacterial pathogens 23 were characterized biochemically and results revealed that the isolates are of *Ralstonia solanacearum,* but variations in reaction has been noticed among the isolates. Out of 33 fungal pathogens isolated, 20 were characterized for their conidia L/W ratio and colony character on PDA. About ten isolates associated with anthracnose symptoms are identified as *Colletotrichum* spp and the diversity of these *Colletotrichum* spp were assessed by variations in growth characteristics and among them 3 were identified as *C. gloeosporioides.*

Antagonistic microorganisms

The antagonistic bacterial microbes isolated were subjected to morphological and biochemical tests (Plate 2 and Plate 3) and identified as genus *Bacillus* spp (47 nos) and *Pseudomonas* spp (54 nos). For the identification of mycoparasitic fungi isolated on TSM, experiments were performed to determine the growth rate on various media. The characters were assessed with standard procedure and the genus and species were identified. Among the total 80 isolates 53 were identified at genus level as *Trichoderma* spp and 10 were identified at species level, i.e., 6 T. *hamatum,* 2 T. *pseudokoningii* and 1 each of *T. koningii* and *T. harzianum.*

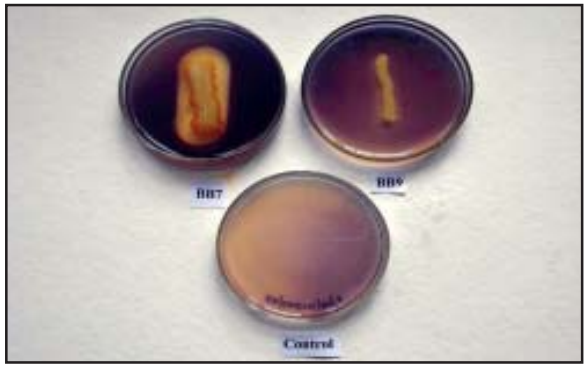
Antagonistic property of Bacillus spp

Tentatively identified 47 *Bacillus* spp isolates were tested for antagonistic property against phytopathogens i.e., *Sclerotium rolfsii, C. capsici* and *R. solaneacearum* by dual culture assay (Dennis & Webster). The screening for antagonistic property is in progress.

Microorganisms submitted to NBAIM, Mau

Among the total isolates 13 isolates were identified at species level and submitted to NBAIM microbial repository (Table 7).

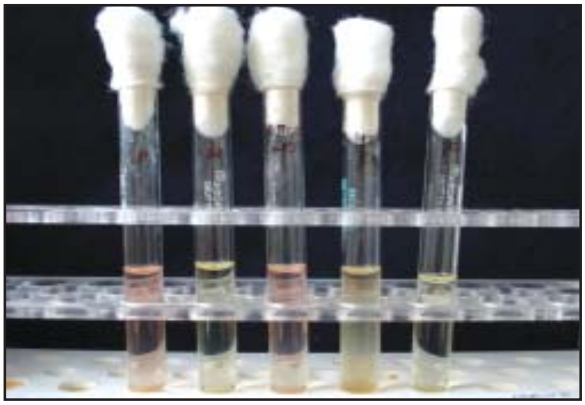
Carbohydrate utilization pattern



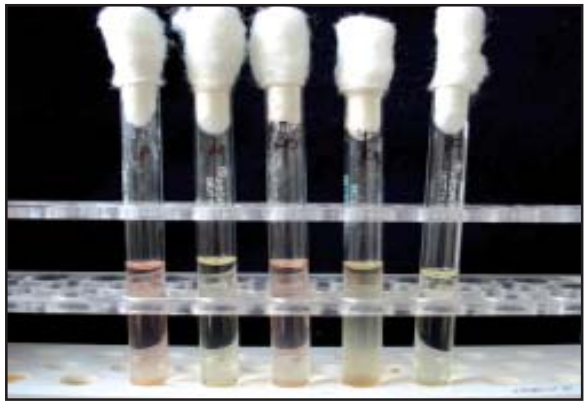
Starch hydrolysis

Table 7. Microorganisms submitted to NBAIM

S. No	Host Crop	Isolate designation	Organisms
1	Ivy gourd(*Coccinia grandis*)	TDK-4	*T. hamatum*
2	Bottle gourd(*Lagenaria sinceraria*)	TNL-2	*T. hamaum*
3	Lobia (*Vigna sinensis*)	TNL-1	*T. hamatum*
4	Bhendi (*Abelmoschus esculentus*)	TMB-3	*T. hamatum*
5	Brinjal (*Solanum melongena*)	TDK-1	*T. hamatum*
6	Cinnamon (*Cinnamomum zeylanicum*)	TSD-1	*T. hamatum*
7	Cowpea (*Vigna sinensis*)	TNC-1	*T. pseudokoningii*
8	Cucumber (*Cucumis sativa*)	TDC-2	*T. pseudokoningii*
9	Tomato (*Lycopersicon esculentum*)	TNT-1	*T. koningii*
10	Pumpkin (*Cucurbita pepo*)	TTP-1	*T. harzianum*
11	Mango (*Mangifera indica*)	FC1	*C. gloeosporioides*
12	Tapioca (*Manihot esculenta*)	FM4	*C. gloeosporioides*
13	Pepper (*Piper nigrum*)	FW1	*C. gloeosporioides*

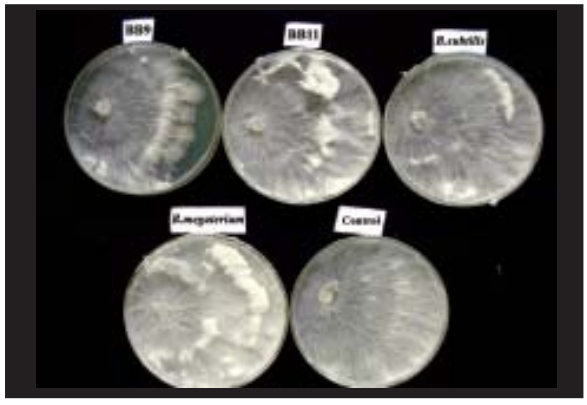


VP test



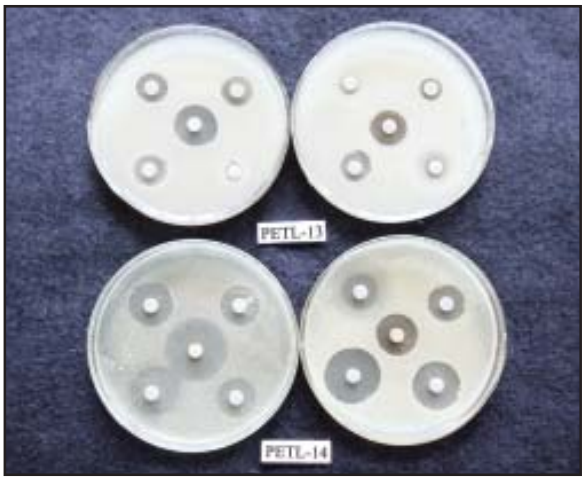
Methyl red test

Tripple sugar iron agar test



Dual culture test

Plate 2. *Bacillus* isolates showing results to various tests



Antibiotic sensitivity

Biochemical & carbohydrate utilization pattern

Fluorescens test

Starch hydrolysis test

Plate 3. *Pseudomonas* isolates showing results to various tests

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 575 literatures on plant resources of Andaman & Nicobar Islands were collected and compiled, i.e., compilation of 450 articles, 116 bulletins and 9 books. The collection contains 24 literatures describing ethnobotany of medicinal plants of Andaman & Nicobar Islands, book on Flora of Andaman & Nicobar Islands, book on Flora of Great

Nicobar islands, Red data book of Indian plants Vol I , Red data book of Indian plants Vol II, Red data book of Indian plants Vol III, forest flora of the Andaman Islands, plant resources of the Andaman & Nicobar Islands Vol I, Plant resources of the Andaman & Nicobar Islands Vol II and Biodiversity characterization at landscape level in Andaman & Nicobar Islands using satellite remote sensing and geographic information system.

Preparation of data sheets

The data sheets were prepared in MS Access format according to districts, taluks and Islands of Andaman & Nicobar and HTML format is prepared in Front page software (Plate 4).

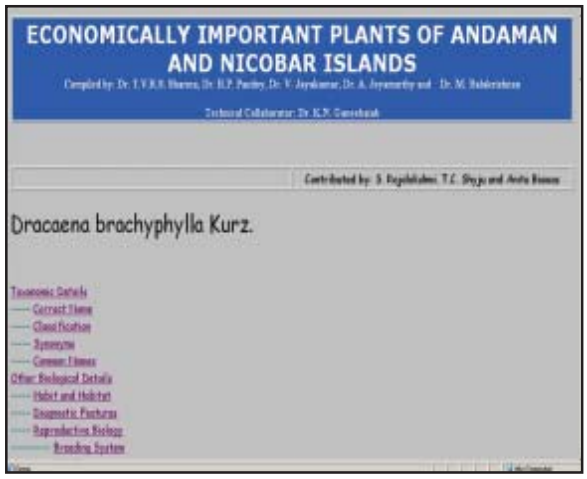


Plate 4. Datasheets of plant resources of Andaman & Nicobar Islands

Database development

In MS Access 1096 plant species descriptions were entered from flora of Andaman & Nicobar Islands and book on flora of Great Nicobar islands. In addition 1345 plant species descriptions were entered from book on plant resources of the Andaman & Nicobar Islands Vol II. In HTML format 1450 plant species descriptions were completed in detail, i.e., descriptions of plant taxonomy, economic uses and related photos. About 483 plants of Andaman & Nicobar Islands were photographed for its inclusion in digitization.

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

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

During the survey, samples were collected and identified. *Colletotrichum gloeosporoides* was causing disease symptoms in vegetable crops like Chilli, beans, ivy gourd and weed, a collateral host, Mikania. Similarly *Macrophomina phaseolina* was also recorded and identified causing leaf spot. Two susceptible tomato and one chilli cultivars at 15 days intervals on 5 dates were transplanted at Garacharma Farm.

Disease screening trials

About 168 germplasm were screened under natural disease pressure at Bloomsdale farm, against sheath blight, brown spot and bacterial leaf blight under National Screening

Nursery (NSN-1). Against bacterial leaf blight 168 germplasm showed immune reaction, 2 germplasm gave score of 1 and another 2 germplasm gave 2 score. Likewise in case of sheath blight 87 were immune, 36 gave 1 score and rest 40 entries gave more than 3 scores. Entries tested against brown spot, 153 showed immune response and 15 score of 1.

Management trials

i. Evaluation of new fungicides against sheath blight

Experiment was conducted to test four fungicides (Nativa 75 WG, Contaf 5 SC, Sheathmar 3 L and Spencer 24 SC) against sheath blight. Lowest disease incidence was recorded in Sheathmar (15.75%) sprayed plots followed by Spencer (19.25 %), Contaf (22.00%) and highest in Nativo (29.75 %) whereas untreated check had 48.75 per cent.

ii. Evaluation of fungicides against location specific diseases.

Seven fungicides (Antracol 75 WP, Campanion 75 WP, Dhanteam 75 WP, Dhanustin 50 WP, Indofil M-45 75 WP, Rhizocin 3 L and Sitara 5 EC) were tested against sheath blight. All the fungicides were found effective in reducing disease severity over control. Lowest diseases incidence was recorded in Companion and Dhanustin (each 27.3 %) treated plots whereas higher yield (3.716/10M^2 plots) was recorded in case of Rhizocin treated plots.

iii. Evaluation of bio-pesticides against location specific diseases

Defender, Florezin-T and Trichogen-T along with one fungicide Bavistin 50 WP were tested for their efficacy against sheath blight. Bavistin was found to be effective over the all the bio-pesticides. There was no considerable yield difference recorded among bio-pesticides and fungicide treated plots.

Division of Animal Science

ADAPTABILITY AND PRODUCTIVITY OF TURKEY AND GUINEA FOWL IN BAY ISLANDS

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

The Turkey and Guinea fowl was introduced by Central Agricultural Research Institute in Andaman and Nicobar in the year 2004 and studied the adaptability and productivity in the hot and humid climate milieu. Various management practices such as floor space requirement, semi range vs. intensive housing system of rearing have been evaluated. The Turkey performed better in 0.116 m^2/bird floor space for 0-8 weeks of age under deepliter rearing. The artificial insemination technique in turkey breeding has been standardized and compared with natural mating. The result revealed higher fertility (hatchability rate 50% on egg set basis) than natural mating (30%). Immunocompetance status was higher HA titre in Guinea fowl (4.20 ± 0.37) compared to Turkey (2.40 ±0.60). The immuno-competance status of Turkey and guinea fowl was also compared with other birds available in CARI (Fig.1). The CMI response was higher in Turkey (0.29 ± 0.008) than Guinea fowl (0.25± 0.013) (Fig. 2). The Phagocytic Index (PI) in Turkey was higher (0.003 ± 0.001) than Guinea fowl (0.0038 ± 0.001) (Fig. 3) Different varieties of Guinea fowl (Pearl, Lavender and white) were compared for egg production (eggs/hen/year) and hatchability. The egg production was found higher in Pearl variety

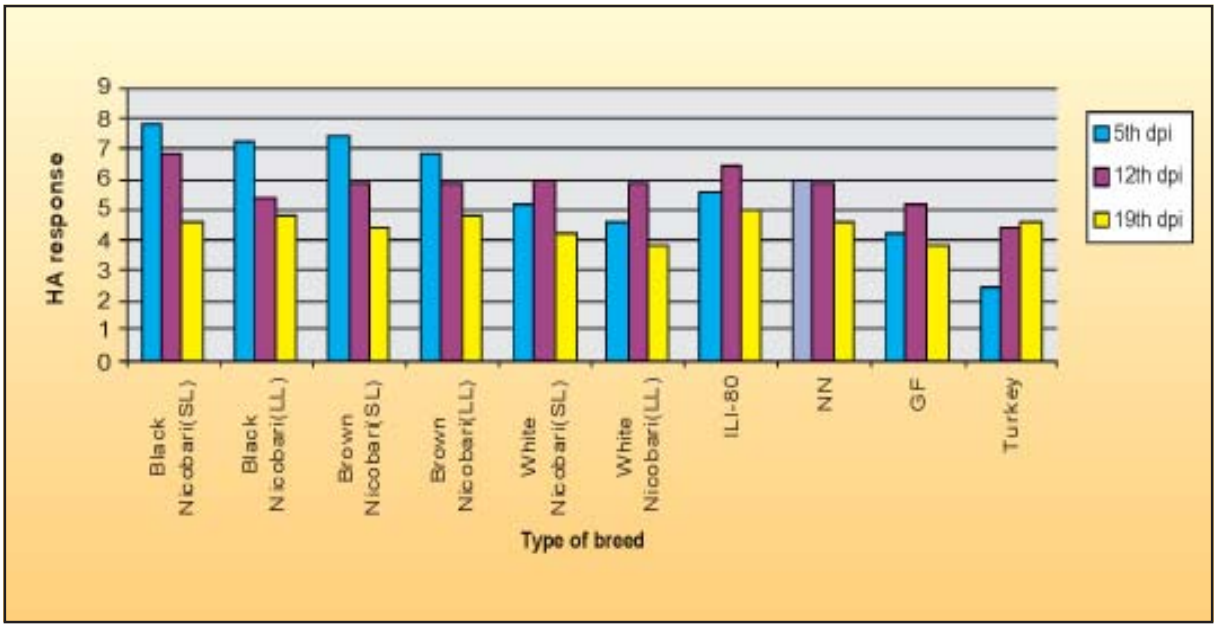


Fig 1. Comparative immunocompetence status of Turkey and Guinea fowl with other poultry birds

(60 eggs/hen/year) than White (47 eggs/hen/year) and Lavender (42/hen/year). The hatchability was also higher in Pearl (50%) than White (36%) and Lavender (45%). The average dressing percentage in Turkey was 86.20±1.14 and 87.49±2.7 in Guineafowl.

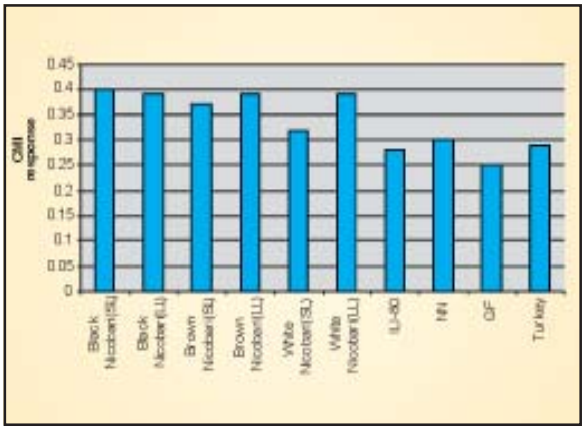


Fig 2. Comparative cell mediated immune response of Turkey and Guinea fowl with other birds

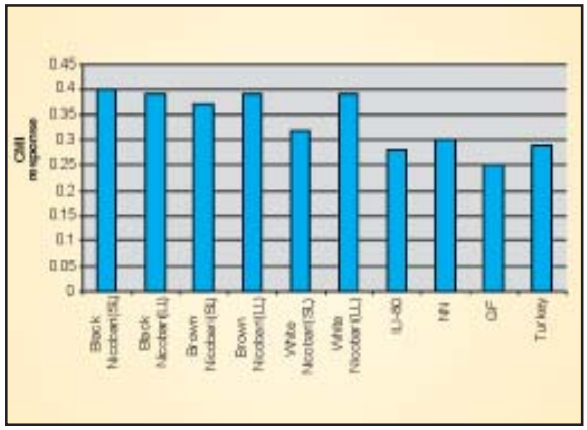


Fig 3. Comparative phagocytic index response of Turkey and Guinea fowl with other birds

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

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

Nicobari Fowl are reared under backyard farming system with minimum feed and health cover. There are three strains of Nicobari fowl such as Brown, Black and White Nicobari. Black Nicobari can produce about 130 eggs under intensive system but have lower growth rate and smaller egg size. Therefore, various Nicobari crosses were produced and evaluated under intensive system of management. Black Rock males were crossed with White Nicobari and Black Nicobari female and ILI-80 male were crossed with Brown Nicobari female and the progenies produced were evaluated for various performance traits. The performances of these progenies are presented in Table 1.

Chara Chambelli males were crossed with females of Pekin and Khaki Campbell. Pekin males were crossed with Chara-Chambelli females and Khaki Campbell males were crossed with Chara Chambelli females. The progenies produced from these four crosses were evaluated.

Table 1. Performance of various Nicobari crosses and their reciprocals

Traits	Brown Nicobari X ILI80	ILI80 X Brown Nicobari	Black Rock x Black Nicobari	Black Rock X White Nicobari	White Nicobari X Black Rock
Hatch weight (g)	32±0.7	32±1.2	38.4±1.8	36.0±1.9	33±1.2
8wk body weight (g)	229±7.0	231±12.0	235±8	241.0±11	233±2.0
20 wk b. wt (g)	691±18	692±34	982±28	788±30	708±18
WASM (g)	1148±21	1193±38	1741.36±40.17	1208±28	1018±28
ASM (days)	187±4	170±11	161.25±2.66	172±12	160±3
Annual Egg production (nos.)	196±7	226±11	172±6.7	190±8	192±12
Average egg weight(g)	47±0.7	49±0.89	52.5±0.52	50±1.0	48±1.0
Total mortality % (0-72Wks)	6	9	8	5	6
FCR (kg feed/dozen egg)	2.67	2.74	2.52	2.59	2.50

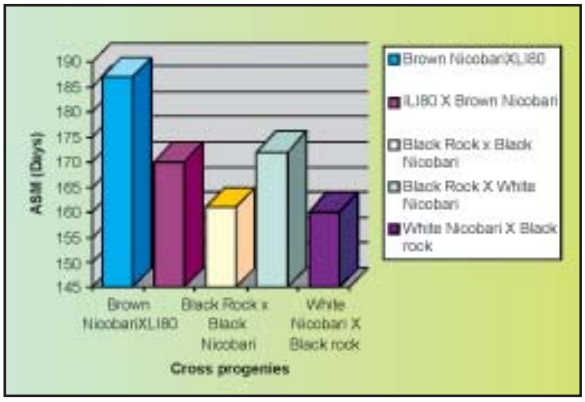


Fig.4 Age at sexual maturity of different Nicobari crossess

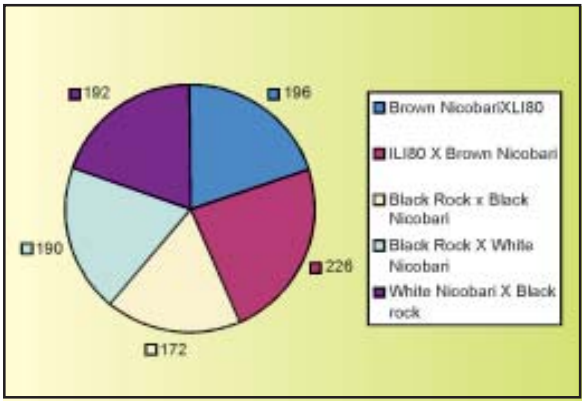


Fig.5 Annual egg production (no.) of various progenies of Nicobari crosses

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

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

Effect of *M.citrifolia* leaf extract on blood biochemical profile of poultry

The result of the present study revealed that the feeding of *M.citrifolia* fruit and leaf extract daily in the poultry ration has lowered the serum cholesterol level in the broiler. The total serum protein (TSP), albumin, and creatinine showed no significant difference but result was better in morinda fed group than the control. Similarly feeding of *M.citrifolia* leaf extract lowered the level of cholesterol in the blood serum of Nicobari fowl. Overall, fruit extract showed better performance than the leaf extract.

Table 2. Effect of leaf and fruit extract on blood serum profile of poultry

Parameter	Leaf extract	Fruit extract
Cholesterol (mg/dl)	200±7.5	190±11
Total Protein (g/dl)	3.46±0.21	3.69±0.3
Creatinine (mg/dl)	0.79±0.04	0.74±0.2
Albumin (g/dl)	1.18±0.08	1.65±0.18

Antimicrobial assay of *M. citrifolia* and some other medicinal herbs

The leaf extracts were prepared by using organic solvents like methanol, ethanol and ethyl acetate. The antimicrobial assay was conducted for 26 bacterial isolates and 3 reference strains. Assay of anti bacterial activity was done by disc diffusion method. The Chloramphenicol antibiotic disc (30µg) was used as a positive control and the solvent disc used as negative control. The diameter of zone of inhibition was measured by using HiMedia antibiotic scale. The leaf extract of *Morinda citrifolia* in methanol, ethanol and ethyl extract showed 75.3, 93.1 and 62 percent inhibition against the tested bacteria respectively. The fruit extract of *Morinda citrifolia* in methanol, ethanol and ethyl extract showed 75.8, 96.5 and 58.6 percent of inhibition against the tested bacteria

Plate 1. *Eupatorium odoratum*

Plate 2. *Gliricidia sepium*

Plate 3. *M. citrifolia*

Plate 4. *Vitex trifoliata*

respectively. The stem extract of *Morinda citrifolia* in methanol, ethanol and ethyl extract showed 58.6, 89.6 and 55.1 percent inhibition against the tested bacteria respectively. The average zone of inhibition in leaf extract was found to be more than fruit and stem extracts. Among the solvent the ethanol extract showed best antibacterial activity compared to ethyl acetate and methanol.

Antimicrobial assay of *E. odoratum, G. sepium and V. trifoliata* leaf extract

The leaf extract of *Vitex trifoliata* in methanol, ethanol and ethyl extract showed 58.6, 100 and 86.2 percent inhibition against the tested bacteria respectively. The leaf extract of *Eupatorium odoratum* in methanol, ethanol and ethyl extract showed 75.8, 100 and 58.6 percent inhibition against the tested bacteria respectively. The leaf extract of *Gliricidia sepium* in methanol, ethanol and ethyl extract showed 89.6, 89.6 and 79.3 percent inhibition against the tested bacteria respectively. The average zone of inhibition in leaf extract was found more than fruit and stem extracts. Among the solvent the ethanol extract showed best antibacterial activity compared to ethyl acetate and methanol.

The average zone of inhibition of all the medicinal plants showed that the methanol extract of *G.sepium* was better than other methanol extract. The ethanol extract of *E.odoratum* showed best antibacterial activity amongst other medicinal plants extracts. The ethyl acetate extract of *G. sepium* showed best activity compared to other plant extract. Overall, best activity was obtained in *G.sepium* leaf extract. Among the extracts, the best antibacterial activity was found with the ethanol.

Table 3. The antibacterial activity (in per cent) of plant extracts

S.No	Name of the plant	Methanol	Ethanol	Ethyl acetate	Average
1.	*Gliricidia sepium* leaf	89.6	89.6	79.3	86.1
2.	*Vitex trifoliata* leaf	58.6	100	86.2	81.6
3.	*Eupatorium odoratum* leaf	75.8	100	58.6	78.1
4.	*Morinda citrifolia* fruit	75.8	96.5	58.6	76.9
5.	*Morinda citrifolia* leaf	75.3	93.1	62.0	76.8
6.	*Morinda citrifolia* stem	58.6	89.6	55.1	67.7
	Average	72.28	94.8	66.63	

The average Minimum Inhibitory Concentration (MIC) of *Morinda citrifolia* leaf was 2.08 mg/ml. The MIC of *Morinda citrifolia* fruit, *Morinda citrifolia* stem, *Vitex trifoliata* leaf, *Eupatorium odoratum* leaf and *Gliricidia sepium* leaf was 2.33 mg/ml.

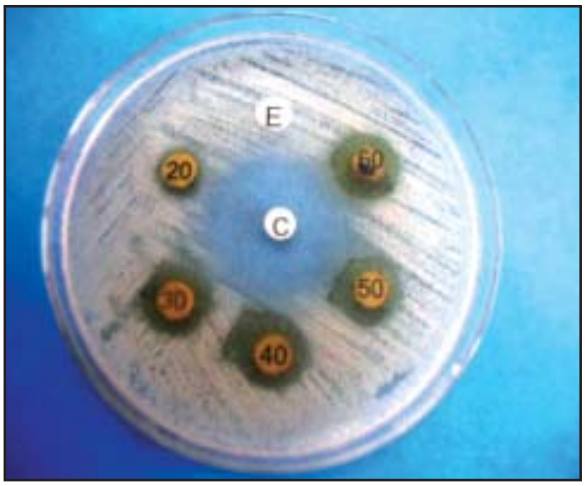


Plate 5. MIC of *M. citrifolia* fruit ethanol extract against *S. aureus*

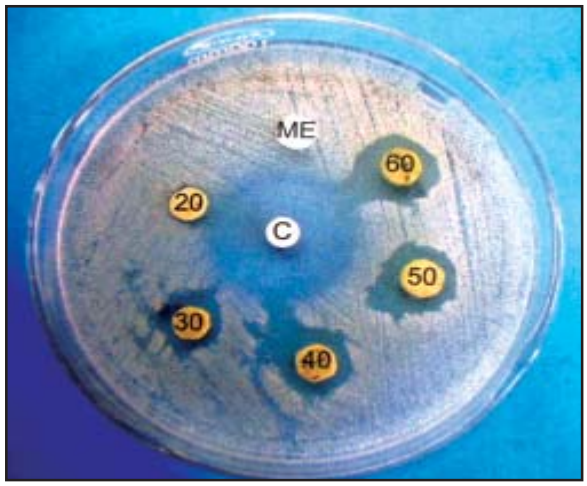


Plate 6. MIC of *Gliricidia sepium* methanol extract against *E. coli*

Antifungal activity assay

The best antifungal activity of leaf was found to be more than fruit and stem extract. The methanol and ethanol extract of the leaf showed better antifungal activity than the control i.e. Amphotericin-B (30µg).The methanol extract of *M.citrifolia* leaf showed best antifungal activity compared to other methanol extracts. The ethanol extract of *E.odoratum* showed best antifungal activity and the ethyl extract of *M.citrifolia* leaf showed best activity amongst the other solvent extracts. The average antifungal activity of *M.citrifolia* leaf was more (97.79%) followed by *V.trifoliata* leaf (83.3%), *E.odoratum* leaf (79.17%), *M.citrifolia* fruit (53.83%), *M.citrifolia* stem (37.5%) and *G.sepium* leaf (33.13%) respectively. The ethanol extract of all the plants showed best antifungal activity against all the tested organisms compared to methanol and ethyl acetate solvent extract.

Table 4. Antifungal activity (in per cent) of plant extracts

S. No	*Name of the plant*	*Name of the Solvent extract*			*Average Antifungal Activity (%)*
		Methanol	**Ethanol**	**Ethyl acetate**	
1.	*Morinda citrifolia* leaf	100	100	93.37	**97.79**
2.	*Vitex trifoliata* leaf	100	100	50	**83.3**
3.	*Eupatorium odoratum* leaf	100	100	37.5	**79.17**
4.	*Morinda citrifolia* fruit	68	62.5	31	**53.83**
5.	*Morinda citrifolia* stem	37.5	50	25	**37.5**
6.	*Gliricidia sepium* leaf	18.7	62	18.7	**33.13**
	Average	**70.7**	**79.08**	**42.59**	

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

S. Jeyakumar, A. Kundu, Jai Sunder, M.Din, T.Sujatha, M. Balak rishnan, S.K.Verma and Subhash Chand

The effect of seasonal influence (dry and monsoon season) and climatic (temperature, rainfall and humidity) factors on the performance of dairy cattle based on time series weather data (Meteorological Statistics – 2006, A&N Adm.) from farm production records from 1986 -2007, germplasm factors (desi and cross bred) and health factors (incidence of diseases, mortality pattern etc.) were studied.

(i) Performance of dairy cows in different season and climatic conditions

Pattern of milk production during dry (January to April) and monsoon season (May to December) were studied for 16 years (years with 12 months production). Monthly milk production (Mean ± SE) during dry season was lower (761.02±38.7 l) than the monsoon season (804.48±6.4 l). Number of cows on lactation during dry and monsoon season was 5.09±0.16 and 5.03±0.08 respectively. Average daily milk yield per cow during dry and monsoon season was 3.51±0.04 and 3.61±0.05 respectively. However, no significant difference was found between dry and monsoon season. Similarly, calving pattern studies (1985 to 2007) during dry vs monsoon season revealed that no significant difference was observed on number of calving (10.25±3.3 vs 13.25±1.4), birth weight of male calf (19.97±0.8 vs 20.39±1.03 kg), birth weight of female calf (20.27±0.7 vs 20.34±0.5 kg) and calf mortality (2.75±0.8 vs 2.13±0.6 nos.) , respectively. However, there was significant ($P<0.05$) influence of season (105.70±13.0 vs 139.12±6.5 lit) on average monthly milk production of individual cows during entire lactation. This could be directly or indirectly related to nutritional status i.e availability of sufficient green fodder resources and climatic conditions during monsoon season.

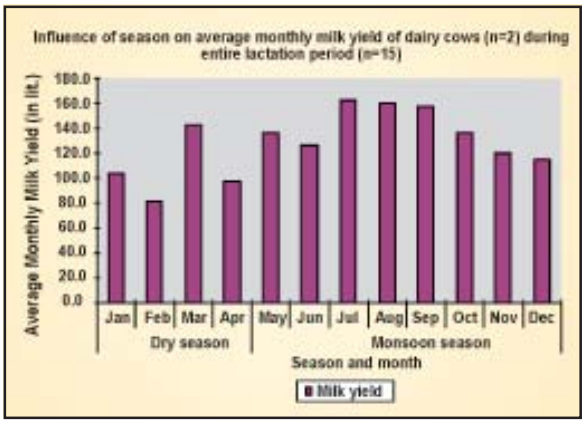


Fig 6. Influence of season on milk production in dairy cows

Various climatic parameters such as minimum and maximum temperature (°C), rain fall (mm) and relative humidity (per cent) were correlated with milk production performance and no.of cows on lactation (Table 5). Regression analysis revealed that there was significant relationship ($r = 0.977$) between climatic parameters and milk production.

Table 5. Month wise weather data (mean) and milk production of cows (1985 - 2006)

Month	Temperature (°C)		Rainfall (mm)	Relative Av. humidity (%)			Milk yield (in lit)	Av. No. of lactating cows
	Min	Max		Morning	Evening	Average		
January	22.4	29.6	35.5	73	75	74	636.81	5.4
February	22.0	30.4	10.5	71	72	72	495.67	4.9
March	22.8	31.3	36.2	70	73	71	559.23	5.3
April	24.0	32.3	69.7	70	74	72	521.25	4.7
May	24.2	31.0	371.7	78	82	80	632.00	4.9
June	24.2	29.7	446.2	83	85	84	624.18	5.1
July	23.7	28.9	423.8	84	85	84	632.69	5.0
August	23.5	29.1	448.9	84	86	85	627.16	4.7
September	23.0	29.0	471.6	84	87	86	604.83	4.9
October	23.2	29.7	303.8	81	86	84	654.19	4.9
November	23.8	29.8	247.0	78	81	79	679.03	5.3
December	23.1	29.6	76.6	73	76	74	702.64	5.4

(ii) Germplasm and health factor on performance of cows

Lactation data of desi (17 lactations) and cross bred cows (72 lactations) for the past 22 years were analyzed. Productive performance (Mean±SE) of cross bred cows showed that there was significant difference (P< 0.01) between desi and cross bred cows on lactation yield (553.51±40.7 vs 1500.48±97.4 l), lactation length (276.05±13.5 vs 361.63±16.5 days) average daily milk yield per lactation (2.01±0.1 vs 4.27±0.2) and peak milk yield (3.85±0.5 vs 7.45±0.3 lit). However, no significant difference was observed on no. of days to reach peak yield (8.6±2.4 vs 17.95±1.2). The order of lactation was also observed to influence the milk production potential of the individual cross bred cow. The reproductive performance of cross bred cows showed that the age at first calving (n=13) and inter calving interval (n=18) was 1107.08±66.28 (days) and 515.88±25.74 (days) respectively. The birth weight (kg) of female calf (21.26±0.6, n=75) was significantly higher (P<0.01) than male calf (19.0±0.3, n=63). Health factors viz. post FMD complications (infertility - 23.5 % (4/17), lameness due to hoof lesions), and mastitis (higher incidence during July, August and September) were the most

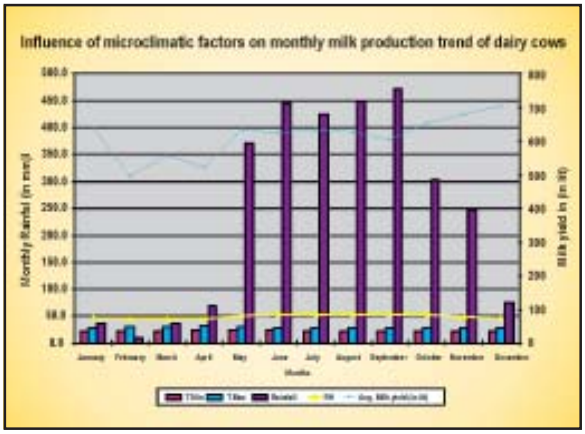


Fig 7. Influence of climatic parameters on milk yield pattern in cows

common problems which directly or indirectly influenced the productive and reproductive performance of the cows.

(iii) Managemental interventions to augment production

The managemental/technological interventions viz. controlled breeding programme, supplementation of mineral mixture, commercially available feed based drug delivery system for deworming were found to be more successful to augment reproductive and productive performance of cows. Development of delivery calendar, data base for better breeding and health management have been done. Electrical Conductivity of milk is considered as diagnostic tool for early detection of mastitis. Veterinary Ultrasonography has been introduced for the first time in this island and found to be the most effective, non-invasive managemental (early pregnancy diagnosis, monitoring reproductive function) and diagnostic (bone and soft tissue lesions, udder problems viz. udder oedema, fibrosis, mastitis, ovarian pathology etc.) tool for effective dairy herd management.

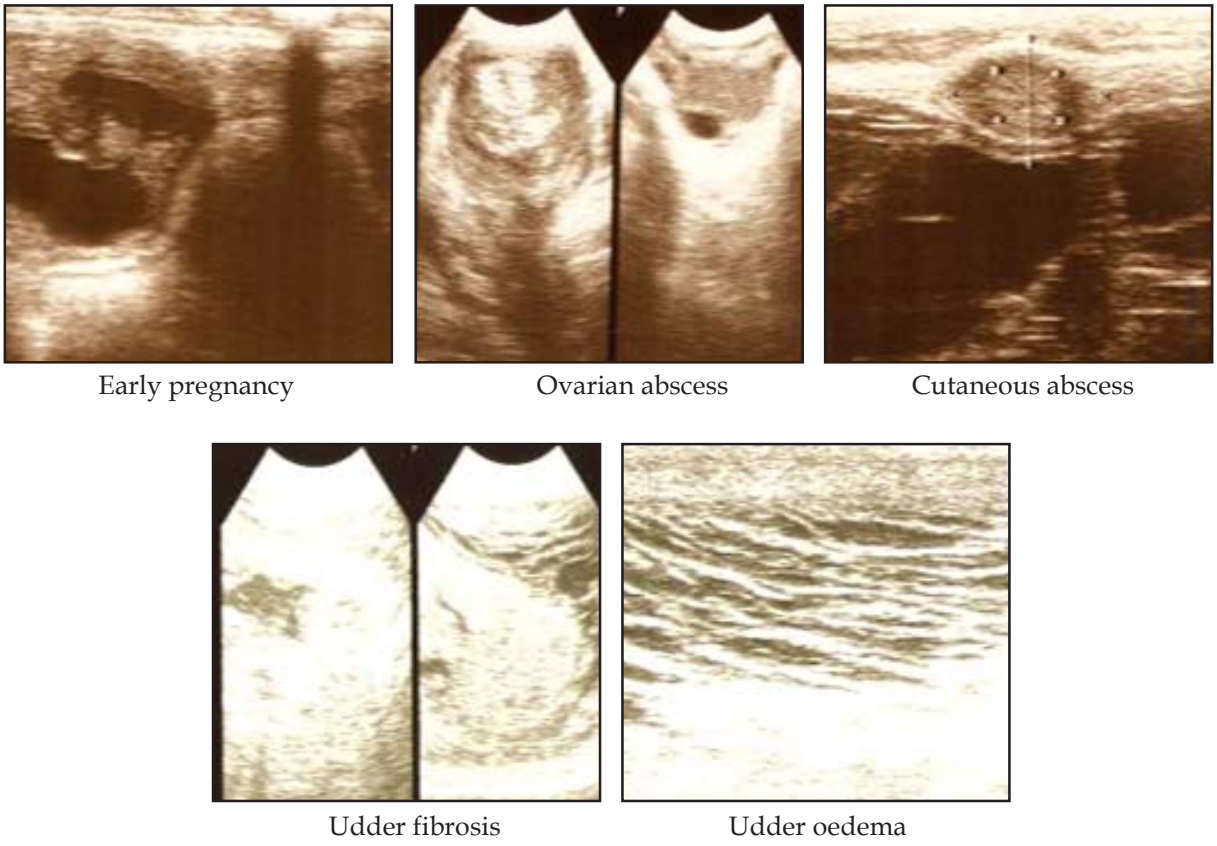


Plate 7. Ultrasonogram showing various physio-pathological conditions in dairy cow

ENHANCEMENT AND SUSTAINABLE DAIRY CATTLE AND BUFFALO PRODUCTION IN BAY ISLANDS

S. Jeyakumar, A. Kundu, M.S. Kundu, Jai Sunder, S.P. Yadav, T. Sujatha, R. Raja S.K. Verma, Subash Chand, M. Balakrishnan and R.C. Srivastava

Performance of Holstein Friesian (HF) cross and Jersey crossbred cows were studied (Table 6). The lactation yield (in Lit.) and lactation length (days) was higher in (P<0.05) Jersey cross than HF cross but days to reach peak yield were significantly (P<0.05) higher in HF cross than Jersey cross. No significant difference was observed between HF cross and Jersey cross in average daily milk yield per lactation, peak yield and birth weight of calves. Inter calving period (days) was higher in HF cross (534.22±44.0) than Jersey cross (497.56±28.1). Age at first calving (in days) was early in HF cross (885.0±69.8) than Jersey cross (1173.7±71.7). Renovation of cattle shed and introduction of buffalo is in progress.

Table 6. Performance of Jersey and HF crossbred cows

Breed type (no.of lactations observed)	Lactation yield (in lit)	Lactation length (in days)	Daily milk yield (in lit) / lactation	No. of days to reach peak yield	Peak milk yield (in lit)
Jersey cross (43)	1866.17±163.5	410.78±21.23	4.02±0.27	14.26±1.60	8.30±0.42
HF Cross (22)	1236.94±117.5*	318.45±28.6*	4.19±0.40	21.55±2.71*	7.00±0.53

* Value in columns differ significantly at P<0.05 level

Plate 8. Renovated shed showing double row (tail-to-tail) and single row (milking barn) system

PRODUCTIVITY ENHANCEMENT OF GOATS IN BAY ISLANDS

S. Jeyakumar, S.P. Yadav, Jai Sunder, M.S. Kundu, A.Kundu, S. K. Verma, M. Balakrishnan, Subhash Chand, S.K. Zamir Ahmed and R.C. Srivastava

Goats were introduced in this island by British/sea travelers during pre independence period and recently by the settlers and are distributed in different islands. There are four distinct population of goats available in these islands, viz. Andaman Local Goat, Feral/semi feral goat, Teressa goat and Malabari goat. The current population (2007 census) of goat is 66,544, which is 16 % lesser than the population prior to tsunami 79,219 (2003 census). The goats in Andaman and Nicobar island are produced under semi intensive or free range system of management by the farmers as a source of livelihood and no commercial goat farm exist in the islands. The feeding requirement is met by grazing in the post harvest land and on waste land. In addition to this, farmers feed locally available tree fodders from the forest. No supplementary feeding was practiced. Health coverage is carried out by the Veterinary Department. The majority of goats produced in different islands are locally transported by road/sea route to main city i.e. Port Blair for slaughter. The present market rate of fresh goat meat is Rs. 220 - 250 per kg which is available mostly on Sundays and festivals. To meet the requirement of defence personnel, goat meat is imported from mainland.

Productivity enhancement of desi goat through AI technology

To improve the productivity of desi goat, cross breeding programme was attempted with Boer goat through AI technology. Frozen semen straws of original breed of Boer goats were brought from Kerala Livestock Development Board, Palakkad, Kerala. The A.I. technique was standardized and the desi goats in natural/induced heat were inseminated (transcervical insemination)

Desi Goat (Female) x Boer Goat (Male)

PD-Ultrasonogram

Birth of F1

Plate 9. Crossing between goats and birth of first live Boer cross goat

Plate 10. An adult Boer cross male

Plate11. Distribution of Boer cross goat to an entrepreneur

twice at an interval of 6-8h in the same oestrus by depositing thawed semen. The pregnancy was confirmed between 21 and 25th day post insemination using intrarectal linear probe by Ultrasonography technology. The Ultrasonography technology has been found to be a valuable noninvasive diagnostic tool for early pregnancy diagnosis (18-25 days) in goats.

F1 generation goats appeared phenotypically similar to Boer (Plate 10). Under the farm

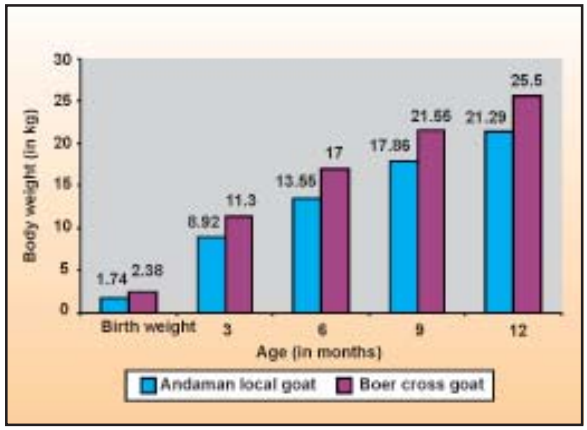


Fig 8. Growth performance (body weight) of Desi and Boer cross goat

condition, the growth rate in terms of body weight at birth (0 month), 3, 6, 9 and 12 months weight was significantly higher than the local goats. Boer cross goats were released by the CARI to a private entrepreneur (Plate 11). The approximate body weight of Boer cross (F1) at 2 years was found to be 45 to 50 kg under farm and field condition. The production and evaluation of cross bred goat is in progress both under farm and field condition.

PRODUCTIVITY ENHANCEMENT OF PIGS UNDER ISLAND ECO-SYSTEM

M.S. Kundu, A. Kundu, S. K. Verma, Jai Sunder, S. Jeyakumar, S.P.Yadav and T. Sujatha

Survey was conducted on pig farming and nutrition in Andaman group of islands. A total of forty-nine farm family were surveyed and it was observed that in Port Blair and Neil Island 100 per cent farmers reared the exotic breed of pigs where as the farmers from Rangat and Ferrargunj reared both exotic and local breeds of pigs. The farmers from Port Blair and Neil Island mostly reared the pig for fattening but few farmers of Rangat and Ferrarganj reared the pigs for breeding purpose.

Feeding practice

The pig feed includes mostly the colocasia leaves supplemented with the kitchen waste, coconut and fish meal. Only few farmers were feeding their pigs with cooked wheat or rice. It was found that most of the farmers (33.87%) were using the colocasia with vegetable waste/ kitchen waste for feeding their pigs followed by scavenging with kitchen waste (27.41%) and scavenging with coconut

Plate 12. Cooking of Colocasia mixed with vegetable / kitchen waste

supplementation (17.74%). Normally the colocasia leaves were cut into pieces and mixed with kitchen waste/ vegetables waste. Then it was cooked for 30-40 minutes and offered to the pigs. Pigs are let loose in fields during day time and stall fed in the morning and evening with small amount of the feed mentioned above. Mineral mixtures are not supplemented to the ration of the pigs but salt is offered occasionally. However, a few farmers having off farm income from various sources to maintain their pig on ready made feed purchased from the market. It was re-

vealed that the supplies of nutrients to the pigs depend on the socio-economic condition of the farmers and differed significantly. The adoption of principles of scientific feeding is on low score.

Housing & health care management

The pigs are kept along with the house dwellings of the farmers. 85.32% farm families keep their pigs in the mud houses and others use pucca houses with the roofing materials made up of either tin (64.36%) or thatch (23.18%). Except deworming and F.M.D. vaccination to the pigs no other health care measures are followed by the farmers. Other management practices like care of newborn, pregnant and nursing mother are least attended. It may be due to the lack of knowledge about scientific pig farming practices, pig diseases and non availability of the veterinary support services in nearby areas at proper time.

Training programme

Plate 13. Backyard pig rearing by a women farmer, Ferrargunj

It was observed that the knowledge level of the farmers is at low ebb regarding rearing the pigs. Efforts were made during this period to impart training to the farmers for scientific pig rearing. A total of 70 farmers were trained and 12 farmers were supplied with 43 Large White Yorkshire piglets for rearing and for performance evaluation at the field level.

Plate 14. DDG (Hort.) interacting with the farmers during distribution of critical inputs (piglets)

Performance of Large White Yorkshire breed of pigs

Performance of Large White Yorkshire breed of pigs at institutional farm revealed that, a total of 11 farrowing occurred during the period of study. The litter size at birth and weaning was observed to be 6.36±0.59 and 4.63 ± 0.85, respectively. The percent mortality at the time of weaning was 27.14±10.31.

TO STUDY THE FEASIBILITY AND CONVERGENCE ON SUBSISTENCE PIG REARING TO COMMERCIAL PIG FARMING INCLUSIVE OF ITS PROCESS

M. S. Kundu, A. Kundu, S. Jeyakumar, Subhash Chand, S. K. Zamir Ahmed, P. Balakrishnan and R.C. Srivastava

A survey was conducted in three islands of Nicobar group, viz Car Nicobar, Kamorta and Trinket and it was observed that pig is being reared in a subsistence manner without any scientific knowledge. A total 13 farm families were surveyed and it was observed that they rear Nicobari pigs. Nicobari tribes rear the pigs using the locally available feed materials like coconut, ripe pandanus fruits, tuber crops and roots. All the farmers (100%) allowed their pigs for scavenging. About 69.23% farmers used coconut and boiled rice to feed their pigs in addition to scavenging. Other type of feed materials like sea fish, fish waste, snails and sea shells as and when available is also used by the farmers (7.69%). They housed the pigs below the Nicobari hut/ shelter.

Plate 15. Shelter for pig under the hut

Plate 16. Feeding of coconut to Nicobari pigs

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

A total of 135 farm families were surveyed belonging to North, Middle and South Andaman for characterization of livestock production sub-system and assessment of critical nutritional gap in Bay Islands. During sample survey, it was found that most of the farmers were having small land holdings.

Average land holding in North, Middle and South Andaman was 1.31, 0.79 and 1.26 ha/ family respectively. Most of the farmers were operating mixed farming system comprising of crops, livestock, plantation and horticultural crops. In North Andaman, most of the farmers had paddy land and they were engaged in vegetable cultivation along with plantation crops. In South Andaman, the livestock species generally reared were cattle and goat, while in Middle Andaman farmers were having cattle, goats and pigs. In North Andaman, most of the farmers were rearing cattle, goat, poultry and pigs. Farmers were having fish ponds and ducks also. Adult livestock Units (ALU) reared by North Andaman Farmers were 3.025 while Middle and South Andaman farmers reared 2.135 and 2.897 ALU respectively. On an average 1.935 ALU were reared by the Andaman farmers. Most of the farmers were facing shortage of fodder during dry period in South and Middle Andaman. In North Andaman farmers were facing shortage of fodder round the year due to the fact that during Kharif season most of the farmers were growing paddy therefore there was no land left for production of wild grasses and after harvesting of paddy there was no wild grasses due to dry spell. Cultivation of fodder crops was almost nil. Quantification of critical nutritional gap is in progress.

CHARACTERIZATION OF LH β AND FSH β AND THEIR RECEPTOR GENES IN GOAT BREEDS OF ANDAMAN AND NICOBAR ISLANDS

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

PCR amplification of Exon 2 of FSHβ and LHβ exon 1 and 2

Follicular Stimulating Hormone (FSH) and Luteinizing Hormone are heterodimer of a common alpha (α) subunit and a unique beta (β) subunit. The study was aimed to understand the molecular mechanism and the role of mutation in FSHβ and LHβ gene in goat fertility. The PCR conditions were optimized for the amplification of FSHβ exon 2 (~187bp at 55^{0}C for 30 sec.) and LHβ exon 1 and 2 (495 bp at 58^{0}C for 30 sec.).

Single strand confirmation polymorphism

The nucleotide variation in the exon 2 of Follicle Stimulating Hormone beta and exon1 & 2 of Luteinizing hormone beta gene in Local Andaman Goat was studied by PCR- SSCP (Single Strand Conformation Polymorphism). The 495 bp amplicon representing exon 1and 2 of LHβ gene from 38 goats (Local Andaman goat) were subjected to non-denaturing polyacrylamide gel matrix (Gel 7% at a constant voltage of 70 for 6 hours at room temperature 20-30^{o}C). After silver staining the two band shifts were observed viz. A and B

in the frequency viz. variant 1 (86.84) and variant 2 (13.15). In FSHβ exon 2 (42 individuals) (Gel 7% at a constant voltage of 70 for 3) three band shifts (figure 1) were observed viz. A, B and C in the frequency of 88.09, 7.14 and 4.76 respectively.

Fig 9. Exon 2 Local Andaman Goat SSCP showing three band shifts.

Sequencing and sequence analysis (FSHβ)

Different band shifts from exon 2 (three band shifts) were selected by the PCR-SSCP and purified with PCR purification kit (Genei). Three samples from each variant were custom sequenced with forward and reverse primers. High quality sequences were edited with the Chromas 1.45 (http://www.technelysium.com.au/chromas.html) and were converted to FASTA format. The consensus sequences were created by aligning the forward and reverse sequence. The nucleotide sequences were analyzed by BLASTn homology and clustal W program. NetNGlyc (http://www.cbs.dtu.dk/services/NetNGlyc/) was used to ascertain the putative N-glycosylation sites in the sequence. In Local Andaman goat the sequencing result of FSHβ exon 2 revealed that two variants were present in the population (Fig.10). The mutation at third nucleotide position of codon 15 (GCA 15 GCT) is silent one i.e. not leading to change in the amino acid. The conserved cysteine residue and motif ^{46}C-A-G-Y^{49}" encoded by FSH beta exon 2 was in the same format (conserved) in goat as in other species.

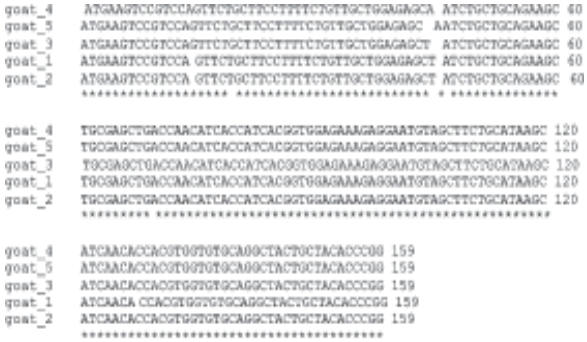


Fig 10. Nucleotide sequence of goat FSHβ exon 2 the silent mutation position at T45A is depicted in box.

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

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

The phenotypic parameters of the Teressa goat recorded from Nicobar groups of Islands are represented in Table 7. The average height (in inches) of an adult male and female was 27.73 ± 0.94 and 25.01 ± 0.44 respectively. The average length (in inches) of an adult male and female was 26.34 ± 1.38 and 22.77 ± 0.37 respectively. The average chest girth (in inches) of an adult male and female was 30.15 ± 0.95 and 28.63 ± 0.50. Ears were little erect and directed downwards with an average length of 5.7 ± 0.10 and width of 3.02 ± 0.22 (inches) for an adult male goat, while for female it was 5.35 ± 0.12 and 2.66 ± 0.05 respectively. Horns were large, flat at base and directed backwards with an average length of 5.79 ± 0.51 (inches) in an adult male Teressa goat. The average body weight (kg) of adult male and female Teressa goat was 41.28 ± 2.99 and 35.65 ± 1.40 respectively.

For *in-situ* conservation of the goat breeds of Andaman and Nicobar Islands various awareness and training programmes were conducted in different Islands in coordination with the Department of Animal Husbandry and Veterinary Services, Tribal Council and NGO's of Andaman and Nicobar Islands (Plate17). The Tribal students were also sensitized about the need of conservation of indigenous goat germplasm. Teresa goats are

Table 7. The phenotypic parameters of Teresa Goat

Body Measurements (inches)	Adult Goats	
	Male	Female
Length	26.34 ± 1.38	22.77 ± 0.37
Height	27.73 ± 0.94	25.01 ± 0.44
Abdomen circumference	34.81 ± 1.20	35.36 ± 0.98
Chest circumference	30.15 ± 0.95	28.63 ± 0.50
Neck circumference	15.21 ± 0.60	12.77 ± 0.31
Head length	7.94 ± 0.32	6.44 ± 0.23
Leg length	19.23 ± 0.68	18.21 ± 0.58
Hoof circumference	5.94 ± 0.29	5.95 ± 0.21
Ear length	5.7 ± 0.10	5.35 ± 0.12
Ear width	3.02 ± 0.22	2.66 ± 0.05
Ear circumference	4.92 ± 0.20	5.01 ± 0.19
Horn length	5.79 ± 0.51	3.98 ± 0.30
Tail length	5.5 ± 0.23	4.4 ± 0.12
Body weight (Kg.)	41.28 ± 2.99	35.65 ± 1.40

multiplied and maintained at Institute Goat Research Farm.

Blood samples of unrelated individuals of the three goat population viz. Local Andaman goats (122), Teressa goat (75) and Malabari goat (26) were collected from the different Islands of Andaman and Nicobar. DNA was isolated and PCR conditions for the 20 sets of goat specific primers (ISAG/FAO recommended) were optimized.

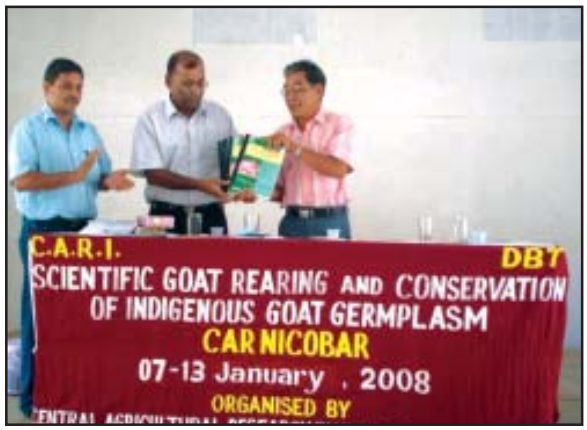


Plate 17. Awareness on *in-situ* conservation of goats through training at Car Nicobar

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

T. Sujatha, A. Kundu, S. Jeyakumar, Jai Sunder, C.S. Chaturvedi and A. K. Singh

The experiment was conducted in laying quail for a period of 21 weeks. 72 layers of 9 weeks old were divided into three groups with four replications in each group and 6 quails in each replicate. Group I: Azolla supplementation @10 g/bird/day, Group II: Azolla supplementation @20g/bird/day, Group III: without any supplementation/control group. Production parameters viz., age at sexual maturity, body weight at sexual maturity, feed intake, egg production and feed cost benefit ratio were monitored. The egg quality parameters viz., egg weight, yolk index, albumen index and shell thickness were recorded. The results revealed that azolla supplementation at the rate of 10g per bird day could replace 21.7% concentrate feed with an egg productivity of 53% vs. control 51% and savings in feed cost of 8 paise per bird per day. Azolla supplementation at the rate of 20g per bird day could replace 30% concentrate feed with an egg productivity of 48% vs control 51% and savings in feed cost of 12 paise per bird per day.

There was no significant difference in egg productivity, age at sexual maturity and weight at sexual maturity between Azolla supplemented and control group. There was no adverse effect on egg production as well as egg quality with Azolla supplementation in layer quails. Thus, Azolla could safely be supplemented in the feed of laying quails with recognizable percent savings in feed cost.

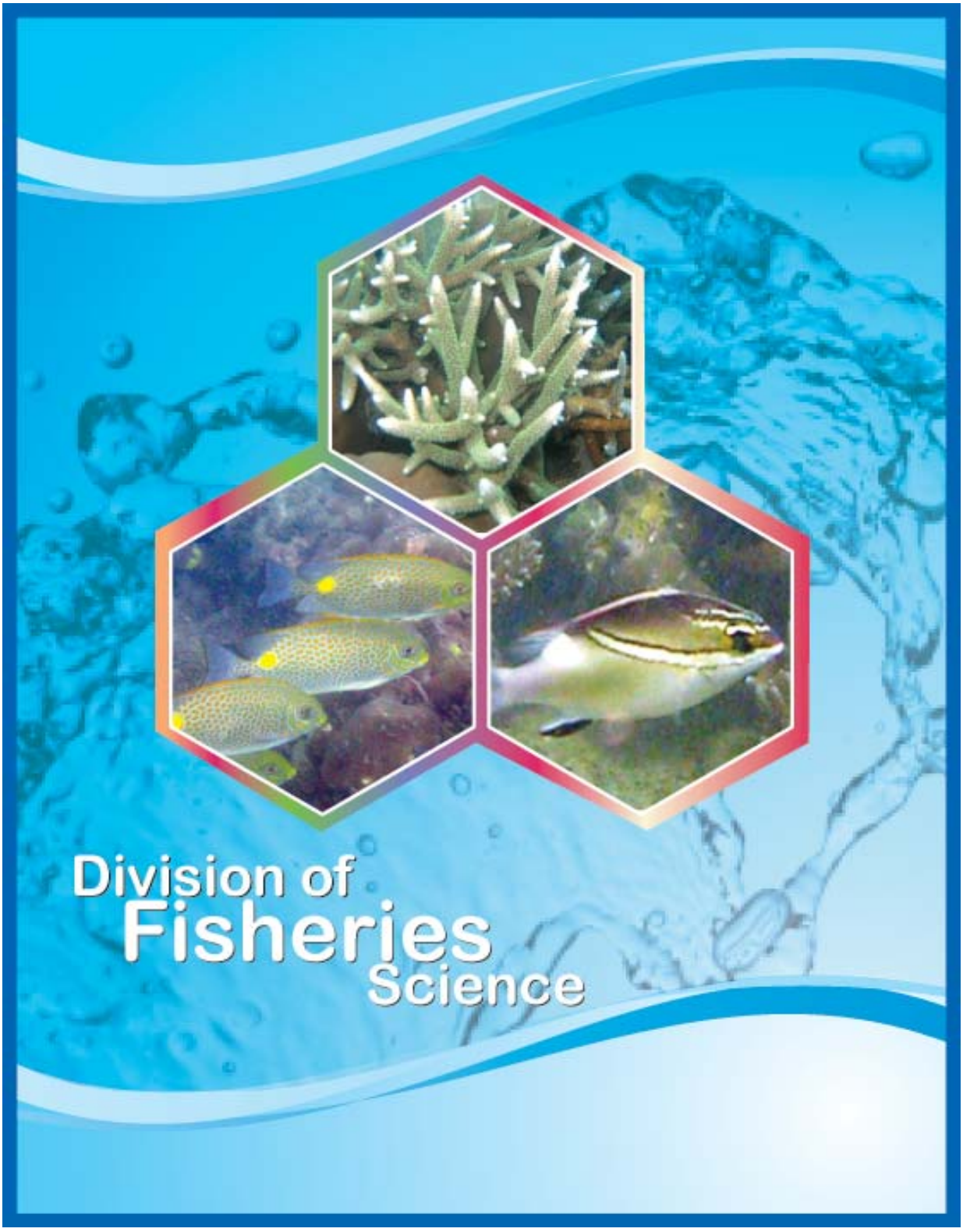
Table 8. Effect of azolla feeding on egg quality parameters of quail

	Egg weight		Shape index		Albumen index		Shell thickness		Yolk index	
	Azolla group	Control group	Azolla group	Control group	Azolla group	Control group	Azolla group	Control group	Azolla group	Control group
Mean	10.82	10.95	133.26	134.04	0.32	0.34	1.106	1.100	0.82	0.94
SE	0.14	0.12	0.68	0.74	0.015	0.02	0.001	0.001	0.03	0.03
SD	0.68	0.63	2.87	3.13	0.06	0.09	0.004	0.002	0.12	0.13
CV%	6.28	5.75	2.15	2.33	18.75	27.67	0.35	0.18	14.63	13.83

Azolla feeding in quail at field

Plate 18. Harvesting and feeding of azolla to Quails at farmer's field.

Simultaneously, Azolla was distributed to farmer's field for supplementation in the feed of quail up to marketing age (6 weeks). Azolla was supplemented in quail feed at the age of 7 days till marketing (6 weeks). The level of supplementation was 10g per bird per day. A total of 190 quail chicks were utilized for Azolla feeding and performance was observed in three consequent batches. In the first batch the farmer could save the feed cost @ 74 paisa per quail with bodyweight of approximatley155 g per quail at 6 weeks of age. In the second batch, he could save 64 paisa with 166g of bodyweight per quail. For the third batch, he started Azolla supplementation from 11th day onwards and the feed cost of 40 paisa was saved per quail with body weight of approximately 155g. It is clearly evident that supplementation of Azolla in the quail feed at the age of 7 days @ 10gm per bird per day could replace 7.5% of commercial feed without affecting the bodyweight of quails at market age (6 weeks) and could save the feed cost @ 59 paisa per quail at market age. As per the field result, azolla could also be supplemented in the quail feed up to market age.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Science

BROOD STOCK DEVELOPMENT AND BREEDING OF DAMSEL FISHES

Grinson George, S. Dam Roy, C.S. Chaturvedi, Kamal Sarma, S. Murugesan and Benny Varghese

Damsel fishes were collected from North Bay, Chidiyatapu, North Wandoor, and Burmanallah for the study. Brood stock development of Damsel fishes is under progress at Marine Research Laboratory. Collected fishes were kept in Fibre Reinforced Plastic (FRP) tanks for two days for acclimatization of fish to the laboratory conditions. Fishes and anemones were treated with diluted $KMnO_4$ solution for disinfecting them. All the treated fishes and anemones were transferred to glass tanks for maintenance. The fishes were fed with prawn meat, green mussel and fish egg. The anemones were fed with micro algae like chlorella, *Isochrysis* and *Skeletonema*. Even Artemia is given to anemones as feed. Water quality was frequently checked at regular interval for preventing any contamination in the tanks. Filtered sea water is being used in the tanks for maintaining the fishes. For the purpose of maintaining the health of sea anemone unicellular algae like *Chlorella*, *Isochrysis*, *Nanochloropsis* etc were maintained and mass cultures were developed using Walne's or Conway's medium. For the purpose of maintaining the juveniles detailed survey was conducted for the rotifer identification from the brackish as well as marine waters of Andaman. Rotifer fauna of Andaman waters is rich in *Brachionus* species. The presence of *Brachionus* species complex (P. S. Anitha, 2006) is a notable character of the rotifers present in Andaman waters. Back waters of Kochi describe the Brachionus species complex as a combination of *B. plicatilis*, *B. rotundiformis* and *B. murrayi*. But there is a slight variation in the description of this complex in Andaman waters as *B.murrayi* is less envisaged in the complex with a majority of them being a combination of *B plicatilis* and *B. rotundiformis*. Earlier study describes the *Brachionus* species complex in Andaman waters as Brachionus 'L' and 'S' and 'SS' forms as smaller *Brachionus*, larger *Brachionus* and super small *Brachionus* (K. Madhu *et.al.*,2004). But the present study reveals that they are *Brachionus rotundiformis, B. murrayi and B. plicatilis* respectively in concurrence with the reports from Cochin backwaters. But the difference observed among *Brachionus* species complex of Andaman is with respect to the lesser availability of *B. murrayi* among the various samples collected from Andaman waters. Presence of *B. murrayi* was notable only at Carbyns Cove. At rest of the sites the complex consisted of *B. rotundiformis* and *B. plicatilis*. The representatives of other species are specific for certain areas but *Brachionus* species complex is common for all the areas. The rotifers identified during this study are *Brachionus plicatilis, B. rotundiformis, B.murrayi, B.urceolaris, B. calyciflorus, B. falcatus and Kellicotia sp.* (Plates 1-7)

Different types of rotifers available in Andaman water

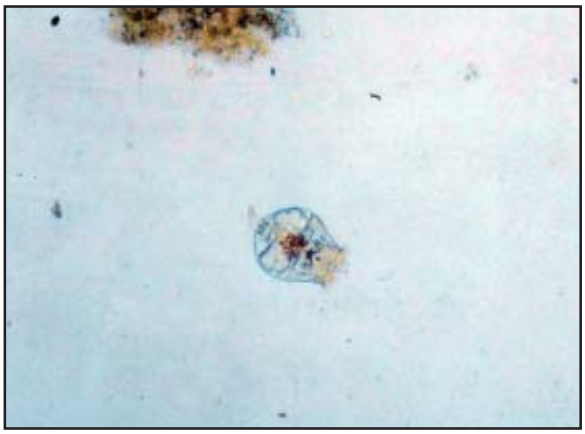

Plate 1. *Brachionus calyciflorus*

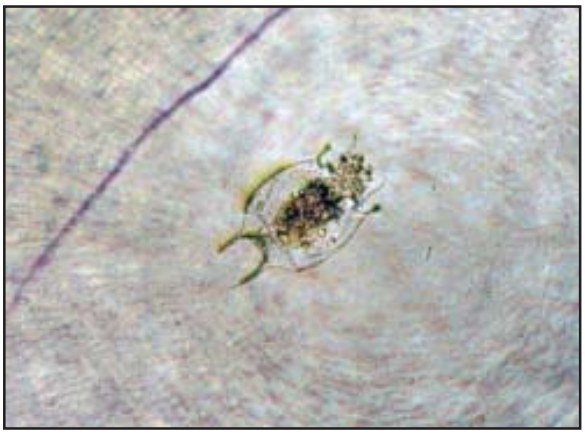

Plate 2. *B. falcatus*

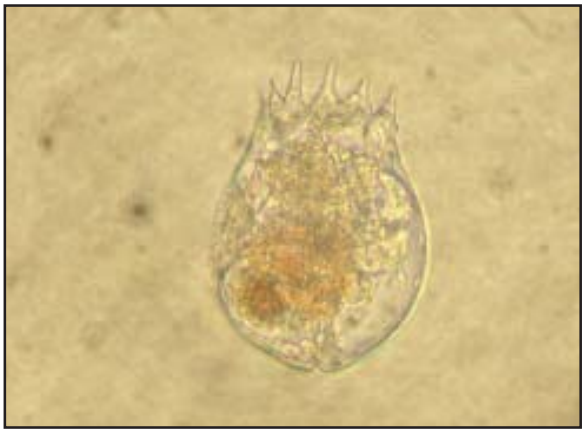

Plate 3. *B. murrayi*

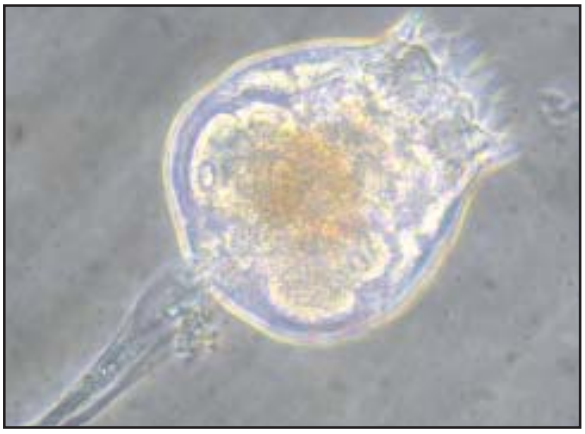

Plate 4. *B. plicatilis*

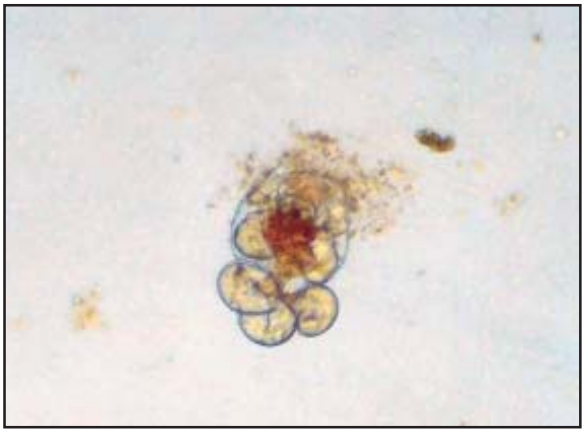

Plate 5. *B. rotundiformis*

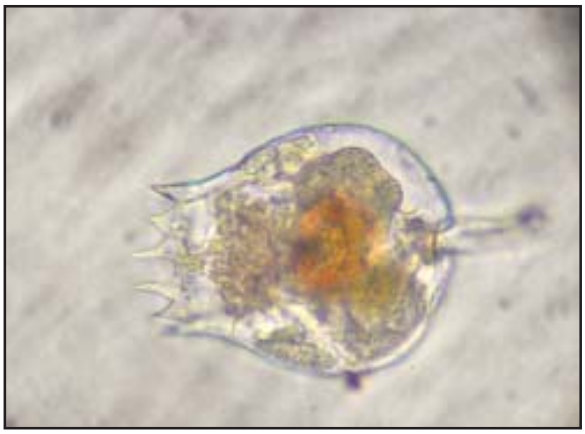

Plate 6. *B. urceolaris*

Plate 7. *Kellicotia species*

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

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

A major research effort was necessitated to understand the distribution, biology, population dynamics and ecology of the species and the effect of fishing effort on the resources. Data on these aspects are basic for suggesting any management and development measures. During nursery phase seed of *Trochus niloticus* is required to be given protection in the sea against predators. Sea ranching in appropriate area needs to done taking into account the ecology and nutritional requirement of *Trochus*. Transect survey was carried out to find out the distribution of *T. niloticus* in various localities of the Island.

Table 1. Distribution of *T. niloticus* in different locations.

Surveyed places	Month	Survey (10m x 20m)	No. of organism
Havelock	Jan-08	200 sqm	8
Phongi Balu	February-08	200 sqm	15
Chidyatappu	February-08	202 sqm	18
Tarmugil Island	February-08	203 sqm	16
Jolly Buoy	February-08	204 sqm	15
Boat Island	March-08	200 sqm	22
Jolly Buoy	March-08	201 sqm	14

Table 2. Detail regarding substrate of Top shell's (*T. niloticus*) habitat.

Different components	Transect 1 (140 Mt)		Transect 2 (113 mt)	
	in cm	%	in cm	%
Rock	850	6.07		
Rubble	1150	8.21		
Sand	1810	12.93	3000	26.55
DC +Sand	670	4.79		
Live coral	**2740**	**19.57**	**1540**	**13.63**
Dead Coral (DC)	2790	19.93	1020	9.03
DC+ Algae	3300	23.57		
Sand + DC + Algae			5200	46.02
Sand + Algae	60	0.43		
Soft coral	560	4.00	510	4.51
Others	70	0.50	30	0.27
Total %	**14000**	100.00	11300	100.00

Table 3. Hydrographical parameters of the areas surveyed.

Surveyed places	Month & Yr	Temp (Air) °C	Temp (Wt) °C	D O (mg/lit)	Salinity (ppt)	pH	CO_2 (mg/lit)	Alkalinity (mg/lit)
Havelock	Jan-08	32	29.5	6.1	34	8	0	135
Phongi Bolu	Feb -08	33	30	5.3	33	7.5	0	133
Chidyatappu	Feb -08	32	30	5.4	33	7.8	0	125
Tarmugil Island	Feb -08	32	30	6.2	34	8	0	130
Jolly Buoy	Feb -08	31	29.5	6.4	33.5	7.8	0	140
Boat Island	March-08	32	30	6.3	34	8	0	130
Jolly Buoy	March-08	30	29	6.3	33.5	7.9	0	128

T. niloticus were found in near shore areas as well as in the coral reefs areas (Plate 8). Along with the Trochus various other gastropods and coral reef fishes were also recorded in the coral reef area surveyed.

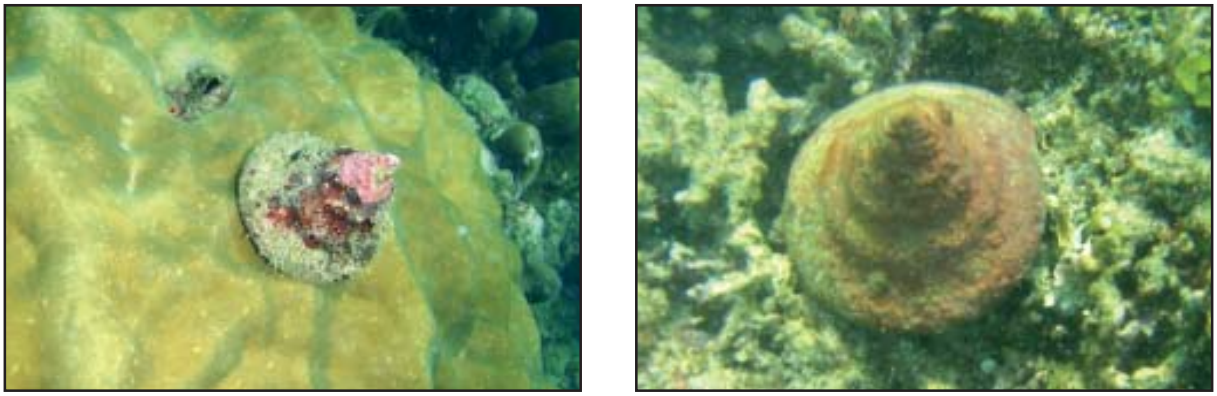

Plate 8. *Trochus niloticus*

Table 4. Associated fauna of *Trochus* habitat found in the transects.

No	Species	Transect 1	Transect 2
1	*Conus amadis*	3	4
2	*Lambis lambis*	10	8
3	*Trochus niloticus*	2	4
4	*Pinctada margaritifera*	3	2
5	*Crassostrea rivularis*	4	-
6	*Tridacna crocea*	50	30
7	*Sea anemone*	5	3
8	*Culcita schmideliana*	1	-
9	*Linkea laevigata*	1	1
10	*Holothuria atra*	14	9
11	*Holothuria scabra*	3	5
12	*Sticopus variegatus*	5	2

Table 5. Reef fishes found in the Trochus habitat.

No	Species	Transect 1	Transect 2
1	*Epinepheleus merra*	3	1
2	*E. hexagonatus*	2	-
3	*Lutjanus decussatus*	-	2
4	*L. kasmira*	1	4
5	*Chaetodon auriga*	5	7
6	*C. trifasciatus*	4	3
7	*C. vagabundas*	3	-
8	*Amphiprion percula*	15	7
9	*A. ephippium*	2	-
10	*Chromis dimidiatus*	20	34
11	*Dascyllus aruanaus*	3	5
12	*Siganus spinus*	-	3
13	*Zanclus cornutus*	4	3
14	*A. lineatus*	3	4
15	*Caranx hippos*	6	

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

S. Dam Roy and Grinson George

About 42 species of ornamental reef fishes from North Bay were collected and catalogued. All the 42 specimens are being preserved at Marine Research Laboratory.

Table 6. List of ornamental reef fishes from North Bay

Family	Species Name
Lethrinidae	*Lethrinus variegates*
	Monotaxis grandoculis
Pomacentridae	*Dischistodus perspicillatus*
	Chromis margaritifer
	Abudefduf vaigiensis
	Premnas biaculeatus
	Amphiprion percula
	Abudefduf sordidas
Holocentridae	*Sargacentron rubrum*
	Myripristis adusta
	Sargacentron ittodai
Lujjanidae	*Lutjanus lemniscatus*
	Lutjanus bohar
	Lutjanus decussates
	Lutjanus russellii
Apogonidae	*Apogon fraenatus*
	Apogon cookie
Chaetodontidae	*Heniochus acuminatus*
Muraenidae	*Gymnothorax fimbriatus*

Family	Species Name
Serranidae	*Anyperodon leucogrammicus*
	Epinephelus longispinis
	Epinephelus fasciatus
	Epinephelus merra
	Epinephelus ongus
	Epinephelus faveatus
	Epinephelus areolatus
	Cephalopholis cyanostigma
	Cephalopholis argus
	Cephalopholis leopardus
	Cephalopholis boenak
Siganidae	*Siganus canaliculatus*
	Siganus virgatus
Mullidae	*Parupeneus barberinus*
	Parupeneus macronema
Nemipteridae	*Scolopsis bilineata*
	Scolopsis ciliate
	Scolopsis xenochrous
	Scolopsis taeniopterus
Balistatidae	*Balistapus undulates*
	Melichthys indicus
Labridae	*Thalassoma hardwicke*
	Thalassoma lunare

Plate 9. *Premnas biaculeatus*

Plate 10. *Amphiprion percula*

Plate 11. *Parupeneus species*

Plate 12. *Lutjanus decussates*

Plate 13. *Heniochus acuminatus*

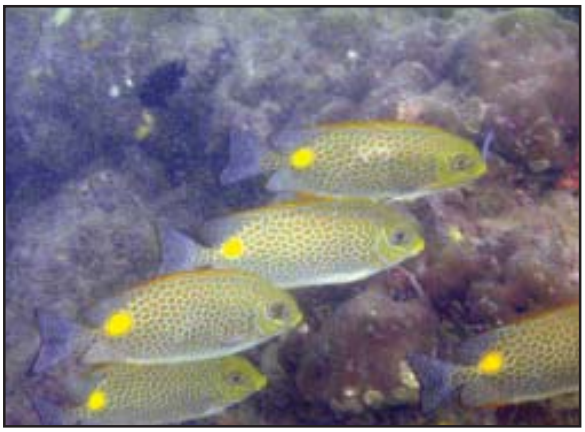

Plate 14. *Siganus species*

Plate 15. *Scolopsis bilineatus*

Plate 16. *Balistapus undulates*

Further, for exploring the possibility of germplasm variations, a study was conducted to differentiate tilapia adapted to various ecological niches in Andaman waters using microbial and molecular (RAPD) techniques. Notable differences were obtained among the microbes isolated and in the RAPD finger printing done between freshwater and brackish water Tilapia.

Five Species of microbes *Vibrio sp., Streptococcus sp., Salmonella sp., Aeromonas sp., Pseudomonas sp.*, were isolated from both fresh and brackish water fish samples. But *Pseudomonas sp.* was found only in brackish water fish sample. This is in par with the previous studies where the presence of *Pseudomonas sp.* was reported earlier from brackish water and marine samples. Some studies from freshwater areas also reported the presence of *Pseudomonas sp.*, but were not envisaged in the present study. Absence of *Stephylococcus sp.* as different from earlier works is notable. But this cannot be taken for consideration of reduced pollution level as presence of some other organisms like Enterobactor Species is an indicator of

anthropogenic influence. Among the isolates *Vibrio sp*. was very few in numbers. Rests of the Species were spread throughout the media with an exception of *Psuedomonas sp*. The dominance of *Enterobacter* species in the study indicates the human interference or faecal contamination.

Brackish water and fresh water fishes were showing a typical cluster at 73% similarity level in the dendogram (Figure 1) when 18 different samples were analyzed. The dendogram is showing less variation (94% similarity) with the species samples of fw 6 (fresh water samples 6) and bw7 (brackish water samples 7), which is not even attributed among similar samples taken within freshwaters and within brackish water. It is evident that fishes are thriving in both the environments with a similar genetic makeup with a difference of only 6% as envisaged in the present sampling and primer usage. Hitherto, this is an indicative result on how the study can throw light on intra species adaptations to two different osmotic environments. Similarly a cluster formed at 89% similarity level between fw9 (fresh water sample9) and bws 8 (brackish water samples 8) is a clear corroborative evidence for above-mentioned statement.

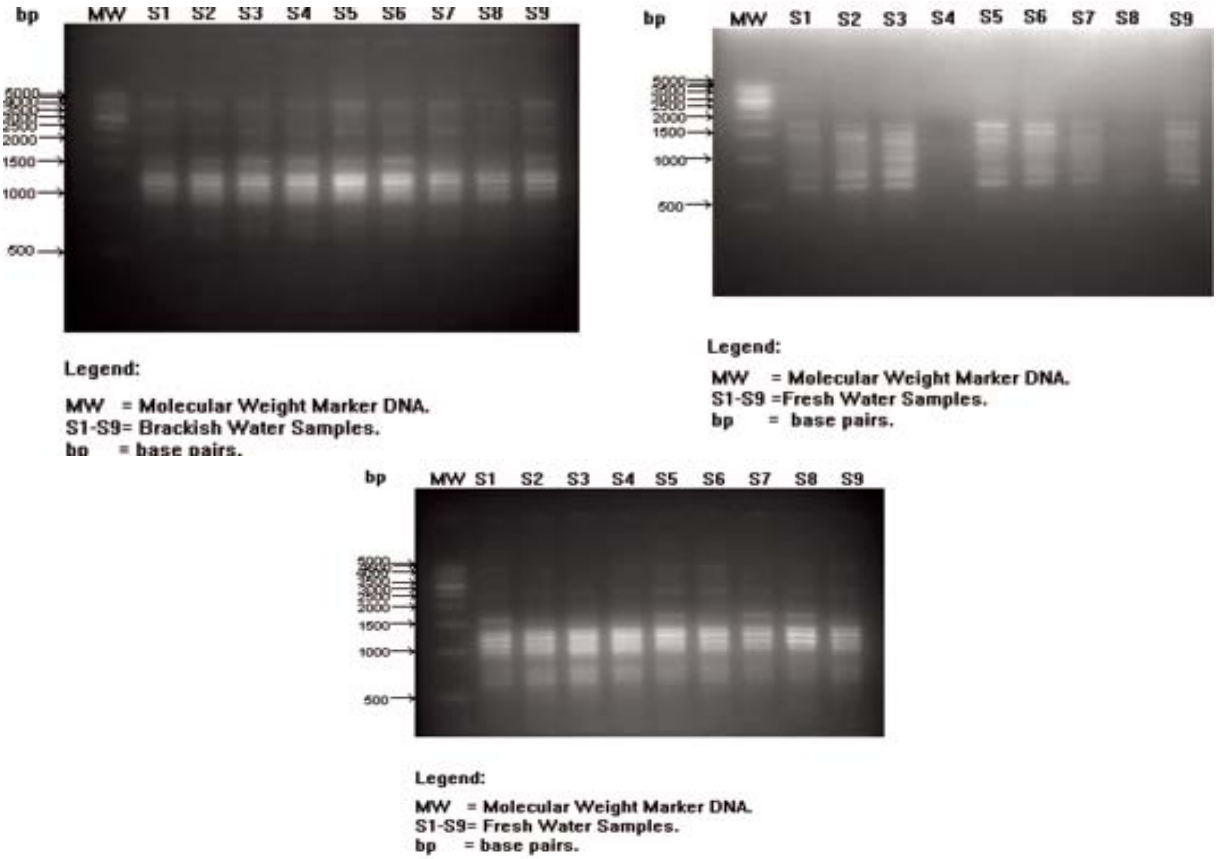

Plate 17. RAPD Analysis using primer no. 6 and 2

Plate 18 and Figure: 1 RAPD analysis and Dendogram showing genetic similarity of 18 different samples of Tilapia *O. urolepis*

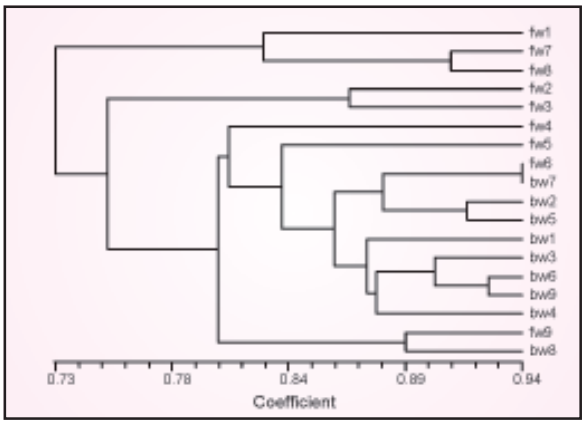

Figure 1

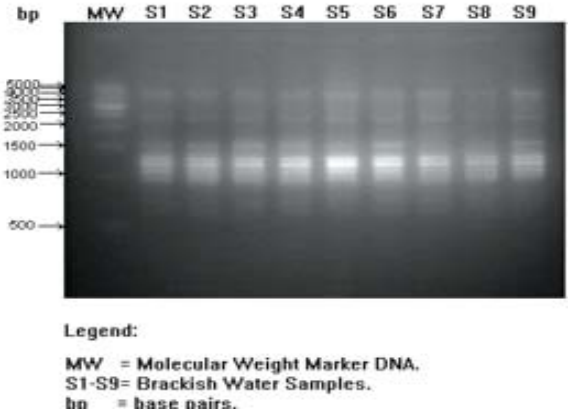

Figure 18

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, G. George, B. Varghese and S. Murugesan

Andaman and Nicobar Islands are blessed with innumerable bays and creeks where cage culture can be taken up with commercial important fishes like grouper, snapper, seabass etc. Cage culture project has been initiated to find out the suitable candidate species for the culture as well as for standardisation of design of the cages in relation to hydro dynamics of the selected site. Ten nylon cages (size 5'x4'x2') have been procured from CIFA, Bhubaneswar, Orissa. A design has been made and fabrication of the cages is in progress. Mean while several species of grouper and snapper fishes has been collected from different landing centres and biological parameters has been studied. A total of 20 species of grouper and 5 species of snapper have been identified. Average length and weight of grouper and snapper recorded in the present study is presented in Fig 2 & 3. A laboratory trial was also conducted with 4 locally available feed ingredients *ie*. fish flesh, mussel meat, chicken waste and mixed feed (equal percentage of all other feeds) on a grouper species *Cephalopholis microprion*. From two months study it was found that mussel meat gave the best result, followed by fish flesh. Chicken waste gave the least growth in this species. This indicates that species can be cultured in cages by providing either mussel meat or fish flesh (Fig 4).

Table 1. Grouper and snapper species collected from different landing centres of South Andaman.

Grouper	
1	*Aethaloperca rogaa*
2	*Cephalopholis argus*
3	*C. boenak*
4	*C. formosa*
5	*C. microprion*
6	*C. sonnerati*
7	*C. urodeta*
8	*C. miniata*
9	*Cromileptes altevelis*
10	*Epinephelus areolatus*
11	*E. longispinis*
12	*E. tauvenia*
13	*E. bleekeri*
14	*E. fasciatus*
15	*E. fuscoguttatus*
16	*E.s malabaricus*
17	*E. merra*
18	*Plectropomus pessuliferus*
19	*Variola albimarginata*
20	*V. louti*
Snapper	
1	*Lutijanus kasmira*
2	*L. russeli*
3	*L. gibbus*
4	*L. decussatus*
5	*L. argentimaculatus*

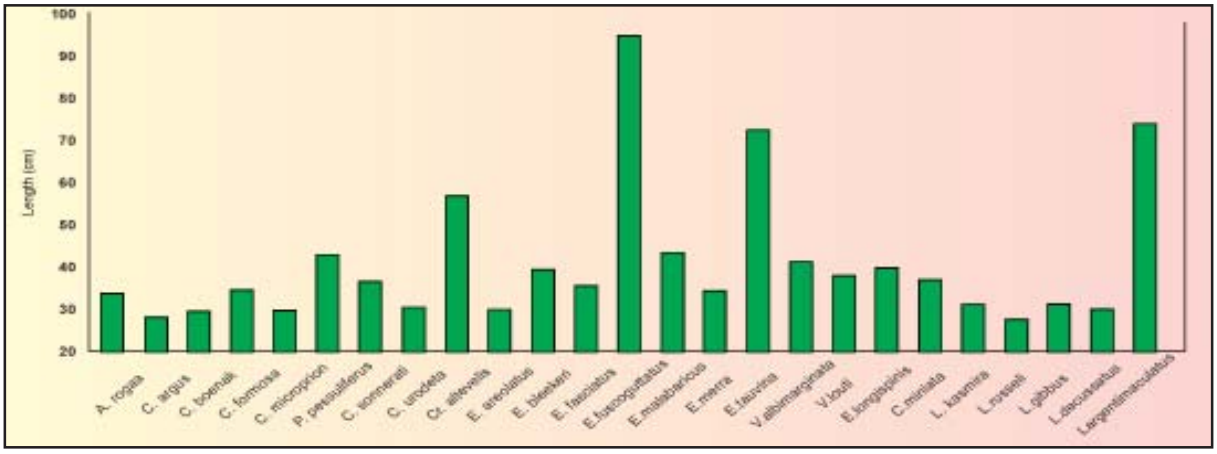

Fig. 2. Average length of grouper and snapper collected from different landing centres of Andaman.

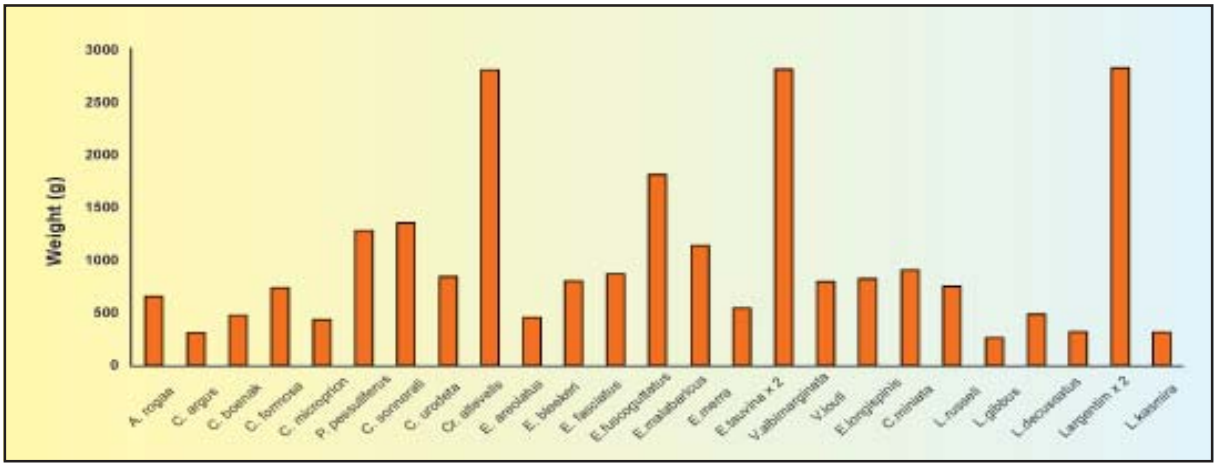

Fig 3 : Average weight of grouper and snapper collected from different landing centres of Andaman

Commercially important marine fishes

Plate 19. *Aecthaloperca rogaa*

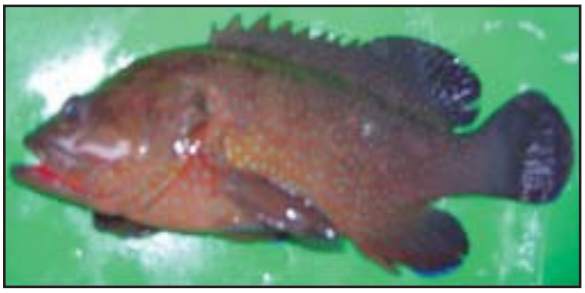

Plate 20. *Cephalopholis microprion*

Plate 21. *Cephalopholis urodeta*

Plate 22. *Epinephelus aerolatus*

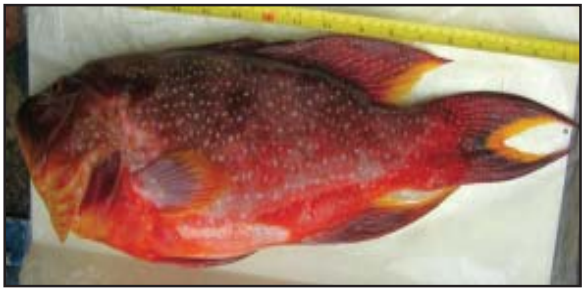

Plate 23. *Variola louti*

Plate24. *Variola albimarginata*

Plate 25. *Lutijanus kasmira*

Plate 26. *Lutijanus russeli*

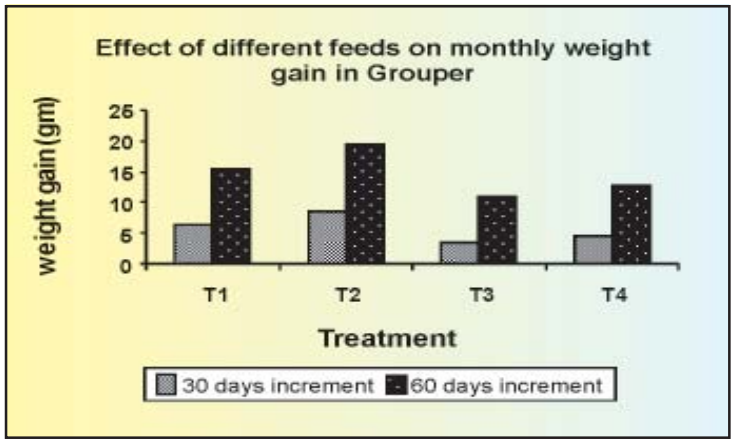

Fig 4. Effect of different feeds on monthly weight gain in Grouper

TEMPORAL AND SPATIAL VARIABILITY OF WATER QUALITY PARAMETERS AND MINERAL PROFILE OF WATERS OF ANDAMAN AND THEIR IMPACT ON SHELL FISHES AND FIN FISHES

Kamal Sarma, S. Dam Roy, Grinson George, C. S. Chaturvedi, Benny Varghese and Murugesan

The aquatic environment of Andaman and Nicobar Islands are one of the most diversified and fragile ecosystem harbouring rich genomic resources, unique to the island condition. Natural calamities (like earth quake, Tsunami, Global warming) and anthropogenic activities (like mining, pollutants etc) are continuously acting upon this environment and causing alteration in the physico-chemical and biological characteristics of the waters. Water quality conditions like salinity, temperature, pH and dissolved oxygen play significant role in general health condition (survival, growth and reproduction) and distribution of the organisms. Hence, this study has been initiated to collect the information about the seasonal variability of water quality parameters of Andaman and to establish correlation with the organism level like mineral profile and also to explore possibilities for judicial utilization of information related to environmental parameter for aquaculture purpose. After thorough studies six sampling sites has been identified namely Chatham: Ship passages, Phoenix Bay jetty: organic pollution site, Potential aquacultural site: Sippighat, Mangrove site: Sippighat, Coral reef site: Wandoor, Minimum disturbance site: North Wandoor. The sampling has been started from the month of March '08. A preliminary study was also conducted on effect of salinity of the growth and survival of *Liza tade* under experimental condition. Fishes are procured

from Sippighat brackish water nallah of Andaman and Nicobar Island having average length (cm±std error) and weight (gm±std error) of 8.15±0.08 and 7.202±0.13 respectively and salinity at the time of collection was 18 ppt. Fishes were acclimatised for about 30 days in laboratory condition prior to experiment. Fishes were exposed to eight different salinity viz. 0, 10, 15, 20, 25, 30 and 35 ppt after slowly increasing or decreasing the salinity. Monthly length and weight, and water quality parameters were recorded. Normal feed were given at the rate of 5% of the body weight throughout acclimation period and also during experiment. The study was conducted for a period of three months. The results indicate (Fig. 5&6) that overall growth was not very encouraging in this species. Maximum growth in terms of weight was achieved at 15 ppt salinity followed by 10 ppt salinity. At 0 ppt salinity (fresh water) showed 93.3% mortality by the end of 3 months of culture period. No other mortality was recorded in other salinity condition indicating that this species can tolerate wide fluctuation of salinity condition. At 25 ppt negative growth was observed in the fishes mostly in the initial period. This is mainly due to the mechanical injury caused during siphoning of fishes.

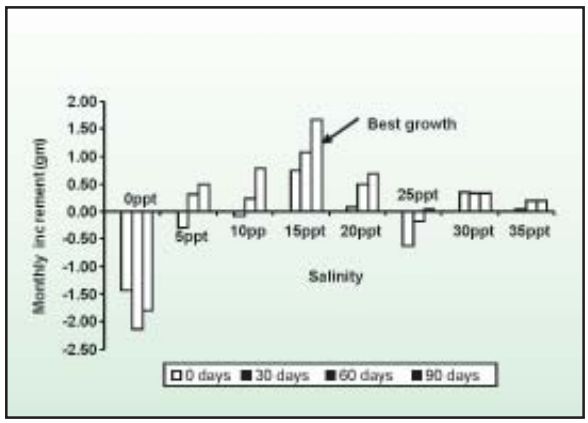

Fig 5. Effect of salinity on monthly growth increment of L. tade

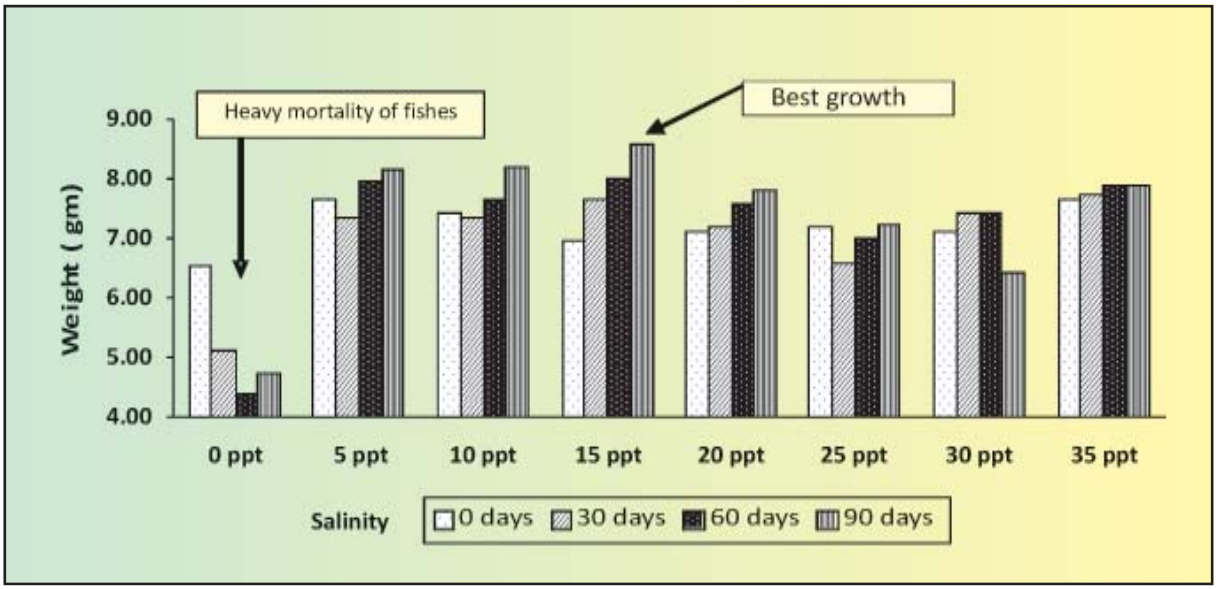

Fig 6. Change in average body weight of *L. tade* in each months in different salinity

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

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

The objective of the project was to survey mangrove stands of North, South and Middle Andaman in order to assess the impact of Tsunami, earthquake and man made activities in those areas. Physico-chemical characteristic of mangrove water ways and soil were recorded with standard analytical techniques and well defined proforma collection of mangrove plants and animals for the impact study. The detail information on biodiversity was also collected. Managemental strategies were worked out for the restoration and reclamation of mangrove area. Strategies were formulated for the conservation of resources in order to protect mangrove biodiversity.

The earthquake (9.0 Richter scale), which struck Andaman and Nicobar Islands on 26th December 2004 and the consequent Tsunami have caused considerable change on the mangrove stands of Andamans. The tidal waves that swamped the mangrove stands have affected the giant fern *Acrostichum aureum* and aquatic sedge *Fimbrisstylis littoralis*. The true mangroves viz *Rhizophora spp., Brugeira spp., Avicennia spp., Sonneratia spp* etc. have also got affected in various degrees based on their physiological response to the continuous inundation/exposure under the changed scenario.

In South Andaman in particular localities 30-80% mangrove stands have got affected. In the Middle Andaman the impact is negligible whereas in the North Andaman due to elevation of land, the seawater is not reaching

Plate 27. *Rhizophora spp.*

Plate 28. *Avicennia spp*

Plate 29. Mangrove area

Plate 30. Arecanut plantation

Both destroyed due to tsunami

Table 8. Species wise distribution of mangrove in Shoal Bay area

Name of the species	Site No. A (%)	Site No. B (%)	Site No. C (%)	Average (%)
Scyphiphora hydrophyllacea	0.9	4.2	15.3	5.4
Lumnitzera littorea	0.9	3.7	13.0	4.6
Heritiera littoralis	2.7	2.1	1.8	2.4
Rhizophora apiculata	59.8	46.6	9.4	43.6
Rhizophora mucraonata	22.0	12.2	5.2	15.0
Bruguiera gymnorrhiza	3.4	4.8	8.2	5.0
Bruguiera cylindrica	0.0	0.5	1.8	0.7
Ceriops tagal	3.7	16.4	28.9	13.3
Sonneratia alba	0.3	1.1	1.2	0.7
Xylocarpus granatum	2.1	2.6	2.4	2.4
Acrostichum aureum	4.3	3.7	5.3	4.4
Flegellaria indica	0.0	1.1	4.7	1.5
Phoenix paludosa	0.0	1.1	2.9	1.1

some of the mangrove. Some visible impact has been felt in the habitat of various finfishes and shell fishes. A detail survey of Mangrove stands of Andaman *vis a vis* Tsunami and Earthquake has been carried out in the affected sites of Sippighat, Chouldari, Wandoor, Loha Barrack, Ograbraz, Minnie Bay, Rangat, Mayabunder, Karmatang, Danapur, Dabidera, Baludera. Photographs of the affected mangroves were taken. The water parameters of mangrove areas were analyzed. The affected species of the

mangrove were identified and recorded. To study the mangrove ecosystem, regular survey work has been carried out at Shoal Bay area of South Andaman to find out the distribution and abundance of different mangrove species. The major groups of Mangroves found are *Rhizophora apiculata* account for 43.6%, *Rhizophora mucraonata* for 15.0 % and *Ceriops tagal* for 13.3%

BRACKISHWATER AQUACULTURE AS AN IMPORTANT COMPONENT IN INTEGRATED FARMING SYSTEM

R. C. Srivastava, S. Dam Roy, Grinson George, Kamal Sarma, S. Murugesan and Benny Varghese

The objective of the project is to develop an integrated farming system based on brackish water aquaculture, incorporating components of horticulture, medicinal plants and poultry.

After the December 2004 Mega earthquake and subsequent Tsunami about 4000 ha area has been affected by the ingress of sea water, out of which about 630 ha area are found to be suitable for shrimp culture. The vast inundated wetlands of South Andaman can be looked upon as a site promising innovative shrimp farming, which will be an alternate livelihood source for the farmers affected by Tsunami. The difficulties rendered by tsunami can be converted positively for an innovative shrimp-farming venture.

Integrated Brackish water Aquaculture can be very promising in context with the agricultural scenario of Andaman and Nicobar Islands. Since inundation of arable lands with Tsunami waters necessitated in developing alternate livelihood opportunities for affected farmers, Shrimp farming appeared as a lucrative and sustainable venture. It was thought of integrating shrimp culture with horticultural components such as planting medicinal plant (*Viz. Morianda citrifolia)*, spices like black pepper, cinnamon, nut meg, plantation crop like aracanut, coconut in the bund area of the pond.

Tiger prawn seeds (PL-20) produced from Andaman mother shrimp at multi-purpose hatchery at MRL, Marine Hill were transferred to a temporarily constructed farm site at Sippighat of a farmer to see the growth response. Since there is no regular supply of inputs for a shrimp farmer, the management practice was almost nil with the feed given in the form of chicken waste, which was available free of cost from a near by poultry center. Still the growth was notable and a production of 15 kg of shrimp at the rate of Rs.250/- per kilogram was made from an area of 600 m^2 of water spread, which was otherwise remaining unused in the post-tsunami scenario. CARI has successfully demonstrated the seed production of *P.*

INTEGRATED FARMING SYSTEM

Plate 31. Shrimp culturing pond

Plate 32. Shrimp seeds provided by CARI-KVK

Plate 33. Tiger prawn (sampling for harvest)

Plate 34. Harvested prawn

Plate 35. Poultry Shed

Plate 36. Nicobari fowl

monodon and transferred the seed to farmers field for an on-farm trial under an extensive farming system. This will act as a benchmark for further technical-interventions to enhance the production and profit.

After the harvest of first crop the pond was cleared off unwanted weeds and the silt were also removed. The bund was strengthened and in bund area *Morinda citrifolia* and black pepper were planted along with already existing coconut plants. The farmer was given chicks of Nicobari fowl, which was kept in the small poultry shed built in the vicinity of the pond.

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, Kamal Sarma, S.N. Sethi, Grinson George and Benny Varghese

Under this research project, a new model Cat fish Hatchery was designed and developed in CARI. A flow through system was developed for breeding of Magur and Singhi species. About 20 Kg of *C. batrachus* & 5 kg *H. fossilis* fishes were procured from different localities such as Chouldari, Guptapara, Manjeri, Rangat and Junglighat in an around Port Blair. These fishes were reared in fiber glass tank in controlled condition. After a culture period of 6 months the fishes have grown to the size of 15 – 20 cm with an average weight of 100 – 120 gm. Breeding experiment of cat fishes (20 sets) were tried successfully and fry and fingerlings of Magur and Singhi were produced and distributed to private fish farmers for culture. The research project successfully initiated the breeding activity of Indian Magur for the first time in Bay Islands. A total number of 5000 Magur seed were produced. Out of which only 1800survived which were sold.

Plate 37. Adult Magur

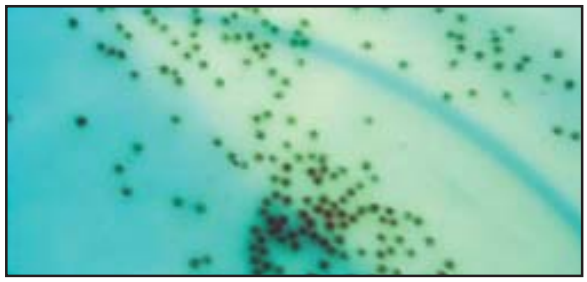

Plate 38. Fertilized eggs

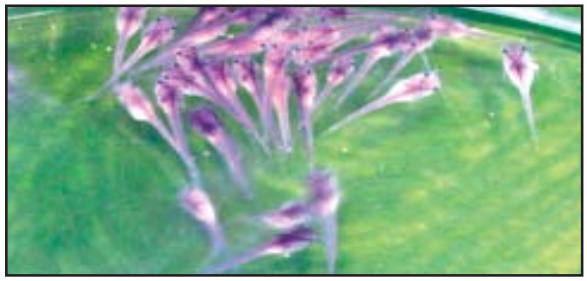

Plate 39. Magur fry

ASSESSMENT OF CORAL REEF HEALTH USING SATELLITE IMAGES

S. Dam Roy, P. Krishnan and Grinson George

In order to assess the health status of Andaman reef, three indices have been created in concurrence to the national level model being developed for assessing reef health by SAC, Ahmedabad. According to the model there are three different sets of Operational Ecosystem Reference Points (OERPs). Warning Index has been generated based on the Leading OERPs. Ecological Index has been generated based on Co-incident indicators and the Lagging indicators have been helped to generate the Damage Index. The leading OERPs can be used to give an early warning directly for any reef region. If any region is found to be exhibiting these OERPs, they are then marked as hotspots and given early warning signal for monitoring the taking management actions. It is also observed that the effect of these OERPs is highly dependent on their frequency and duration of occurrence along with the current state of the reef and location of the reefs. In Andaman, the SST rise was noted in March and May 1998, 1999, 2004 and 2005. Turbidity is also high here post-tsunami. Table cited below illustrates the classification of Rani Jhansi Marine National Park as per the indices generated by the model and ground truth studies:

Table 9. Reef health indices developed for Rani Jhansi Marine National Park and the status of Reef

Index	Remarks
Warning Index = 3.5,	Reef is under moderate stress
Ecological Index = 2	Reef has Medium Ecological Value
Damage Index =3	Reef is under Medium Damage Condition, Damage here is mainly due to erosion.
The Reef Health Index (RIII) = EI + DI = 5	Currently reef is in Degrading condition

Important coral species of Andaman

Plate 40. *Acropora spp*

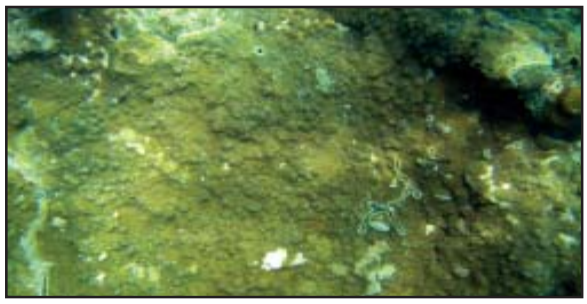

Plate 41. *Montipora spp*

Plate 42. *Porites spp*

Plate 43. *Pocillopora spp.*

Plate 44. *Serriatopora spp*

Plate 45. *Fungia spp.*

Plate 46. *Favites spp*

Plate 47. *Soft coral*

WSSV INCIDENCE AND MOLECULAR CHARACTERIZATION OF TIGER SHRIMPS, *Penaeus monodon* OF ANDAMAN WATERS

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

Penaeid shrimp occupy a pride of place both in culture and capture fisheries of India. They constitute a major export earning of 80% by value and 60% by volume of the total marine food export of the country. Andaman has been considered as a potential source for supply of WSSV free brooders to the mainland hatcheries. There a need for a report based on scientific study on the resource abundance and WSSV incidence for deciding the level of brooder exploitation that can be permitted in Andaman waters.

Monthly samples of Tiger Prawns and possible carriers of WSSV were collected from Betapur & Chouldari. The Viral DNA from the collected samples were extracted and detected using nested PCR techniques developed by CIBA using Bangalore Gene kit. It was found that infection rate was 17.77% in 2007, however it was 35% in 2006. In the present study mild infection of WSSV was found in tiger prawn *Penaeus monodon* and Banana prawn, *Ferropenaeus merguensis*.

Tiger Prawns were collected from three main landing centers of Andaman, Chouldari (South Andaman), Betapur and Rangat (Middle Andaman). Pleopode muscle of the prawns were collected and kept in absolute ethanol during transportation. Specimens were stored –80°C. The extraction of Genomic DNA from frozen or fresh muscles tissue was performed by standard SDS-Phenol/Chloroform method. Six random primer used by Tassankajan (1997) was used for genetic characterization of individual and among population of *Penaeus monodon*. The RAPD-PCR data was subjected to cluster analysis using NTYSYS 2.02 system program to estimate similarity indices and genetic relatedness among the 18 different samples. Based on the DNA fingerprinting data, the genetic distances were used to construct a dendrogram using SM´s similarity coefficient for all the 18 different samples following UPMGA method using NTYSYS program. Option SAHN (sequential agglomerative hierarchical non-overlapping) was performed which resulted in the dendrogram. Based on this results samples collected from Chouldari (South Andaman) having 27% polymorphism with other samples Betapur and Rangat (Middle Andaman). Samples collected from Rangat having 10% polymorphism and Samples collected from Betapur having 8.5% polymorphism. The studies showed that samples collected from Chouldari (South Andaman) having 27% polymorphism compared to another two stocks of Middle Andaman may be due to geographical barrier which is more than 200 km distance.

COASTAL ZONE STUDIES

S. Dam Roy and Grinson George

The coastal zone can be divided/classified into three regions such as fallow: sub littoral, littoral, and supra littoral based on the tidal flux. The last two zones (littoral and supra littoral) are focused for the coastal zone studies as they are the two important livelihood structures of coastal community. They can protect the coast from storms such as hurricanes, soil erosion, Tsunami, and can stabilize the coastlines. Coastal zone habitat for many marine organisms such as fish, crabs, oysters, and other invertebrates and wildlife such as birds and reptiles, in addition to that they serve as nurseries and refuge for many marine organisms which are of commercial or sport value in the form of ecotourism. The endeavour of a coastal zone study is to create the image of coastal zone components for mapping ecosystems like reefs and mangroves. The mapping is envisaged by utilizing satellite images which are verified by ground truth observations. This map may help both fishermen as well as scientists and policy planners. In the mean time it helps assessing the health status of corals and mangroves with the use of the satellite be done. In our study the images have taken by the IRSIC/ID LISS III data of 2002 – 2003 & IRS P6 LISS III & LISS IV data of 2004 – 2006 satellite. Ground truth is being carried out at reef sites of Rani Jhansi Marine National Park, Havelock and in Mahatma Gandhi Marine National Park, Wandoor. Mangroves are studied in and around Shoal Bay and Porlob Jig.

Important corals of all sites

Plate 48. *Acropora species*

Plate 49. *Montipora species*

Plate 50. *Goniopora species*

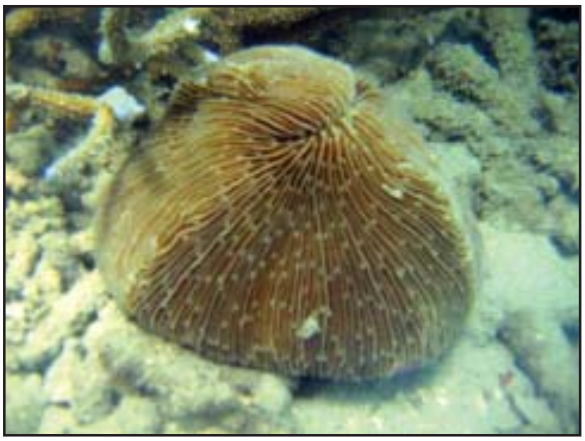

Plate 51. *Fungia species*

Important mangrove species in Shoal Bay and Porlob Jig Creeks

Plate 52. Rhizophora species

Plate 53. Bruguiera species

Plate 54. Ceriops species

Plate 55. Sonneratia species

Plate 56. Scyphiphora species

Plate 57. Lumnitzera species

Social Science Section

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

Subhash Chand, R. Raja, V. Jayakumar, S. Jeyakumar and S.N. Sethi

This project was undertaken in order 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 production constraints after Tsunami.

Data collection from the farmers of the five affected villages namely Chouldari, Mithakari, Guptapara, Wandoor and Stewartgunj was done thrice; one, immediately after tsunami (2004-05) and another two in the year 2005-06 and 2007-08. The average family size of the respondents was 6.04 with an average family composition of 2.40 adult male, 2.02 adult female, 0.90 male and 0.72 female kids. Village wise Stewartgunj had comparatively larger family size (10.50) followed by Wandoor (6.42), Guptapara (5.30), Mithakhari (4.63) and Chouldari (4.39).

It was revealed that the old generation was mostly involved in farming practices, while younger ones were found inclined towards service sectors. The average age of the family head was found to be 49.88 years, which varied from 43 to 58 years.

The experience in paddy, plantation, vegetables, pulses, dairy, poultry, fisheries, services and business were found to be 31.18, 15.08, 25.66, 4.95, 21.41, 25.62, 2.51, 9.17 and 2.07 years respectively. Maximum tsunami affected farmers of South Andaman i.e. 62.60% were having the education up to primary school level, followed by 17.60 % with secondary education, 3.60 % with higher secondary, 3.00% with graduation, whereas 13.20% farmers were illiterate.

Before the tsunami devastation, most of the affected were living in semi pucca, (41.18 %) followed by katcha (43.13 %) and semi-pucca (15.69 %) type of houses, but after tsunami majority of them (53.33 %) were shifted to pucca houses followed by intermediate shelters (41.67 %) and only 5% of the farmers are still living in the katcha type of houses, because of their socio-economic conditions.

The study revealed the overall average land holding size of tsunami affected farmers of sample area were 1.92 ha including the allotted (1.69 ha) and encroached land (0.29 ha). In the pre-tsunami period the major part of the land was under paddy cultivation (1.13 ha) followed by plantation (0.25 ha), vegetables (0.19) and pulses (0.05 ha). The remaining 0.30 ha was used for housing, ponds or as fallow land. The tsunami and subduction of land mass affected on an average 1.21 ha land of which paddy land is

the worst affected one. During the year 2005-06 the paddy cultivation was done only in 0.19 ha land. Now, there is slight increase in land utilization under different crops when compared between just after tsunami (2004-05) and the subsequent years i.e. 2005-06 and 2007-08. The result with respect to status of land affected by tsunami is presented in Figure 1.

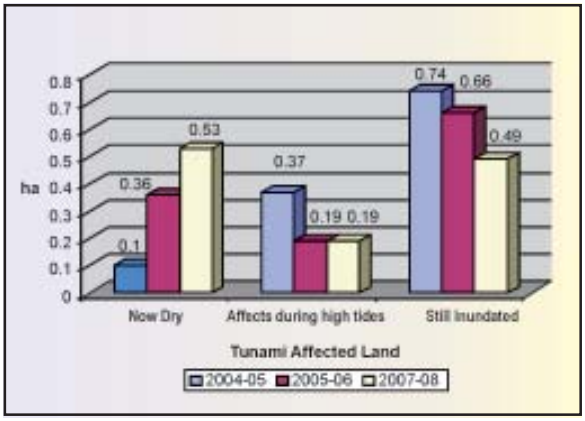

Fig 1. Status of Tsunami affected land (In ha)

Based on sample survey it was observed that, there was considerable reduction in livestock holding due to tsunami. This was accounted for cattle 3.27 to 0.73, buffalo 0.92 to 0.25, goat 2.85 to 0.68 and for poultry birds 86.49 to 32.49 per family after tsunami. There was significant drop in the production level of milk (4.48 to 0.98 litres) and egg production (from 18.20 to 7.23) per day per farmer in the study area.

In the pre-tsunami period (2003-04) the average annual income of affected farmers were Rs. 78067/- but in the year of Tsunami i.e. 2004-05 the annual income was reduced to Rs. 53763/-. In the subsequent years i.e. 2005-06 and 2007-08 the farm sector contributed only 18 % and 19 %, respectively of the annual income which shows the shift of livelihood of tsunami affected farmers to non farming sectors. The average annual income of the respondent in 2004-05 was lower than that of the subsequent year (2005-06) i.e. Rs. 53763/- and Rs. 62040/- per annum per year respectively. This indicates the loss of standing crops by tsunami and the farmers had comparatively higher dependency on agriculture in pre-tsunami. Presently i.e. 2007-08 the average annual income (Rs. 70004/-) increased over previous year marginally.

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

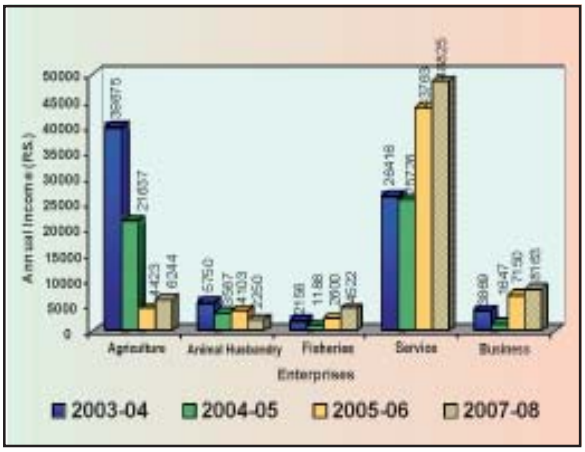

Fig 2. Income pattern of tsunami affected farmers (In Rupees)

AN ECONOMIC ANALYSIS OF FLORICULTURE POTENTIAL IN ANDAMAN AND NICOBAR ISLANDS

Subhash Chand, D.R. Singh and R. C. Srivastava

Socio Economic Features of Flower Seller

A total of 6 flower seller from different parts of South Andaman were randomly selected and surveyed. It was observed that most of the flower seller are with low educational status and does this business as a subsidiary occupation. They started this business about two decades back but still their business is not in advance condition. The study revealed that the major mode of flower selling i.e. 75 percent of flowers is sold through shops, 10 percent through door to door distribution. These sellers purchase / produce flowers and sale by different modes as mentioned above. This provide them part time employment and livelihood.

The demand, type of flower and its quantity is presented in table 1. The result revealed that during Durga Puja there is a huge demand of loose flower as well as garland in these islands. Hence the farmers can grow the flowers to coincide the with festive season which will fetch high profit margin. Apart from Durga puja other festivals also create high demand of flowers such as Diwali, Holy, Pongal etc.

Table 1. Demand of Flowers during different Festivals and Occasions

Festivals	Type of Flower	Quantity Demanded
Durga Puja	Loose flower, garland	Very high
Diwali	Loose flower	High
Pongal	Loose flower	Low
Holy	Loose flower	High
Marriage	Loose flower	Moderate
Other Festivals	Loose flower	Low

Source of Flower and Related Materials

The results related to source of flower and related materials in the market of islands are presented in table 2. The local supply of flower is meager being only 6 percent of the total consumption. And rest of the 94 percent comes from mainland. Chennai leads with 76 percent and Kolkata supplies 18 percent of the flowers. Due to the transportation of flowers from mainland the flowers are costlier and supply is erratic. The flowers that are not sold are stored in refrigerators by the flower seller, those do not have the facilities kept the flower as such which eventually getting spoiled. Hence, proper storage mechanism has to be devised.

Table 2. Source of Flower and Related Materials

Sl. No.	Major Sources	Quantity from each source (%)	Purchase Price (Rs. / kg)	Selling Price (Rs./ kg)
1		**Local Growers**		
a	Calicut	2	100 - 150	150 - 200
b	Maccapahar	1	100 – 150	150 – 200
c	Diglipur	3	100 - 150	150 – 200
2		**Main Land**		
a	Chennai	76	125 - 190	200 – 250
b	Kolkata	18	125 - 191	200 - 250

Demand projection for different purposes

The demand projection of flowers for different purpose and festivals are presented in table 3. The study revealed that the annual demand of flower in these islands to be 9746.09 Qt. of which the major demand of flower i.e. 9375 Qt. per annum is from women. They place them on hair as gajaras or loose flowers on many occasions. During festivals especially in Durga Puja the demand is high.

Table 3. Demand Projection for different purposes

Sl. No.	Purposes	Quantity per Annum Demanded (Q)	Amount (Rs.)
1	Women	9375.00	117187500
2	Different Functions		
a	Durga Puja	323.53	4044125
b	Pongal	53.54	669200
c	Diwali	9.89	123673
d	Christmas	0.20	2500
e	Tourist	0.05	625
f	Govt. Functions	1.60	20000
g	Death Ceremony	1.00	12500
h	Other Functions	35.62	445190
	Total	**9746.09**	**127505313**

Constraints in Floriculture

Table 4 indicates the major constraints faced by flower growers and the sellers in these islands. The study revealed that the major constraint faced by them is lack of cold storage and marketing facilities. This leads to huge post harvest loss of flowers leading to higher sale price of flowers. Lack of finance and scientific knowledge also adds to the suffering of the flower seller and growers. The other constraints faced by them are price fluctuation, lack of good quality seed materials and man power.

Table 4. Constraints in floriculture

Major Constraints	F=11	Percent to Total
Lack of good quality seed materials	6	55
Lack of finance	10	91
Lack of scientific techniques	9	82
Lack of marketting facilities	11	100
Price fluctuations	7	64
Lack of cold storage	11	100
Lack of man power	5	46

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

Subhash Chand, S. Jeyakumar and Raj Vir Singh

A study was conducted to compare tehsil and village wise distribution of milch animals, farmer size categories, their type of house hold and their 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.

A comparative study on the practices of Artificial Insemination (A.I.) and Natural Services (N.S.) followed by the farmers in Port Blair and Ferrargunj tehsil for the dairy animals was carried out along with the frequency of the sex of the calves. An overall picture from the results revealed that frequency of AI was little more (53.32%) than NS (46.68%). It was also found that there was little difference regarding the sex of the calves born through AI (50.69% male and 49.31% female). On the other hand there was slight difference observed in case NS where 55.79% calves were male and rest 44.21 were female. In case of local animals the percentage of adoption of AI was lower (36.42 %) than NS (63.58%) on the other hand majority of the crossbred cows were done AI (86.44 %) with low NS rate (13.56 %). The practice of AI in buffalo was meager (1.75 %) in the study area.

Different productive and reproductive traits of different dairy animals were assessed. A comparison of age at first calving (AFC) among different species maintained by sample households revealed that AFC was lowest for crossbred cow (3.13 years) followed by local cows (3.69 years) and buffaloes (3.73 years). The average lactation period was

observed to be more in case of crossbred cows i.e., 10.12 months followed by buffaloes (8.79 months) and local cows (8.48 months) respectively. It was found that, crossbred cows had shorter dry period of 6.29 months followed by buffaloes (7.37 months) and local cows (9.03 months) indicating specific breed characteristics and also the better managemental care including feeding followed for crossbred cows than the buffaloes and local cows in the study area. The highest intercalving period was found to be 17.72 months in case of local cows followed by the crossbred cows (16.46 months) and buffaloes (16.09 months).

The total investment was found to be highest in case of crossbred cows followed by local cows and buffaloes (Fig.3).

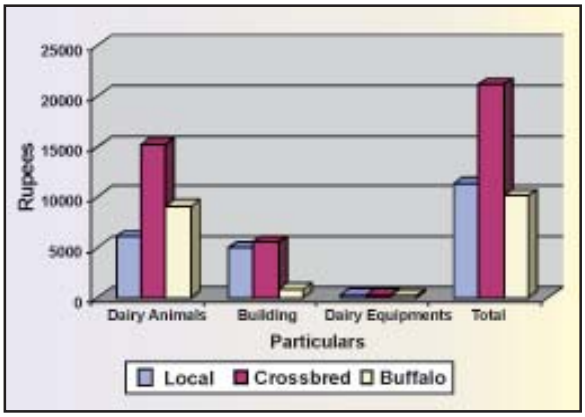

Fig 3. Breed / Species wise comparison of Investment Pattern.

The highest net return was observed in case of buffalo farming in both rainy and dry season followed by crossbred and local cows (Fig. 4). A category wise comparison evinced that in case of local cows, net income was found to have an increasing trend with increase in farm size. In case of crossbred cows and buffaloes, net income was highest for large farmers followed by small farmers and medium farmers.

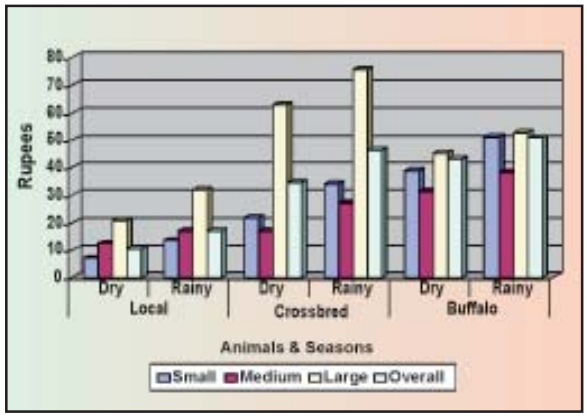

Fig 4. Comparative net returns of different animals in different seasons in different farm-size categories.

The percentage of breakeven output to total output was lowest in buffaloes followed by crossbred cows and local cows in all the farm categories. This is a good indicator in choosing the animal for dairy farming by different strata of people. The study revealed that the major channel existed for marketing milk is directly selling it to the consumers by the producer followed by society, vendor and shop with respective percentage share of 57.49, 18.94, 10.48 and 0.36 %. The same trend was noticed in both Port Blair and Ferrargunj Tehsils.

Framework of milk marketing channel and price spread

There are four marketing channels for milk as shown in (Fig. 5) viz., Producer – Vender – Consumer, Producer - Cooperative Society – Consumer, Producer - Tea shops – Consumer and Producer – Consumer.

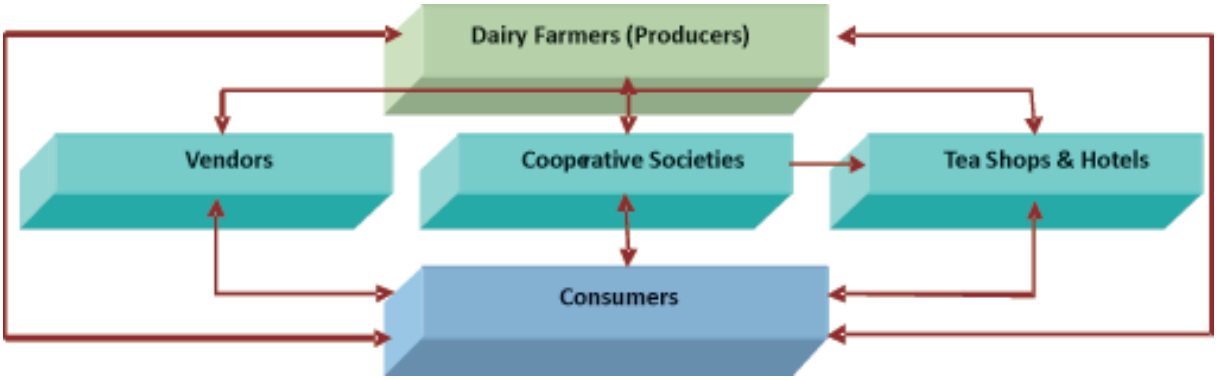

Fig 5. Marketing channels for milk

It was revealed that producer's net price in absolute as well as relative term varied channel to channel and it was highest in the case of Channel IV followed by III, II and I channels. The cost incurred by teashop and hotels was higher 16.07 percent followed by Cooperative society (14.58%). The net margin to Channel I was found to be higher (28.30%) as compared to Channel II and III. In case of net price received by the producers, milk marketing Channel IV and same time consumer price was also remunerative. The consumer price was lower in the case of market Channel II. Thus, Channel II was found to be best. The consumer may have to go towards Cooperative Societies to get milk at remunerative price. It is expected that the price of milk charged by the Cooperative Society may get reduced if marketed surplus increased in the study area.

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, Subhash Chand, R.C. Srivastava and S.K Zamir Ahmed, Krishna Kumar and T.V.R.S. Sharma

Schedule was prepared for data collection which involves the parameters such as rice varietal spectrum in the different islands, weather parameters, yield components, soil parameters and pest and disease index. Secondary data was collected from developmental departments and CARI. Development of algorithm based on the available data has been initiated.

Information on rice cultivation and distribution in different rice growing areas of South and North Andaman were collected. The collection of this valuable information and subsequent documentation would help in classifying different rice areas and for developing suitable technological backup. It

will help the breeders to understand as to why some varieties adapt so well and provide them insight to formulate breeding programmes to develop good varieties. This would also help rice breeders to develop location specific rice varieties with improved quantitative and qualitative traits. Information on quantitative and qualitative descriptors along with weather parameters such as rainfall, relative humidity, number of sunshine hours and other relevant parameters would help in developing rice pre-harvest forecasting model that would also help in forecasting yield as well as production of prominent varieties grown in different ecologies of the country well before harvest. Hence in order to forecast the rice yield in advance for the policy makers and varietal information to breeders, this project has been conceived. Schedules have been prepared for data collection which included the parameters such as rice varietal spectrum in the different islands, weather parameters, yield components, soil parameters and pest and disease index. Secondary data were collected from developmental departments and CARI. Compilation of data is in progress.

Collected rice varietal spectrum from South & North Andaman, Region wise weather, parameters were collected (A & N Statistics),Yield components, Soil parameters, Pest and disease index

In this study the following data has been collected from South and North Andaman from various resources. Yield of different varieties grown are presented in figure 6.

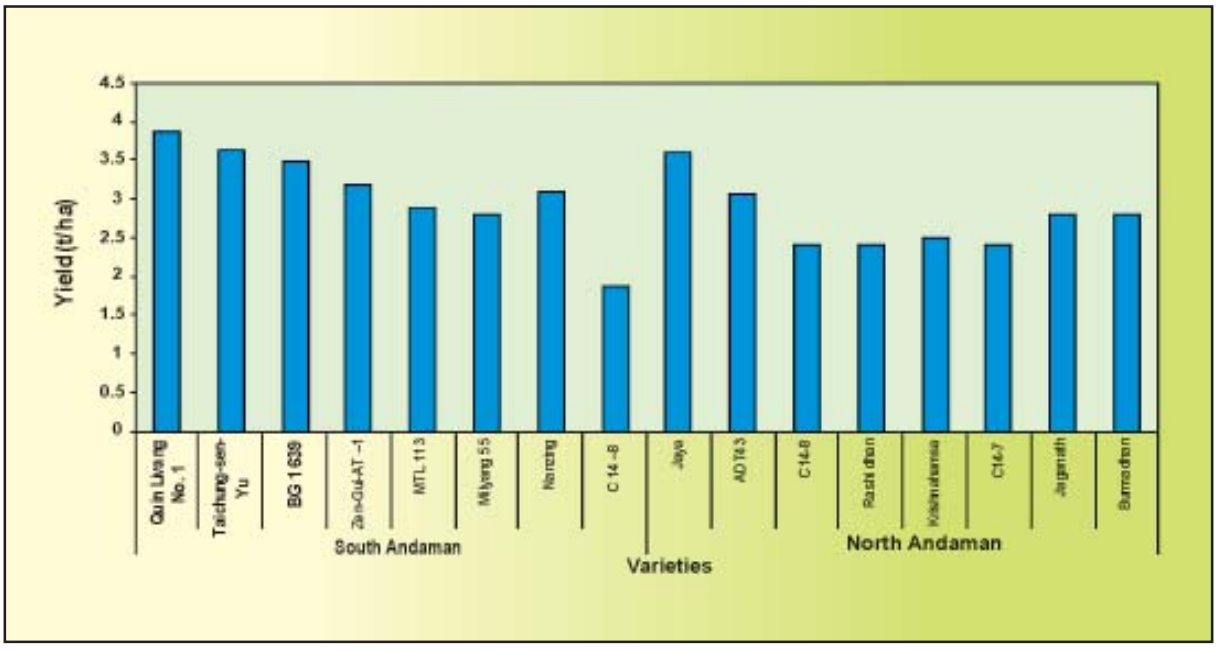

Fig 6. Yield of varieties grown in South and North Andaman

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

M. Balakrishnan, S. Jeyakumar, R.C. Srivastava, T. Sujatha and A. Kundu

The project was conceived during August 2007 with the specific objectives to collect primary and secondary data on livestock and poultry germplasm of Andaman & Nicobar Islands; and develop a database on animal genetic resources and farming system of Andaman & Nicobar Islands.

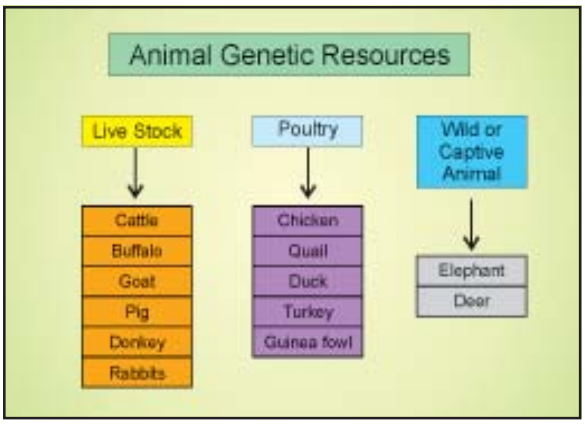

Fig 7. Database design for AGRANI

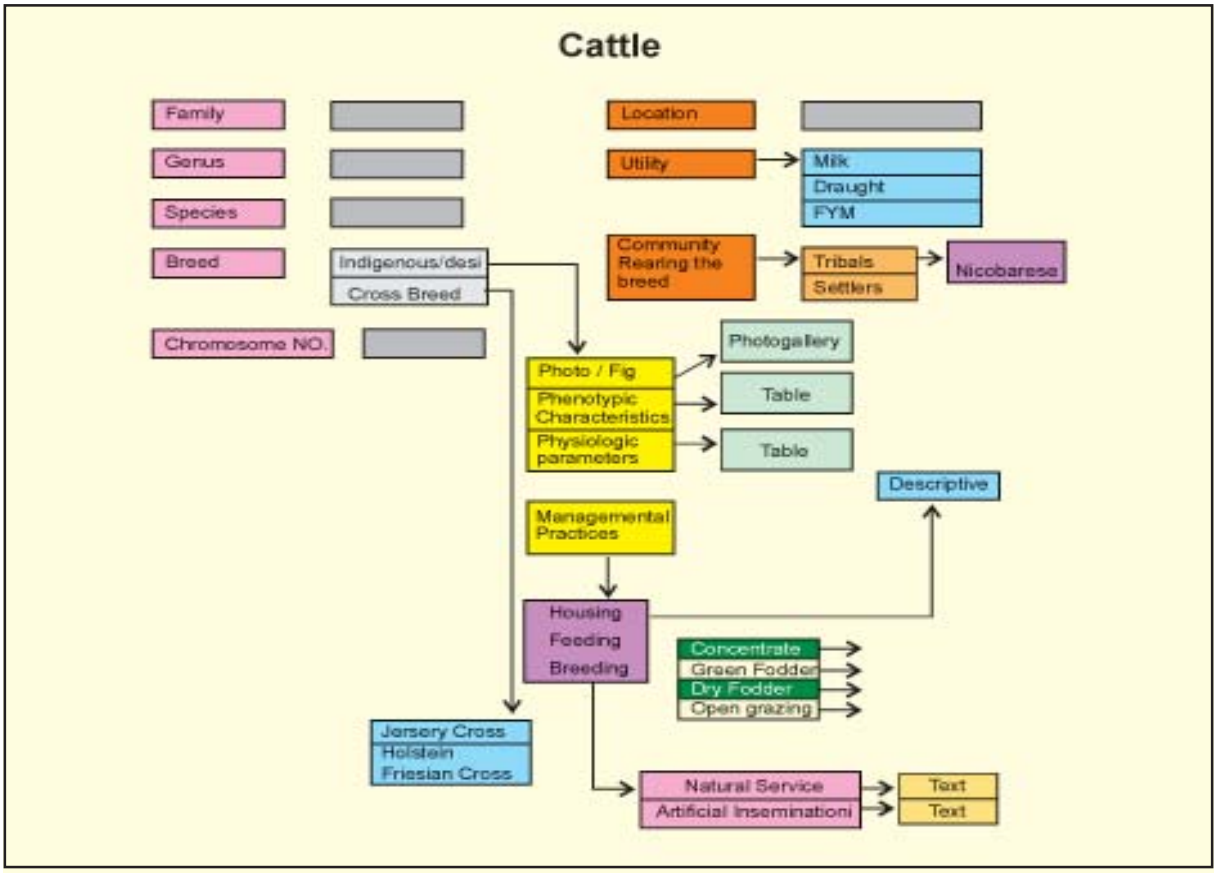

Fig 8. Data entry form for Cattle

Fig 9. Data base for AGRANI

Animal husbandry is fast emerging as one of the viable enterprises among the farming community of Andaman and Nicobar islands of late. This is mainly because of the shrinking land availability for the crop husbandry, especially after tsunami. Hence a need was felt to catalogue and develop a database of information comprising the available livestock breeds of these islands. It contains description and basic set of information on every breed, variety or line of genetic resources of cattle, goats, pigs and poultry in Andaman & Nicobar Islands is shown in the following figures 8 and 9 and it is entered in the tabular format preparation of schedule Created the tables using MS access is initiated. Created templates for entering the data using with the help of HTML.

The database named as AGRANI has been developed and it will be updated regularly and soon it will be linked to CARI Website

An Information System on Animal Genetic Resources of Andaman and Nicobar Islands (AGRANI) has been developed by using ASP at the front end and Microsoft Access at the back end. All the forms have been designed in the form of a single package. The database design is such that it can store information on all aspects of animal genetics resources in an integrated form. This menu driven database has the facility to store district-wise information on animal resources w.r.t population, infrastructure, production, farms, on every breed, variety or line of genetic resources of cattle, goats, pigs and poultry in Andaman & Nicobar Islands.

DEVELOPMENT OF DATABASE ON FODDER RESOURCES AND WASTE LAND IN BAY ISLANDS

M. Balakrishnan, S.K. Verma, S. Jeyakumar, N. Ravisankar, A. Kundu, S.P. Yadav, Subhash Chand, S.K. Zamir Ahmed and R.C. Srivastava

The project was conceived during August 2007 with the specific objectives to collect data on fodder resources of A & N Island and to develop a database on fodder resources of Andaman & Nicobar Islands in view of emerging importance of animal husbandry in post tsunami scenario.

Hence the need was felt to catalogue and develop a database of information comprising

the available fodder resources and waste land of these islands with the following constraints viz., low livestock population, low productivity, present situation of fodder resources & feeding methods, lack of knowledge on fodder resources and their cultivation practices among the farming community.

A schedule has been prepared for data collection. Secondary data collected from developmental departments and CARI. It contains description and basic set of information related to fodder resources related information like name ,scientific name and yield etc., Created the tables using MS access is initiated. Created templates for entering the data using with the help of ASP. The designed template is presented in fig. 10.

Fig 10. Data base design for fodder resources

IDENTIFYING LIVELIHOOD OPTIONS AND TRAINING NEEDS COMPATIBLE TO SELF HELP GROUPS TO FRUCTIFY THESE OPTIONS

S. K. Zamir Ahmed, Subhash Chand, M. Balakrishnan & R.C. Srivastava

Empowerment of women is one of the agenda of the policy makers and Self Help Group Promotion is one such attempt in these islands. As on March, 2007, after 15 years of the launching of the SHG mission in these islands, 1,500 groups have been promoted of which only 260 have been credit linked (around 17%). An ex-post-facto study was conducted in the same year to unfold the ground reality by randomly selecting 190 SHG's as samples from North, Middle and South Andaman of Andaman & Nicobar Islands with main emphasis on the involvement of Self Helf Group Promoting Agencies (SHGPA), genderwise distribution, strength, corpus fund, livelihood enterprises practiced,expenditure pattern of income and impact of training who had been credit linked between 1996 to 2006 and interviewed through well structured interview schedule and observation technique.

Finding revealed that out of twenty three SHGPA functioning in these islands, only eleven were found to be involved in facilitating credit linkage of the groups from South, Middle and North Andaman.

National Co-operative Unit of India with 134 groups, A & N State Co-operative Bank (19) and Krishi Vigyan Kendra of Central Agricultural Research Institute (13) have acted as the leading agencies (Table 5).

Table 5. Involvement of SHG Promoting Agencies

Sl.No.	SHG Promoting Agency/ Place	Groups Promoted (No.)
1.	NCUI South , N & M Andaman	134
2.	A&N SCB ltd. South, N & M Andaman	19
3.	KVK-CARI South Andaman	13
4.	Surabi, South Andaman	7
5.	Mahila Vikas Kendra (MVK) South Andaman	5
6.	Yuvashakti South Andaman	3
7.	Vivekananda Smrity Samity, South Andaman	3
8.	Dweep Youth Club (DYC), South Andaman	2
9.	Unnathi South Andaman	2
10.	ACANI, North & Middle Andaman	1
11.	Swaraj Vikas, Brindaban, South Andaman	1
	Total	**190**

percentage of credit linkages over the saving linkages is comparatively low which may be due to lack of knowledge of SHG principles by promoting agencies, target oriented work of the Non-Govt. agencies and lack of accountability, which leave the group in nomands land just after day one of the promotion of the group. Majority of them (78%) comprises of women followed by mixed (15%) and men (7.0%) with 1754, 314 & 152 as member respectively (Table 6 & Fig. 11). This also indicates that groups with women as member are leading and are more successful group because of the reason that they are homogenous in nature, compatible to each other and pro-active in taking any enterprising activities comparatively.

Table 6. Strength of SHG in Andamans

Members	No. of groups
6-7	9
8-14	136
15-20	45
Total	190

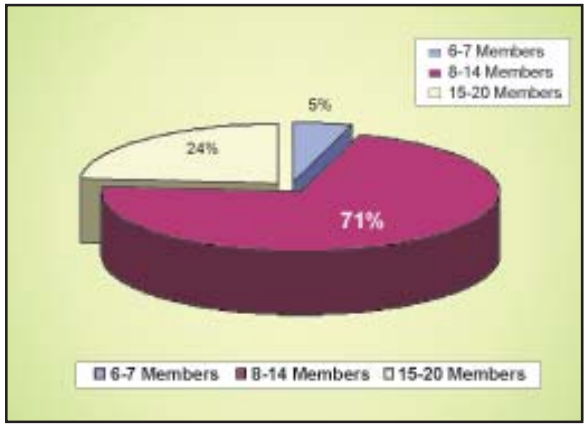

Fig 11. Distribution of SHGs based on the member strength

On viewing the strength (size) of the group, majority (72%) of them were found to have 8 to 14 members followed by 23% with 15 to 20 and only 5% with 6 to 7. So the size of the group in the island was to the tune of 8 to 14 members respectively Analysis of the corpus fund available with the groups and its utilization of livelihood manifested that majority of the groups (65%) had corpus money in the range of Rs. 45,000/- as minimum and Rs. 75,000/- as maximum. They took up a total of twenty two (22) livelihood enterprises in the field of agricultural sector. viz Goatry, Poultry, Copra business, Arecanut business, Piggery, Vegetable , Fish marketing, Beetel plantation, Cow rearing, Buffalo rearing, Duck rearing, Vegetable growing, Flower cultivation ,Vegetable shop, Coconut business, Mushroom cultivation, Dry fish marketing, Milk business, Dairy unit, Crab business, Egg business & Coir making and thirty three (33) in non-agricultural sector i.e. Soft toys making, STD Booth, Grocery shop, Puja stall, tailoring, Embroidery, Stationary shop, Handicraft works, Pan shop, Tea stall, Masala marketing, Canteen, Snacks items making, Broom making, Cloth business, Tution centre, Muruku business, Masala business, Beauty parlour, Electrical shop, Cycle shop, Laundry, Hotel, Supply of mid day meal to school children, Book binding, Ice making, Barbar shop, Computer job works, Bamboo unit, Nursery School, Gold covering, Cable TV connection & Moorthy making. Out of fifty five (55) livelihood options practiced majority of the group took up vocations in non-agriculture sector than agriculture sector. More ever preference was given to diary (16%) followed by tailoring (14%), goatry (13%), poultry (12%) whereas vegetable growing, fishing, arecanut business, pan shop shared 5% to 7% of the group activity. This indicated that agriculture sector has still got scope towards self employment.

Expenditure pattern on the erratic additional income derived from the petty enterprises practiced in unsystematic way reflected that education (50%), had got the maximum share followed by purchase of house hold item (25%) social events, health and nutrition shared (15% each), transport 6% and only 4% was kept for personal saving.

Impact of Customized Training for Decent Livelihood

A cross sectional analysis of 240 randomly selected SHG's members (respondents) who attended eight different training programmes viz., pig farming, quail farming, goat farming, mushroom cultivation, vermi-composting, floriculture, marine ornamental fish and protected cultivation in the year 2007 at CARI, Port Blair showed that on the whole the respondents who underwent training were found to be in the range of young (maximum) to middle age group, possessed middle level of both education and risk orientation, had low economic and scientific orientation but medium to high level of innovativeness was exhibited by the majority. Increase in

knowledge level to medium (71%) followed by high (17.50 %) was seen among the trainees after the training programme. Similarly overwhelming response among the trainees to the level of 70-80 percent was also exhibited after the completion of the training which justifies to the symbolic adoption of the technologies by the SHG's in their locality. The main approach to be adopted by the policy makers should be a bottom up peoples oriented rather than target oriented approach, fixing up of accountability, stock taking of the work undertaken to ensure facilitating decent livelihood to the women SHGs.

Farmers Field School (FFS) on IPM in rice

S.K. Zamir Ahmed and N. Ravisankar

Fourteen Week Programme on FFS in IPM on Kharif Paddy in collaboration with CIPMC, Port Blair was conducted from 27 July to 25th October, 2007 at Manjery and Guptapara cluster of villages in South Andaman with an objective to minimize the application of chemical pesticides and advocate the use of bio and neem based pesticides for control of pest. About 30 farmers attended the FFS at weekly intervals and got benefited.

Pesticide usage were not advocated instead neem based formulations were adopted. Damage due to case worm, yellow stem borer and leaf folder was very minimum when IPM practices were adopted by farmers against the chemical. However, not much variation was observed in the case of gundhi bug between chemical and IPM (Table 7).

Table 7. Performance indicators of paddy under IPM practices in farmers field

Performance Indicator	With chemical	With IPM
Damage due to YSB infestation (%)	11.3	5.6
Damage due to Leaf folder (%)	22.1	3.2
Damage due to Gundhi bug (%)	12.4	11.6
Damage due to case worm (%)	54.2	14.8

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

R.C. Srivastava, T. Damodaram, N. Ravisankar, S. Jeyakumar, Prashanth Deshmukh, S.K. Zamir Ahmed, M. Balakrishnan and C.S. Chaturvdi

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" in the adopted villages of Manjeri, Manglutan and Guptapara (three situations). A total 56 ha has been affected by tsunami in the adopted villages. Following three situations occurred after tsunami and for each situation appropriate technological interventions were taken up.

1. Low lying coastal areas where there is permanent stagnation of sea water and the depth of impounding increases with high tide (Plate 1).
2. Low lying coastal areas where sea water reaches with every high tide and recedes with low tide (areas affected with fluctuating sea water table (Plate 2).
3. Low lying coastal areas where sea water has intruded only during Tsunami and then receded permanently (Plate 3).

Situation I

For the first condition, the measures for alternate use of submerged area for aquaculture are being taken by administration. As this involves huge expenditure, it was not included in the project. However, for people who lost their livelihood source due to submergence, alternate livelihood sources by introducing / strengthening the animal rearing component was taken up. Under this, four programs were undertaken viz., goat farming, family poultry production for nutritional security and livelihood opportunities, correction of reproductive disorders and therapeutic measures in cattles and introduction of azolla as a feed supplement for backyard poultry.

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 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 one adult buck 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 goatary, Shri. Biranjan Das, a farmer of Manjeri ventured into dairying (Plate 4).

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 of 2-4 weeks old 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. 1000 per month through sale of eggs and poultry birds (Plate 5).

Incidence of Reproductive Disorders and Therapeutic Measures in Cattle under Village Condition

The incidence of different forms of infertility like delayed sexual maturity, anoestrus, repeat breeder, infantile genitalia was found to be the major limiting factor to productivity of cattle. Interventions were made in form of health camps where a total of 106 animals were treated. As a therapeutic measure, the infertile cattle were dewormed and they were supplemented with mineral mixture. Phosphorus injection was also given to the affected animals to improve the health condition. Based on the presence or absence of corpus luteum palpated during rectal examination, the animals were administered with PGF2 alpha and CIDR (Controlled Internal Drug Releasing Device) to bring the animal to normal cyclicity. Thirty percent animals were brought to normal cyclicity. An average increase of ½ to 1 litre per day in milk yield was recorded after the supplementation of mineral mixture (Plate 6).

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 B – carotene. Azolla cultivation technology in 2006 – 07 was disseminated to the tsunami affected farmers of Manjeri, New Manglutan and Guptapara village of South Andaman where the birds were fed with fresh Azolla (wet weight) @ 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 (Plate 7).

Situation II

For second condition, a sea dyke along with self operated sluice structure to arrest the ingression of sea water into the agricultural land was constructed. Once the overland ingression was stopped, three interventions were made in the area to enhance the productivity.

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

The affected areas were converted into cultivable land by the raised bed method. Beds were raised to a height of 1 feet from the ground level, coconut husks 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. The high value vegetables were grown on the surface of the raised beds. This facilitated survival of vegetable crops against the continuous and heavy rains as well as rise in the level of seawater. An average net profit of about Rs.,30,000/- from 1000 m^2 i.e Rs.3,00,000/- ha was achieved in the adopted farmers fields (Plate 8, 9 & Table 8).

The advantages of this technology are :

- Helps in increasing the soil mircrobial content content and also 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.

Table 8. Economics of raised bed cultivation

Particulars	Gross returns (Rs.)	Total Cost (Rs.)	Net returns (Rs.)* for 1153m^2
Net income of I year in 1153 m^2	56450	23271	**33179**
Total income /year / ha	489592	201830	287762

Broad Bed and Furrow (BBF)

Vegetable and fodder production in the bay islands are hampered because of shortage of space and excess rainfall during rainy season (June - December). The other major problems for vegetable production are extensive damage by giant african snail, bacterial wilt and water shortage in post monsoon period. Broad bed and furrow (BBF) is a technology identified to grow vegetables and fodders right in the midst of rice field. It involves making of broad beds (width 4 m, height 1m) and furrows (width 6 m, depth 1m) alternatively to provide drainage and standing water to the required crop *viz.*, vegetables and rice respectively. In addition to the vegetables, the BBF helps the farmer to include various IFS components like fish rearing in the furrows, fodder crops on the beds which in turn helps to include animal component in the system (Plate 10 & Table 9).

Table 9. Economics of Broad Bed & Furrow

Particulars	Gross returns (Rs.)	Cost (Rs.)	Net returns (Rs.)*	Net returns (Rs.)*/ha
Income from I year from 2000 m^2	52965	*40500	12465	62,325
Income from II year onwards	52965	20500	32465	1,72,325

*Making of BBF (through Hitachi) 20 hours @ Rs. 1000/hour **(One time investment)** 20000.00 for 2000 m^2

Integrated Farming System in Brackish Water Pond

The affected land was converted to brackish water aquaculture ponds with spill way facility to regulate the entry of sea water was intervened. Along the dyke, crops were taken in beds of size 1x5x0.1sq.m such as spinach, amaranthus, okra, fenugreek, bitter gourd, bottle gourd, pumpkin. Three rows of sweet potato were also taken along the slopes of the dykes. Plantation and fruits crops of coconut, Banana, Morinda has being taken. Fodder slips of Hybrid Napier and Para grass were planted along the sides of the ponds. Apart from the income from fishes in the brackish water, the crops on the embankments gave an additional initial income of Rs.2000 /- from fruits and vegetables in one year. The fodder that was naturally grown in the inner and outer slopes of the embankments was identified as a variety of buffalo grass whose palatability and nutrient analysis was analysed and recommended for feeding to the cattle and goats. This has catered the fodder requirement of the beneficiary especially during the dry season where the grazing land is limited and acute shortage of fodder occurs in the islands (Plate 11).

Situation III

For third condition, interventions were made in terms of Mat nursery for rice, crop diversification with vegetables, freshwater based integrated farming system and water resource development and management in participatory mode. The brief details of each intervention are as below:

Mat nursery and SRI Method of paddy cultivation

Mat nursery was demonstrated in the adopted villages for the first time in the entire Andaman and Nicobar Islands. Paddy varieties viz., Taichung – sen-Yu, Quing Livan No. 1 (Normal soil), BTS 24, SR 26B, CST 7-1 (Problem soil) were raised in a flat land (out side the field). Training cum field demonstration was arranged for the benefit of the farmers. 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. SRI method registered

significantly higher yield (3.00 t/ha) compared to conventional method of planting (2.00 t/ha) (Plate 12).

Crop diversification with introduction of vegetables

Crop diversification with vegetable and fruit crops forms the main part of the technological intervention in the affected villages. The vegetables like spinach, coriander, chillies, capsicum, French beans were introduced in the appropriate seasons with the suitable varieties already developed and screened in the research farms. This also led to the successful performance of the evaluated varieties in the farmer's field with the proper management practices and organic substitution of nutrients (Plate 13).

Freshwater pond based IFS

Freshwater ponds already exist and few have been constructed by A & N administration as tsunami rehabilitation package. To restore the livelihood, integrated farming system was adopted to fully utilize this resource. The embankment was effectively used to grow crops like coconut, arecanut, banana, papaya along with vegetables like pumpkin, bitter gourd, etc. Fodder whose scarcity was a major constraint in the milk production system in the islands was also introduced in the both inner and outer slopes which also protected the ponds against erosion. Poultry was introduced as additional income source over the ponds, whose droppings were utilised as the manure source for crop plants (Plate 14).

The income from the scarce land area increased singnificantly attributing to the overall improvement in the livelihood of the farmer. The income of the farmer increased from Rs. 12860/- to Rs.31280/- in one year from a pond of 1500m^2 area.

Water resource development and management in participatory mode through WUA

Lack of irrigation facilities is a major constraint in intensification of island agriculture. However, in addition to technology, the management of water resources is crucial for sustained utilization. With this in view, the water resources were developed by a combination of recharge structures and open dug wells. A series of gabion structures were constructed across the stream to enhance the ground water recharge and open dug wells of 2m diameter were dug along the stream to harvest the recharged water. To involve the stakeholders in water resource development and management, a Water Users Association was formed by farmers with active support from CARI. The basic purpose of the association was to involve the farmers in creation and management of the irrigation facilities in addition to other technological interventions undertaken by the institute as well as inculcating a sense of ownership of the assests created. The association was registered with registrar under societies act (Regd. No. 1296) (Plate 15 & 16).

Following are the activities of the association

- Empowering the farmers in creation and management of their irrigation facilities along with other technological intervention undertaken by the institute in their villages through participatory mode.
- The members participated in the bidding and the contract for ring well, gabion construction and tank construction was awarded to the association and the work has been successfully completed by community participation (Plate 17 & 18).
- Seedlings of vegetables were raised by the youth member of the association in the community nursery and it is being distributed to other interested members and other farmers of nearby village. A revenue of Rs 500/- has been generated.
- Cultivation of vegetables during rainy season has been initiated among the farmers through the adoption of raised bed with coconut technology.
- Youth wing of the association voluntarily came forward for doing agricultural related activities in the village like sharing labour charges among themselves.
- 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.
- After three years persuasion and motivation by the project intervention in the village the unemployed youths of Manjeri clubbed together to form a group under the umbrella of Water Users Association.

Impact of crop diversification and water resources development in the village Manjeri

Once the irrigations facilities were created the technology of crop diversification was introduced in to cultivation with high value and nutritious vegetables and fruits with scientific methods like suitable varieties, composting technologies, and bio pesticides. The area under the cultivation of these crops increased to 71 % from 29 % as evident from Fig. 1 and Table 10.

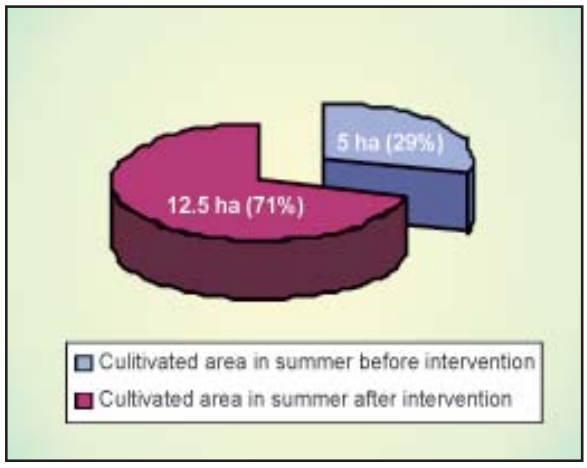

Fig 1. Impact of development of irrigation system in the adopted villages of Manjeri

Table 10 : Change of cropping Pattern and income after irrigation system

Technology	Before intervention	After intervention
Year		2007-08
Cultivated Area	5.0 ha	12.5 ha
Intervention	Nil	2
Crops taken	Pumpkin, bottlegourd, amaranthus	Chilli, brinjal, french bean, okra,Coriander, watermelon bittergourd, sweet potato, amaranthus, bitter gourd, pumpkin, raddish,fodder, Maize
Average income	Only subsistence farming (Self consumption)	Rs.35000/ beneficiary after family consumption
No of beneficiaries	Nil	18
Employment Generated	Nil	40
Adoption (%)	Nil	60

The intervention under the project has changed the total scenario of the village. The technologies have spread horizontally from Fig. 2 and the nutritional status of the adopted village has shown a sea change as evident from Table 11.

Table 11. Nutritional status of the adopted village before and after intervention

Name of the crop	Average consumption /family/ week before Intervention	Average consumption /family/ week after Intervention
Amaranthus	1 kg	4 kg
Cowpea	1 kg	2 kg
Okra	500g	1 kg
Gourds	1 kg	2 kg
French beans	Nil	500g (September – February)
Spinach	Nil	3 kg (August – March)
Asparagus	Nil	1 kg (August – March)
Papaya	500g	3 kg
Banana	2 kg	5 kg
Sweet potato	Nil	500g (August – March)
Water melon	Nil	2 kg / week (January – April)
Egg	10 nos	20 nos.
Milk		

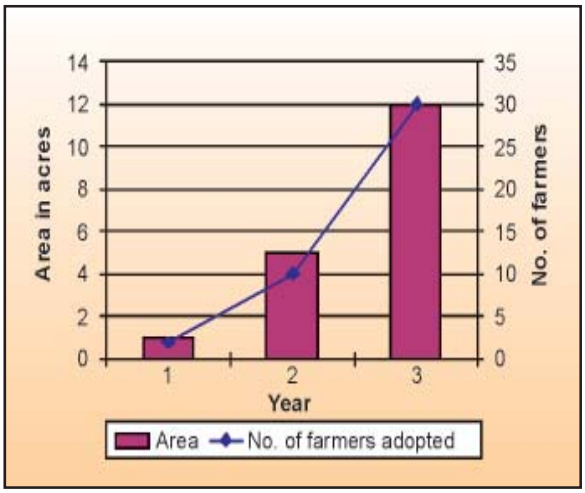

Fig 2. Status of horizontal spread of the technology in the adopted villages

Farm woman labour turned to a cultivator - A success story

A determined effort of an individual with technological intervention compatible to socio economic status can change the destiny. This has been demonstrated by Smt.Sabita Singh who was destitute and has to support three children by working as a farm labourer. She had just ½ acre land and a hut over her head. She had abandoned agriculture after tsunami and was working as farm labour for Rs.100/day for a period of 7 months in a year and was struggling to run her family with three children. Though she had half an acre of cultivable land she was not cultivating for the lack of suitable varieties and awareness of cultivation practices. The land was given on lease. After study of her socio-economic conditions and resource base, following interventions were made.

Technological intervention

- Crop diversification with different vegetables like chillies, brinjal, coriander, cowpea, French beans etc. with suitable varieties.
- Composting of garden weeds with technologies of low cost quick manure and liquid manures using *Psuedomonads* and *Trichoderma* as an organic source.
- Introduction of piggery as an alternative source of income.
- Treatment of the cattle and goats for higher economic production.
- The limited land availability was effectively utilised for economic production by integration of poultry, piggery, goatery and cattle as a component in the farming system. A very good example and an standing outcome of the technology was the success of conversion of Smt.Sabita Singh from a agricultural farm labourer to a cultivator (Plate 18, 20 & 21).

Output of the technology

With the integration of the above technologies she was able to increase her income through agriculture from 15000/- to 55,000/-. Apart from this the inclusion of palak, French beans, amaranthus and cowpea in the cropping system has also increased the nutritional aspect of the family by providing balanced nutrition to her kids. Now her kids are attending school, getting tuition and she has built a house in place of hut. The details of her income pattern are given in Fig. 3.

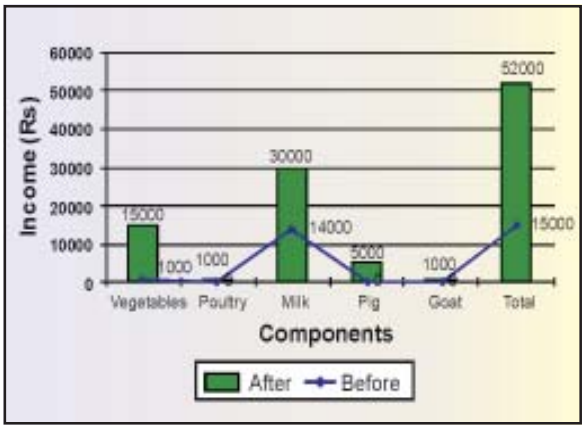

Fig 3. Pre and post intervention income from different components of land based IFS

Three situations of inundations that occurred after the tsunami

Plate 1.

Plate 2.

Plate 3.

Plate 4. Goat Farming

Plate 5. Poultry Farming

Plate 6.
Health camp for infertility treatment

Plate 7. Demonstration of azolla in the adopted villages

Plate 8. Raised bed method of vegetable cultivation with coconut husk incorporation

Plate 9. Chillies on the raised beds

Plate 10. Broad bed and Furrow technique of cultivation

Plate 11. Brackish water pond basedIFS model with sweet potato,coconutand banana

Plate 12. Demonstration on Mat Nursery

Plate 13. Crop diversification with introduction of capsicum and coriander in cropping calendar

Plate 14. Fresh water pond based IFS for SRI method of cultivation of paddy with coconut, poultry, vegetables, ducks and fishes

Plate 15. Formation of Water Users Association

Plate 16. Construction of ring well for irrigation and drinking in participatory mode through Water Users Association

Plate 17. Construction of gabion in participatory mode through Water Users Association

Plate 18. Research Advisory Committee members of CARI interacting with the members of the Water Users Association

Plate 19. Vegetable cultivation after intervention

Plate 20. Pig farming after intervention

Plate 21. Impact of intervention in providing decent livelihood to the farmwomen.

KRISHI VIGYAN KENDRA

M.S. Kundu, Kanak Lata, L.B. Singh, A.K. Singh & N.C. Choudhuri

KVK of CARI conducts vocational training to farmers, youths and extension personnel to orient them in the frontier areas of technology development. Beside front line demonstrations (FLD) to establish the production potential of improved technology in the farmers' fields, on farm trial (OFT) to identify the location specificity of technologies under various farming systems in participatory mode and extension programmes to disseminate and popularize improved agricultural technology was also conducted for the benefit of the stakeholders of the island.

Training Achievements :

Towards human resource development a total of 33 training programmes were conducted for practicing farmer, rural Youth and extension functionaries covering 751 beneficiaries which included 486 male and 265 female in agriculture and allied fields (Table 1).

Table 1. Abstract of training programme

Discipline	Training (Nos.)	Participants (Nos.)		
		Male	Female	Total
Practicing Farmer				
Horticulture	07	130	34	164
Animal Science	05	104	26	130
Fishery Science	05	104	26	130
Home Science	02	03	39	42
Total	**19**	**341**	**125**	**466**
Rural Youth				
Horticulture	04	53	29	82
Animal Science	05	52	57	109
Fishery Science	01	17	03	20
Home Science	02	02	38	40
Total	**12**	**124**	**127**	**251**
Extension Functionaries				
Home Science	02	21	13	34
Grand Total	**33**	**486**	**265**	**751**

FRONT LINE DEMONSTRATIONS

- Front line demonstration with two high yielding varieties of Paddy were taken up in the Urmilapur, Namunaghar and Memyo cluster of villages in an area of 0.4 ha. each accounting to 4.0 ha, covering 10 farmers in Middle and South Andaman. Variety ADT performed better and recorded a yield of 5.15 t/ ha. followed by NARDI(4.8 t/ha) over the local check Jaya (3.4 t/ha).
- Two demonstrations on French bean (with var. Arka Komal) and two on loose flower (var. French marigold) were conducted at Namunaghar, Collinpur and Hathitapu cluster of villages, covering 2.1 ha. French bean recorded a yield of 8.2 t/ha, and loose flower marigold gave 1.85 t/ha.
- Demonstration on quail farming conducted at chouldari with 100 nos. of day old birds revealed that the birds attained an average body weight of 175g in six weeks period in which females were heavier than male. There was no local check against the quail.
- Demonstration on large white Yorkshire pigs were taken up in two farmers' field of Chouldari and Ferrargunj village. The large white Yorkshire recorded a body weight of 78 kg over the local check (60 Kg.) during a period of 12 months.
- One demonstration on Papaya with Andaman Selection was conducted at Namunaghar and Chouldari. Andaman Selection recorded 67.23 percent increase in yield compared to local check. No male plants were observed in Andaman Selection variety.
- Composite fish culture with four species (Catla, Rohu, Mrigal and Grass carp) were taken up in five irrigation ponds (0.08 ha) for a period of one year. The average yield of 122 kg / 0.08 ha. of pond was achieved.
- Field evaluation of backyard quail rearing was carried out at farmer's field through natural brooding by poultry hen at Chouldari village of South Andaman. The results showed 67 percent hatching and 75 percent survival. This indicated a scope for an alternative method for hatching of quail eggs by natural brooding.

ON FARM TRIALS

- On farm trial on feeding of Azolla were conducted at farmer's field of chouldari with four treatments (T 1 commercial feed, T 2 replacing commercial feed by azolla at the level of 5%, T 3 at 10% and T4 at 15%) respectively. Each treatment

had 50 numbers of quail birds. The feed consumption of quail upto 6th week in farmers practice (Control group,T 1) recorded to be in the tune of 485g compared to 446g in the treatment group (T3) were feed was replaced by 10% azolla. It was observed that the performances was better in T3 group. Thus it was reflected that 10% replacement of commercial feed by azolla could be adopted by the farmers.

- OFT on evaluation and assessment of substrate for Oyster mushroom production was conducted with five treatments: T1 100% paddy straw, T 2 80% paddy straw+20% areca nut husk, T 3-75% paddystraw + 25% arecanut husk,T 4 70% paddy straw +30% arecanut husk and T5-60% paddystraw + 40% arecanut husk. In the performance indicator it reflects that there is reduction in cost by use of arecanut as substrate. Thus it may be concluded that the arecanut husk can be used substitute paddy straw partially.
- OFT on evaluation of growth performance of IMC was conducted with four treatments i.e.T 1 - farmers practices, T 2 feed only, T 3 feed + cow dung, T 4 feed + cow dung + lime. It was observed that the growth rate was higher in Treatment 4 which included feed, lime , cow dung and proper management practices.

Self Help Group Meetings

- Twenty four meetings were conducted wherein various issues like maintenance of ledgers accounts, internal loan, bank loan recovery, micro finance, entrepreneurships, sanitation, nutrition management and mobilizing for employment were discussed during the period.

Farmers Field School (FFS)

- FFS on vegetables for women farmers was conducted at Chouldari in collaboration with CIPMC, Port Blair. Fourteen classes were conducted along with demonstrations by the scientist and experts. 30 farm women got benefited.

The details of the extension activities, linkages, collaboration and participation in seminar, meeting during the period is given in Table 2, 3, 4 of Plate 1, 2, 3 & 4 respectively.

Table 2. Extension Activities

Activities	Number	No. of Beneficiaries		
		Male	Female	Total
Field day	11	105	134	239
Kisan Mela	07	788	865	1653
Exhibition	08	77	163	240
Diagnostic service	125	145	118	263
Advisory services	47	235	188	423
SHG formation	04	-	45	45
Newspaper coverage	15	Local Newspaper of A & N Islands		
T.V. / Radio Coverage	12	Broadcasted in DD (local)/ AIR		
Popular Article	06	-	-	-
Extension Literature	10	-	-	-
Participation in Bharat Nirman Exhibition	01	many	many	many
Women in Agriculture Day	01	50	150	200
Hindi Diwas	01	-	46	46

Table 3. Linkages & Collaboration

Name of Organization	Nature of linkage and Collaboration
Department of Agriculture , A & N Admn.	Training and supply of seedlings
Department of AH & VS, A & N Administration	Training & Inputs distribution
Department of Fisheries A & N Administration	Training and fingerling distribution
A & N Co-operative Bank of Lead Bank	SHG promotion
NABARD, Port Blair	Formation of projects
NRSE, Dept. of Electricity, A & N Administration	Non conventional energy resources
CIPMC, Port Blair	IPM
NCUI	Training and field advisory
Lead NGOs	Training
Nehru Yuva Kendra	Youth development

Table 4. Participation in Seminars/ Symposium/ meetings & training.

Title of the Workshop	Venue and date	Name of participant
Training cum orientation on Oil seed and Pulses	Puruliya, Kalyani, KVK. 11th -12th April, 2007.	Kanak lata
State Level inter Departmental meet for sensitization of Central Sector Scheme on development / Strengthening of Agricultural Marketing infrastructure grading and standardization.	Directorate of Industries, A & N Administration, Port Blair, 29th May, 2007.	S. K. Zamir Ahmed, Kanak lata, L.B. Singh, AbhayKumar Singh & N. C. Choudhuri
Interaction with KVK Scientist	ICAR research Complex, Patna, Bihar, 4th August, 2007	N. C. Choudhuri
Training for Empowerment of Animal Science Scientist of KVK	Mohanpur, Nadia, Directorate of Research and Extension, W.B.U.A.F.Sc Kolkata and Sponsored by, ZCU, Zone –II, ICAR. 6th – 11th February, 2008	Abhay Kr. Singh
Zonal Workshop of KVK	Birsa Agricultural University, Kanke. Ranchi. 14th - 16th March, 2008	M. S. Kundu.

GLIMPSES OF ACTIVITIES

Plate 1. Farmers Meet at Rangat under BNPIC

Plate 2. Kisan Mela at CARI Campus

Plate 3. DDG (Hort.) visiting the farmers' field (Left and Middle) and DDG (Extn.) interacting with the women farmer. (Right)

Plate 4. Kisan Mela at Rangat

TECHNOLOGIES ASSESSED AND TRANSFERRED

The technologies generated in agricultural and allied field were assessed for its performance by the scientists 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 in South Andaman, North & Middle Andaman district and Nicobar district.

- Crop diversification through Broad Bed and Furrow (BBF) based farming system for low lying valley areas.
- MAT nursery.
- System of Rice Intensification (SRI) method of paddy cultivation.
- Use of *Trichoderma* and *Pseudomonas* in the management of diseases of solanaceous vegetable crops.
- Oyster mushroom production technology
- Fresh water pond based Integrated Farming System
- Artificial Insemination in Goats.
- Infertility management in cattle.
- Azolla cultivation.

INFORMATION ON OTHER SECTIONS

LIBRARY

The role of the Library with any research institute can be realized only in the context of the objectives to act as national repository of scientific information relevant to Agricultural and allied disciplines of research. During the span of three decades, the Library has grown in size to earn the reputation of having exhaustive collection of books and journals. During report year it has added 237 books and 202 miscellaneous publications. The current holdings of the library consists of 5078 books, 2037 miscellaneous publications, 2455 bound volumes of journals and 9565 loose issues of journals. 30 foreign and 109 Indian journal were subscribed during the year. Gratis publications such as Annual Report, Newsletter, Research Bulletin, reprints etc. received from India and Foreign Institutes as exchange relationship is maintained.

CARI Library plays important role in these islands as a centre for knowledge and information related to the Institute's mandate. It serves to fulfill the need of the scientists/ research workers of CARI as well as of other local research and educational institute.

It also has the complete series of CAB, AGRICOLA, AGRIS, CD-ROM databases for retrieving the information through off line for the use of the scientists.

PLANNING, MONITORING AND COORDINATION CELL

The Planning, Monitoring & Coordination Cell (PMCC) serves as a vital link between the Institute, Council (ICAR), Government, Semi-Government, NGOs, other R & D organization and A & N Administration in addition to providing information on various research, training and extension activities of the institute to these agencies. The cell also reviews and scrutinizes the research projects / proposals and co-ordinates the activities within the institute and outside.

Beside compilation of DARE - ICAR, IPMR, SPMR, HYPR, PMO and Annual report, it also facilitates publishing of research articles, technical bulletins, folders, books, newsletter and proceedings.

COMPUTER CELL / ARIS CELL

The Agricultural Research Information System (ARIS) envisages providing online interconnectivity between the different Research Institutes, National Centers and State Agricultural Universities.

Main activities undertaken

- VSAT upgraded from 256 Kbps to 512 Kbps for faster browsing and downloading information.
- Internet and e-mail connectivity to all Scientists / Officers.

- Web page creation, up-dation and maintenance.
- Computer upkeep, up-gradation and training of Institute personnel.
- Data compilation and statistical analysis.
- Providing visual aids for different programmes.
- Verifying and certifying quality control for personal computer purchased.
- Expenditure details for Council through electronic media.
- Maintenance of networking, DAMA VSAT.
- Intranet maintenance and updation.
- PERMISNET - Personal Management Information System Network- Monthly and quarterly updating of personal records of all the staff of CARI has been carried out through online.
- Intelligent Reporting System – Quarterly up-dation of data and uploading.
- Procurement of soft wares, installation of personal computers and other accessories.
- Downloading the circulars and other information from ICAR website.
- Updating of the CARI website (http://cari.res.in), Intranet of CARI (http://server/carionline) and website of Krishi Vigyan Kendra (http://kvkcari.and.nic.in) was done regularly by publishing the latest Institute progress in terms of research, technologies developed, tender notifications, recruitment notifications and other information.
- Database developed for cartridge maintenance, earned leave maintenance, digital photo library and weather.

SUB DISTRIBUTED INFORMATION CENTRE

Bioinformatics Centre (Sub-DIC)

The mission of Bioinformatics Centre, CARI is to develop databases on Biodiversity of Andaman & Nicobar Islands by using appropriate software, which would provide information to taxonomists, ecologists, biodiversity management specialists, policy makers, planners & related entrepreneurs to store, manage, and exchange electronically published scientific information in standard format. It also serves as an active site for bioinformatics research and development in Andaman and Nicobar Islands. The centre is focused on providing qualify consultancy services in the field of website development, database management and manpower training. The team of this centre can assist any progressive organization/institute in developing, integrating and maintaining valuable biological data so that it can be accessible in a safe and comfortable manner.

The Centre during this year has been actively indulged in the creation of databases for the biodiversity of A & N Islands, IFS and mango along with imparting training to students of various universities in the field of molecular modeling and structure based drug

designing. Apart from this databases on rice genome, PDB and Pfam are maintained. National conference on "Bioinformatics tools for gene and protein analysis" in collaboration with SIGC, Trichy was conducted by the Sub-DIC of the Institute.

OFFICIAL LANGUAGE CELL

To implement the official language policy in the official work, efforts have been made to promote the same in our Institute. Series of programme have been conducted namely;

- 'Hindi fortnight' in September wherein various programmes like quiz, noting-drafting, extempore, dictation, essay competition for scientist/staff, competition for farm ladies and college students to bring awareness about the importance of increasing use of Hindi in official language. of Hindi Fortnight, Institute magazine Samachar Darshan and Dweep Krishi/Island Agriculture were released on the occasion.
- Two days Hindi Workshop on 3rd and 4th May, 2007 for administrative and technical staff.
- One day seminar on "Swadhinta andolan mein Hindi Sahitya ki bhoomika" jointly by CARI and Swadhinta Sangram Senani Vanshaj Samiti, Port Blair.

Beside the above the institute Official Language Implementation Committee held quarterly meeting to review the progress and suggested measures for future programmes. For the extension of new technologies developed by the institute, technical broadcast were done through Prasar Bharati, Port Blair for the island farmers. Article 3(3) is being followed in toto.

List of publication prepared:

- Ûrnr` H$ {f (Island Agriculture) ¡ AYdm[fH$ {Û^mfr n{ÌH$m ¡
- _rR nmZr H$m EŠd[a`_-EH$ {à` emH$ ¡
- HHSm nmbZ
- ~Qa nmbZ
- AÝS_mZ __rR nmZr H$ ~S PtJ H$ ~rO CËnmXZ H$s hMar VH$ZrH$
- H$ÝÐr` H$ {f AZgYmZ gñWmZ-EH$ Ñ{ï _ ({Û^mfr)
- AÝS_mZ __rR nmZr _ ~Sm PmJm H$ ~rO CËnmXZ H$ {bE Ka H$ nrN hMar
- àmŠH$bZ g{_{V bmH$g^m H$m àñVV [anmQ
- {Vb H$s I Vr
- _J H$s I Vr
- dm{fH$ à{VdXZ-gmam e Ed àñVmdZm

AWARDS AND RECOGNITION

Scientist	Award / Recognition	Awarding Agency/ Organization society
R.C. Srivastava	Vasant Rao Naik Award 2006	ICAR, New Delhi
D.R. Singh	Lt. Governor's service Commendation Certificate	Hon'ble Lt. Governor, A & N Islands
S.K. Zamir Ahmed	Appreciation letter	Media and Communication Officer, PIB, Govt. of India for BNPIC from 7th to 11th Dec., 2007.
S. Ghoshal Chaudhuri	Fellow	Indian Society of Coastal Agricultural Research, Kolkata
R. Raja	Best Poster Award	IARI, New Delhi
D.R. Singh	Best Poster Award	National Symposium on Noni Search 2007 at Chennai
S.Ghoshal Chaudhuri	Leadership Award	Soil conservation Society of India, New Delhi.
S. Dam Roy	Advisor	Andaman and Nicobar Ocean Biogeographic Information System (ANBOIS)
	Member	Aquaculture Implementation Committee formed by Andaman and Nicobar Administration.
	Chairman of Expert Committee for inspection of specific pathogen free brood stock of tiger prawn	Andaman and Nicobar Administration
	Member of consultative group meeting of Port Blair	Fishery Survey of India, Port Blair.
	External examiner for Ph.D. thesis evaluation	Cochin University of Science & Technology
C. B. Pandey, S. G. Chaudhuri and M. Din	Fakhruddin Ali Ahmed Award	ICAR

D.R. Singh	Service Star Award	Vice Chancellor, World Wellness Open University, Chennai, India
	Acted as Chairman in Technical Committee of High Value Agriculture Gold Medal in Floriculture	National Horticulture Mission – 6, Coconut Development Board Schemes, Subsidy under various schemes of HVA Governor of Assam during IInd Horticultural Congress 2007 at ICAR, complex for NEH Region, Barapani
S. Jeyakumar S.P. Yadav	Certificate of appreciation for training on "Indigenous goat and pig germplasm conservation" among the Tribes of Car Nicobar	Chairman, Tribal Council, Car Nicobar.
S. Jeyakumar	Best Poster Presentation Award (Certificate of Achievement)	National Symposium on Recent trends in policy initiatives and technological interventions for rural prosperity in small holder livestock production system towards animal rural livelihood from 20-22 June 2007, by the Indian Society for the Study of Animal Production and Management (ISSAPM), College of Veterinary Sciences, Tirupathi.

ON GOING RESEARCH PROJECTS

EXTERNALLY FUNDED

Project Title	Principal Investigator	Budget Outlay (in lakhs)	Date of Start	Date of Completion/ Expected
AP CESS FUND, ICAR				
Economic Status and Scope of Dairy Farming in Andaman & Nicobar Islands – A Microlevel Analysis	Subhash Chand	11.75	01.07.2005	30.06.2008
Impact assessment of agriculture development programmes	R.C. Srivastava	5.42	01.02.2007	31.07.2007
Development of Integrated Farming System (IFS) models under different resource conditions in humid tropics of Bay Islands	N. Ravisankar	21.27	22.04.2004	21.07.2007
Biochemical and molecular characterization of soils of mangrove forests of Andaman	S. Ghoshal Chaudhuri	21.03	01.06.2005	30.06.2008
Adoption of improved implements for rice based farming in Andaman and Nicobar islands	M. Din	21. 02	01.06.2005	30.06.2008
Crop diversification through Broad Bed and Furrow (BBF) based farming system in valley areas of Bay Islands	N. Ravisankar	24.06	15.07.2005	14.10.2008
Breeding seed production and back-yard hatchery development of freshwater prawn, *Macrobrachium rosenbergii* in Andamans	S. Dam Roy	22.00	-	-
DEPARTMENT OF BIOTECHNOLOGY				
Development of Mangrove based agro-aqua farming for restoration of mangrove ecosystem and livelihood through community farming in Andaman Islands	R. C. Srivastava (Project co-ord inator)S. Dam Roy (PI)	37.00	April, 2008	March, 2011
Conservation and phenotypic and molecular characterization of indigenous goat of Andaman and Nicobar Islands	S.P. Yadav	34.07	1st April, 2006	June, 2009

Establishment of Sub Distributed Information Centre	M. Balakrishnan	60.00	01.04.2005	31.03.2008
MoWR				
Farmer Participatory Action Research Programme (FPARPs) on Water Management	R.C.Srivastava/ S.K.Ambast	24.00	01.03.2008	31.12 2009
A&N Admn				
Soil and crop mapping of Andaman Islands using remote sensing and geographical information system	S.K. Ambast	12.97	15.02.2008	30.06.2009
Ministry of Earth Sciences				
Integrated Agromet Advisory Services	R.C.Srivastava/ S.K.Ambast	60.00	01.04.2008	30.04.2012
ICAR				
Network projects "Underutilized Fruits"	D.R. Singh	18.82	May 2005	May, 2010
Seed production of shrimp	S. Dam Roy	45.00		
SAC				
Coastal Zone studies	S. Dam Roy	17.20	April, 2007	March, 2009
NMPB				
Technological Innovations for commercial exploitation of *Morinda citrifolia* as Livelihood option for Island farmers	D.R. Singh	246.00	01.03.2008	March, 2010
WNRF				
Collection, Conservation, Characterization and Identification of Superior clones of *Morinda citrifolia*	D.R. Singh	9.54	01.03.2008	March, 2010
INCOIS, Hyderabad				
Potential Fishing zone validation studies in Andaman Sea	Grinson George	24.00	April, 2008	March, 2012

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
Utilization of native bio-agents for the management of vegetable diseases and cataloguing of crop diseases in A & N Islands	Dr. V. Jayakumar
Evaluation of PGPR based bio-formulation for the management of key diseases of solanaceous vegetable crops	
Assessment of crop losses and epidemiology of major vegetable diseases of A & N Islands	Dr. Krishna Kumar
Development of Integrated Disease Management Modules for Tomato Crop	Dr. Krishna Kumar
HORTICULTURE AND FORESTRY	
Improvement of Plantation Based cropping system for A & N Islands	Dr. T. Damodaran
Collection, conservation and Molecular characterization and of early flowering open pollinated mango clones of Bay Islands	
Silvi-pasture system : Effect of fertilizer and burning on Net primary production (Herbage production) in humid tropical climate of Andamans	Dr. C.B. Panday
Standardization of agrotechnique for organic black pepper cultivation in Andaman and Nicobar Islands	
Studies on effect of plant growth promoting biocontrol agents on growth, yield and quality of papaya	Ms. R. Sudha
NATURAL RESOURCE MANAGEMENT	
Development on fresh and brackish water based Integrated Farming System (IFS) in bay Islands	Dr. R.C. Srivastava
Planning, augmentation and efficient utilization of water resources in Kaju Nallah watershed	Dr. S.K. Ambast
Assessment of spatial and temporal variability in soil physico-chemical and biological properties of *Tsunami* affected agricultural lands	Dr. S. Ghoshal Chaudhuri
Value addition to crops, livestock and fisheries products through application of renewable and non renewable sources	Dr. M. Din

Performance evaluation of different protected cultivation structures in humid tropics	
Standardization of package of practices for table purpose (HPS) groundnut in Andamans	Dr. N. Ravisankar
Effect of supplemental irrigation on crop yield and water use efficiency in rice based cropping system of A & N Islands	Dr. R. Raja
Studies on effective storage of water in ponds	Er. P.S. Deshmukh
Impact of post *tsunami* agriculture mechanization inputs on profitability of farmers in South Andaman	
Evaluation of soil management techniques in problem soils of South Andaman	Dr. T.P. Swarnam
Impact of integrated nutrient management on soil quality under rice –maize cropping system in Andaman	Shri Babulal Meena
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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	
Characterization of livestock production sub system and assessment of critical nutritional gap in Bay Islands	Dr. S.K. Verma
Evaluation of therapeutic and immunomodulatory properties of *Morinda citrifolia* in poultry.	Dr. Jai Sunder
Factors influencing productive and reproductive performance in dairy cattle under island ecosystem	Dr. S. Jeyakumar
Enhancement and sustainable dairy cattle and buffalo production in bay islands	
Productivity enhancement of goats in bay islands	
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To Study the Feasibility and convergence on subsistence pig rearing to commercial pig farming inclusive of its process	
Identification and evaluation of alternate feed resources available in Bay Island for least cost poultry feed formulation	Dr. Simmi Tomar
Characterization of LHâ and FSHâ and their receptor genes in goat breeds of Andaman and Nicobar Islands	Dr. S.P. Yadav

Evaluation and utilization of Azolla as feed supplement for backyard poultry in BayIsland	Dr.T. Sujatha
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Socio-economic Impact Assessment on Agriculture, Animal Husbandry & Aquaculture in the Tsunami-hit Andaman	Dr. Subash Chand
An economic analysis of floriculture potential in Andaman and Nicobar Islands	
Development of Artificial Neural Networks (ANN) based forecasting model for studying Varieties Diversity, Yield and production in prominent rice cultivars of bay islands	Dr.M. Balakrishnan
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Verma, S.K., Kanak Lata and C.B. Pandey (2008). Abstract on Fodder production in homegardens in Andaman and Nicobar Islands. National workshop cum symposium on 'Tree spice cultivation and sustainable development of home gardens for decent livelihood and environmental protection in Andaman and Nicobar Islands held during 4-6th February, p. 57.

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SCIENTIFIC/ TEACHING REVIEWS

Reviewed online paper on "Biochemical studies on off season flowering in Guava induced by bending and pruning from Editor, *Journal of Tropical Agriculture*.

CD ROM /BOOK

Integrated Rehabilitation of Tsunami affected village through technological Intervention in South Andaman, Central Agricultural Research Institute, Port Blair.

DATABASES DEVELOPED

- Database for Biodiversity of Andaman & Nicobar Islands
- Database for Integrated farming system of Andaman and Nicobar Islands.
- Database for Mango in Andaman and Nicobar Islands

MODELING

- Developed homology modeling for the medicinal plants and HIV

STUDENTS GUIDED BY SCIENTIST

Name of the student	Degree/ Course	Year	Title of Project work / Thesis	College/ University
Dr. M. Balakrishnan, Scientist Sr. Scale Mr. S. Rajamanikandan	M.Sc., Bioinformatics	2008	Studies on Modeling UDP-Glucose 4 Epimerase and Docking Studies Based on Log Calculated Nicotinamide Adenine Dinucleotide By Computational Methods	Karpagam Arts & science College, Coimbatore, Tamil Nadu
Ms. M. Jancy Jennifer	M.Sc., Bioinformatics	2008	Studies on Interaction between HIV I Protease and CARBAMIC ACID – Computational Analysis and Structure Prediction by Comparative Modeling	Kongunadu Arts & Science College, Coimbatore, Tamil Nadu
Ms. K.R.Kanimozhi	M.Sc Microbiology	2008	Homology Modeling of Acetyl Glutamate kinase from Leptospira interrogans and docking studies of N-Acetyl-L-Glutamate	Rathinavel Subramanian College, Coimbatore, TN
Ms. R. Chitrarani	M.Sc Biotechnology	2008	Homology Modeling of HIV 1 Protease and Modeling the Interaction with RITONAVIR by Computational Methods	Rathinavel Subramanian College, Coimbatore, TN
Ms. T.Sindhu	M.Sc., Bioinformatics	2008	Prediction of Activity Spectra of Drug Raltegravir and Modelling the Interaction with HIV-1 Integrase by Computational Methods	Karpagam Arts & science College, CBE, Tamil Nadu
Mr. R.Venkateswaran	M.Sc Biotechnology	2008	Molecular Modeling & docking studies of Ribosome Inactivating Proteins from Bryonia dioica	Maruthu Pandiyar College, Tanjore, Tamil Nadu
Mr. Subhash Chandra Bose	M.Sc Biotechnology	2008	Molecular Modeling & Docking studies of HIV-1 protease from HIV	JJ College,Pudukottai , Tamil Nadu
Mr. E. Hudson Asirvatham	M.Sc Biotechnology	2008	Computational Analysis and Structure Prediction of 18s rRNA of Alstonia kurzii	Bishop Heber College Trichy, Tamil Nadu

Mr. V. Stanley Raja	M.Sc Biotechnology	2008	Computational Analysis and structure prediction of 18s rRNA of "Amomum fenzili Kurz"	Bishop Heber College Trichy, Tamil Nadu
Ms. Vidya Murali	M.Sc Biotechnology	2008	Computational Analysis and Structure Prediction of 18s rRNA of Eul ophia andamanensis	Bishop Heber College Trichy, Tamil Nadu
Mr. Pratap kumar	B.Tech	2008	In-Silico Molecular Modelling and docking studies of Acetyl glutamate Kinase	NIT, Durgapur, West Bengal
Mr. Grinson George, Scientist				
G. Kalidas	M.Sc. Biotechnology		Differentiation of tilapia adapted to various ecological niches in Andaman waters using microbial and molecular (RAPD) Techniques	Periyar University
Dr.S.P.Yadav, Scientist				
Ms. Blessy Merlin Thomas	M.Sc.,Biotechnology	2008	Molecular characterization of FSHβ Exon 2 in Local Andaman Goat (*Capra hircus*)	Kongunadu Arts and Science College, Coimbatore (Bharathiyar University), India.
Ms. Jincy Mathew	M.Sc.,Biotechnology	2008	Molecular characterization of LHβ Exon 1 and 2 in Local Andaman Goat (*Capra hircus*)	Kongunadu Arts and Science College, Coimbatore (Bharathiyar University), India.

PEER RECOGNIZATION TO DIRECTOR IN DIFFERENT COMMITTEE/ PANEL/SOCIETY/LOCAL BODY MEETING

- Member of organizing committee of 10th Inter-Regional Conference on Water & Environment with a focus on "Ensuring Water and Environment for Prosperity and posterity" held at New Delhi from 17th to 20th October, 2007.
- Member of Advisory Committee for organizing International Symposium on Management of Coastal Ecosystem : Technological Advancement and Livelihood Security held at Kolkata from 27th -30th October, 2007. Also acted as convener of three theme sessions.
- 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 Agril. 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.
- 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.

- Member, State Level Environment Council, A&N Islands.
- Member, State Level Committee for Identification of Critical Wildlife Habitat for A&N Islands.
- Member, National Development Council to review the progress of Agricultural & Allied Sectors.
- Chairman, Rashtriya Krishi Vikas Yojana, A&N Islands.
- Member, Purchase Committee for the Implementation of Tsunami Rehabilitation Package for Animal Husbandry Sector of A&N Islands.
- Member, Plant Protection and Quarantine & Storage State Level Committee for A&N Islands.

PARTICIPATION OF DIRECTOR IN IMPORTANT MEETING/ WORKSHOP AND SYMPOSIUM

Director	Programme	Venue	Date / Duration
Dr. R.C. Srivastava	Special training program on "Vigilance Administration and Management"	CRRI, Cuttack	16th to 18th April, 2007
	National Conference on Horticulture Meet -2007 and Directors, Project Coordinators meeting	New Delhi	27th to 28th April, 2007
	Training on sensitization	TRANG,	23rd June to 3rd July, 2007
	program on Noni	South Thailand	
	Director's Conference	NASC complex, New Delhi	16th to 18th July, 2007
	Special Interactive workshop on Administrative and financial matters	CRIJAF, Barrackpore	2nd to 3rd August, 2007
	QRT of AICRP on Cashew	OUAT, Bhubaneswar	11th August, 2007
	Interactive Meeting on "Future Challenges on Water Management"	WTCER, Bhuabaneswar.	25th August, 2007
	Institute SFC Meeting	ICAR, New Delhi	24th August, 2007
	Institute QRT meeting	Hyderabad	3rd to 5th September, 2007.
	10th Inter-regional Conference on Water & Environment (ENVIROWAT-2007)	New Delhi	17th to 20th October, 2007
	8th Asian Fisheries Forum	CMFRI, Cochin	20th November, 2007
	Brain storming session on ' Horticulture development in Islands – a road map'	CARI, Portblair	2nd to 3rd December, 2007.
	One day Interaction Programme on Tools and Machinery for Development of Horticulture	CISH, Lucknow	18th January, 2008.
	ISAE Convention	CIAE, Bhopal	1st to 3rd February, 2008

PARTICIPATION OF SCIENTISTS IN CONFERENCES/SEMINARS/ SYMPOSIA

Scientists	Programme	Venue	Date / Duration
R. Sudha	80th Foundation course for Agricultural Research Service.	NAARM, Hyderabad	8th January to 7th May, 2007
S. Dam Roy and Kamal Sarma	3rd annual meeting of the Fishery Scientists working in Agricultural Research Institute, ICAR, research institutes	Central Inland Fisheries Research Institute (CIFRI), Barrackpore	14th April 2007
D.R. Singh	Horticultural Congress.	ICAR Research Complex, Barapani	16th to 21st April, 2007
D.R. Singh	All India Coordinated Research project meeting on Vegetables.	HAU,Hissar,Haryana	2nd to 7th May, 2007
S.K. Zamir Ahmed & N. Ravisankar	State level Inter departmental meet for sensitization about the Central Sector scheme on "Agricultural Marketing Infrastructure, Grading and Standardization.	Department of Agriculture, A&N Administration, Port Blair.	29th May , 2007
D.R. Singh	Meeting to finalize the National Network Project on Orchids.	NRC, Orchids, Sikkim	5th to 6th June, 2007
	Sensitization cum training programme on Noni.	TRANG South Thailand	23rd June to 3rd July 2007.
Kamal Sarma	Attended workshop on "Brackish water Aquaculture Production System and Environmental management"	Central Institute of Brackishwater Aquaculture, Chennai	10th and 11th July, 2007
S.K. Zamir Ahmed	Convergence Programme for Brindaband village..	DC Office, A & N Administration	27th July, 2007
M. Balakrishnan	National Workshop on 'Implementation of personnel Management information System Network in ICAR	NAARM at Hyderabad, A.P	28th to 31St July, 2007

	(PERMISnet)''and Intelligent Reporting System(IRS).		
S.K. Zamir Ahmed	Industry-Institute Interaction Programme.	Dr.B.R. Ambedkar Govt. Polytechnic, Port Blair.	14th August, 2007.
M. Balakrishnan	National Conference cum . training on 'Bioinformatics tools for gene and protein Analysis'	SIGC, Tiruchirapalli	7th to 8thSeptember, 2007
S.K. Zamir Ahmed	Second meeting of Project Implementation Monitoring Committee (PIMC)	CARE - India, Andaman	25th September, 2007
S.K. Ambast, R. Raja & Subhash Chand	10th Inter-regional Conference on Water and Environment (Envirowat 2007): Ensuring Water and Environment for Prosperity and Posterity.	IARI, New Delhi	17th to 20th October, 2007
D.R. Singh	National Symposium on Standardization of seed and planting material of Medicinal plants.	NBPGR, New Delhi	20th to 21st October, 2007
S.K. Ambast	National Workshop on Harvest and Post Harvest of Natural Resins and Gums.	IINRG, Ranchi	25th to 26th October, 2007
D.R. Singh & Subhash Chand	2nd National Symposium on Noni for Health and Wellness.	Organized by world Noni Research Foundation, Chennai.	27th to 28th October, 2007
S.K.Ambast & S. Ghoshal Chaudhuri	International Symposium on Management of Coastal Ecosystem: Technological Advancement and Livelihood Security.	Kolkata	27th to 30th October, 2007
S.K. Zamir Ahmed	10th meeting of the Task Force on 'Biotechnology based programme for women.	DBT, New Delhi	30th to 31st October, 2007
Subhash Chand	Brain Storming Session on the development of road map on horticultural and spices for A & N Islands.	CARI, Port Blair	1st to 2nd December, 2007

S.K. Zamir Ahmed	11th meeting of the Task Force on 'Biotechnology based programme for women'.	DBT, New Delhi	12th December, 2007
M. Balakrishnan	In Proc. of 3rd Indian International Conference on Artificial Intelligence (IICAI-07) .	NIA, Pune, India	17th to 19th December, 2007
S. Dam Roy, Kamal Sarma and Grinson George	Attended the 8th Indian Fisheries Forum	Organised by Asian Fisheries Society, Indian Branch and CMFRI Kochi	20th to 23rd 2007
S. Dam Roy	Network meeting of Fisheries Scientist in Agriculture Research Institute	CIFRI, Barrackpore	2nd February, 2008.
M. Balakrishnan	In Proc. of XVIIIth All India BTISnet Coordinators Meet	CSRTI, Mysore, Karnataka on	3rd to 4th February, 2008
S.K.Ambast, S.K. Zamir Ahmed, S. Ghoshal Chaudhuri, N. Ravisankar, S. Dam Roy, C.S. Chaturvedi, Kamal Sarma, S.N. Sethi, Grinson George & Subhash Chand	National seminar cum workshop on "Tree spices cultivation and sustainable development of home gardens.	CARI, Port Blair	4th to 6th February, 2008
S. Dam Roy	The national Symposium on Attended "Ecology & Fisheries of wetland of India"	4th Indian Fisheries Science Congress at Patna	
S. Dam Roy	National workshop on Development of Strategies for Domestic Marketing of Fish and Fishery products	College of Fisheries Science, Sri Venkates-vara University Muthukur	7th to 8th February 2008.
S. Ghoshal Chaudhuri	International Conference on "Conservation Farming System & Watershed Management in Rain fed Areas for Rural Employment & Poverty Eradication.	NASC Complex, New Delhi	12th to 16th February, 2008.
S.K. Ambast	Interactive Workshop NAIP.	RRS, CSSRI, Canning Town	18th to 19th February, 2008

R. Raja	International Symposium on Agrometeorology and Food Security (INSAFS).	CRIDA, Hyderabad	18th to 21st February, 2008
M. Din	Short course on "Mechanization of cultivation of horticultural crops.	IIHR Bangalore.	18th to 27th February, 2008
Kamal Sarma &	Attended in the National workshop on " Molecular Modelling and protein docking"	CARI, Port Blair	25th to 28th February, 2008.
M. Balakrishnan	National workshop cum . training programme on Bioinformatics, statistics and its applications in Aquaculture	CIFA, Bhubaneswar, Orissa	24th 26th March, 2008
N. Ravisankar	Workshop cum seminar on . "Promotion of organic farming for livelihood in Andaman and Nicobar islands"	Department of Agriculture, A&N Administration, Port Blair.	24th to 25th March, 2008
M.S.Kundu, SimmiTomar, T. Sujatha	National Workshop cum ' Training programme on ''Molecular modeling and Protein Docking'	CARI, Port Blair	25th to 28 th, February 2008
SimmiTomar, S.K.Verma	National Workshop/ Symposium on "Tree spice cultivation and sustainable development of home-gardens for decent livelihood and environ-mental protection in Andaman and Nicobar Islands"	CARI, Port-Blair.	4 th -6 th, February 2008,
A.Kundu, M.S.Kundu, S.K. Verma	306th '*Gahan Hindi Karyashala*'	Central Hindi Training Institute, New Delhi	May 21st – 25th 2007
M.S.Kundu, S.K. Verma	International Tropical Animal Nutrition Conference	Organized by Animal Nutrition Society of India, held at NDRI, Karnal, Haryana	4-7th October 2007

A Kundu	24th Annual conference of Indian Poultry Science Association and National Symposium.	Ludhiana	25th to 27th April 2007
S. Jeyakumar	National Symposium, "Recent trends in policy initiatives and technological interventions for rural prosperity in small holder livestock production system towards animal rural livelihood"	College of Veterinary Sciences, Tirupathi	20th-22nd, June 2007
S. Jeyakumar	Winter School (21 days), Ultrasonography and other imaging techniques in disease diagnosis and reproduction in farm and pet animals	Madras Veterinary College, Vepery, Chennai	03rd to 23rd December 2007
S.P. Yadav	Training Programme on Genetic Epidemiology and Molecular Genetics.	International school of Anthropology, Mysore	2nd to 21st April, 2007
S.P. Yadav	National conference on Bioinformatics tools for gene and protein analysis	Shrimati Indria Gandhi College, Tiruchirapalli	7-8th September, 2007

HUMAN RESOURCE DEVELOPMENT

TRAINING TO STAKEHOLDERS

Title	Period	Partici-pants (Nos.)	Type of Participants	Venue	Collaborating/ Sponsoring Agency
DIVISION OF NATURAL RESOURCE MANAGEMENT					
Management practices for improved agriculture in post tsunami scenario	10th to 13th April, 2007	45	Tsunami affected farmers	CARI	CARI in collaboration with CSSRI, Karnal under Action Aid International (India) funded consultancy project
Integrated Management of Natural and Biodegradable Waste Resources	19th April, 2007	40	Women SHG'S	Hut bay little Andaman	ADRA India
Use of farm machineries, Power tillers and Pump Sets	28th May to 1st June, 2007 and 11th to 18th June, 2007	38	Farmers / Youths	CARI	Directorate of Agriculture, A&N Administration
DIVISION OF ANIMAL SCIENCE					
Poultry farming	30 days	3	Unemployed youths	CARI	-
DIVISION OF FISHERIES SCIENCE					
Brackish water fish culture	20th to 22nd June '07	21	Farmers	KVK	-
Breeding and nursery management of Carps	17th to 19th July' 07	20	Farmers	KVK	-
Duck cum fish farming	12th to 20th December, 2007	25	Farmers	Chouldhari	-
Development of better management	11th to 20th March 2008	-	-	-	-

practice for integrated farming system					
SOCIAL SCIENCE SECTION					
Livelihood generation through technological interventions	19th to 20th April,07 (2 days)	45	SHG Women	Little Andaman	ADRA India
New Horizon in Agriculture	23rd to 28th July, 2007 (6 days)	13	Field Assistant	CARI	Department of Agriculture
Goat farming	7th -10th August 2007 (4 days)	26	SHG Women	CARI	Asha Sagar Project
Oyster mushroom production for Women	14th to 17th November, 2007 (4 days)	21	SHG Women	CARI	Asha Sagar Project
Livelihood option in agricultural and allied fields for women	14th to 30th December,2007 (17 days)	194	SHG Women	CARI	CARE India Andaman
Package and Practices of Scientific Dairy Farming	19th – 26th December, 2007 (7 days)	34	Farmer/ Women	CARI	AP Cess fund project
Conservation of indigenous Goat and Piggermplasm	7th to 14th Jan., 2008 (7 days)	68	Youth/Women	Car Nicobar	AP Cess fund and DBT funded project
Package and Practices of Scientific Dairy Farming	7th to 13th January, 2008 (7 days)	80	Youth	Car Nicobar	AP Cess fund project
Dairy farming for women	19th to 25th March 08 (7 days)	55	SHG Women	CARI	CARE India

EXTENSION ACTIVITIES

Title	Period	Partici-pants (No.)	Type of Participants	Venue	Conducted by
Farmers' Field School (FFS) in IPM on Kharif Paddy	27th July to 25th October, 2007	30	Farmers/ Farm Women	Indiranagar /Manglutan	CARI
Scientist – Farmers - Banker - Interaction	24th Dec. 2007	60	Farm Women	CARI	CARI
Press meet	31st Dec. 2007	09	Press Personnel	CARI	CARI & IGNOU
Press Conference	16th July, 2007	20	Press Personnel	Calicut village	CARI
Kisan Call Centre	154 call received from target group in agriculture allied fields and answered				
EXHIBITION					
Bharat Nirman Public Information Campaign at	7th to 11th Dec. 2007	Many	Men, Women/ Youths/ PRI members	Rangat	PIB
Kisan Mela on "Decent Livelihood through Agricul tural based Micro Enterprises"	16th Feb. 2008	Many	Men, Women/ Youths/ PRI members	CARI	CARI

TRAINING/CONFERENCE ORGANIZED BY SUB-DIC

- National conference on Bioinformatics tools for Gene and Protein Analysis from 7th to 8th September, 2007.
- National Workshop on Molecular Modeling and Protein Docking from 25th to 29th February, 2008

FOREIGN TRAINING:

Dr. C. S. Chaturvedi attended training programme on" Technical Training Course on Aquaculture for Asia Pacific". Sponsored by the Ministry of Commerce Republic of China organized at Freshwater Fisheries Research Centre Wuxi, Chinese Academy of Fishery Science from 24th April 2007 to 25th June 2007 at Freshwater Fisheries Research Centre, Wuxi Shandhai, China.

ROUND UP OF INSTITUTE ACTIVITIES

- Training programme on Livelihood Generation (19th April, 2007)
- Quinquennial Review Team (QRT) (24th to 29th April, 2007)
- Institute Management Committee meeting (28th May, 2007)
- Training on Farm Machineries (28th May to 1st June & 11th June – 18th June, 2007)
- Parliamentary Standing Committee on Agriculture (12th July, 2007)
- Press Meet on IFS (16th July, 2007)
- Training to Field Assistant (23rd to 28th July, 2007)
- Farmers Field School (FFS) in IPM on Kharif Paddy (27th July to 27th October, 2007)
- Farmers advised on the strategies for minimizing crop production losses due to On-going dry spell (July, 2007)
- Transfer of Technology (TOT) during convergence programme of A & N Administration (1st August, 2007)
- Research Advisory Committee (RAC) meeting (6th – 7th August, 2007)
- Livelihood Training on Goat farming (7th -10th August, 2007)
- Institute Research Council Meeting (21st, 22nd & 28th August, 2007)
- Visit of Consulate General of USA (6th September 2007)
- National Level Conference (7th September 2007)
- Training to Administrative Staff (10th to 14th September, 2007)
- Hindi Fortnight (15th September, 2007)
- CARI releases Boer goat crosses for the Island farmers (15th October, 2007)
- Estimates Committee of Lok Sabha Visits CARI (31st October to 1st November, 2007)

- Vth QRT Team visit (12th to 14th November, 2007)
- Training for Women on Oyster Mushroom (14th to 17th November, 2007)
- Seed Store cum field laboratory at Bloomsdale Farm (1st to 3rd December, 2007)
- Brain Storming session on Horticulture (2nd to 3rd December, 2007)
- Bharat Nirman Public Information Campaign (7th to 11th December)
- Training on livelihood options (14th to 30th December, 2007)
- Training on Package and Practices of Scientific Diary Farming (19th to 26th December, 2007)
- Scientist – Farmers - Banker - Interaction (24th December, 2007)
- Press meet on initiation of Diploma Courses in agril. & allied fields (31st December, 2007)
- Training at Car Nicobar (7th to 14th Jan., 2008)
- Republic Day (26th January, 2008)
- Annual Sports (26th January, 2008)
- Launching of Spawn Production Unit of mushroom (26th January, 2008)
- Diagnostic services (29th January, 08)
- National Workshop-cum-Symposium (4th to 6th February,08)
- Kisan Mela (16th February, 2008)
- Press Meet (16th February, 2008)
- Scientist – Farmers Interaction(16th February, 2008)
- National Workshop-Cum Training (25th to 28th February, 2008)
- Visit of Lt. Governor, Lt. General (Retd.) Bhopinder Singh, PVSM, AVSM, A & N Islands to CARI, Port Blair (29th February, 2008)
- Institute Management Committee Meeting (18th March, 2008)
- Training for farmwomen on Dairy (19th March, 2008)
- Farmers Meet at Manjery village (29th March, 2008)

LINKAGES AND COLLABORATION

- Central Soil Salinity Research Institute, Karnal and International Tsunami Response Centre (ITRC), Colombo, Sri Lanka.
- CSSRI, Regional Station Canning, Ramkrishna Mission, Neempith, BCKV, Kalyani, CIBA Regional Station, Kakdweep.
- Regional Office, India Meteorological Department, Kolkata.
- Project Directorate of Cropping System Research (PDCSR), Modipuram.
- Project Coordinator, CIAE, Bhopal.
- National Medicinal Plant Baord (NMPB), New Delhi.
- Department of Bio-technology, New Delhi.
- CARE India, Port Blair.
- TANUVAS, IVRI, C.A.R.I.
- Dept. of AH&VS, A & N Administration.
- Space Application Centre, Ahmedabad.
- CPR foundation.
- CIBA, CMFRI, NBFGR, CIFA, CIFRI, CIFE and DSR.
- Directorate of Fisheries, Andaman and Nicobar Administration.
- Andaman and Nicobar Administration.
- Zoological Survey of India and Fishery Survey of India.
- RGCA, MPEDA and the Ministry.
- Ministry of Environment and Forests as well as Department of Forests, Andaman and Nicobar.
- Tribal Council, Car Nicobar.
- CIPMC, Port Blair.
- Asha Sagar Project.
- Andaman & Nicobar Island Environmental Team Centre for Island Ecology (ANNET).
- Don Bosco Non formal Technical Training Institute.
- NABARD.
- IGNOU.


4th R.A.C. MEETING
CENTRAL AGRICULTURAL RESEARCH INSTITUTE
PORT BLAIR

DISTINGUISHED DIGNITARIES

- Dr. A.K. Singh, Zonal Coordinator, Zone – II, Kolkata on 19th May, 2007.
- Hon'ble Harish Rawat, Chairman & Members, Parliamentary Standing Committee on Agriculture on 11th May, 2007.
- Dr. R.K. Chhillar, Principal Scientist, IARI, Pusa, New Delhi on 19th July, 2007.
- Dr. K. Pradhan, Ex-Vice Chancellor, C24/NIG, Housing Board Colony Baramunda, Bhubaneswar – 751 003 on 7th August, 2007.
- Dr. U.P. Singh, Director, Placement & Counselling, G.B. Pant University of Agriculture & Tech., Pantnagar, Uttarakhand on 7th August, 2007.
- Dr. D.R. Sharma, Director of Research, Dr. Y. Sadarmar University, Hort. & Forestry, NAUNI, SOLAN, Himachal Pradesh on 7th August, 2007.
- Dr. R. C. Tiwari, B-4, Maa Bhagirathi Nagar, Sunderpur, Varanasi 221 005 on 7th August, 2007.
- Prof. D.P. Ray, Vice- Chancellor, Orissa University of Agriculture & Technology, Bhubaneswar, Orissa on 7th August, 2007.
- Dr. P. Paul Pandian, Dy. Adviser (Fisheries), Planning Commission, Yojana Bhawan, New Delhi on 16th August, 2007.
- Henry V. Jardine, U.S. Consul., Kolkata on 6th September, 2007.
- S.M.R. Kuswata & Other 50 teachers on study tour from S.I.E, Shisksha Sadan, Port Blair on 27th September, 2007.
- Dr. S. Saunand, Regional Director, IGNOU Regional Centre, Port Blair on 3rd October, 2007.
- Dr. V. Ragunathan, Sr. Plant Protection Specialist, FAO formerly PPA to GOI on 6th October, 2007.
- Dr. O.P.S. Panwar, Principal Scientist, Crop Production, ICAR Unit : IGFRI Jhansi on 10th October, 2007.
- Dr. S. Kumar, Joint Director, Botanical Survey of India, Port Blair on 11th October, 2007.
- Shri C. Krusami, M.P. & Chairmand L.S. Estimate Committee on 1st November, 2007.
- Dr. S.M.R. Kushwaha, Project Coordinator, SIE, Port Blair with two experts and 34 Graduate trained teachers on 5th December, 2007.
- Dr. Shashi Bhushan, Livelihood Advisor, Naandi Foundation, Hyderabad on 1st January, 2008.
- Neena Rao, National Diet Livelihood, Naand Foundation, Hyderabad on 1st January, 2008.

- V.B. Deshmnda & 6 others, Nashik on 4th January, 2008.
- Dr. M. Sammibabu, Principal Scientist, CTRI, Rajahmundry on 23th January, 2008.
- Dr. Rajender Nath Prasad, Principal, DIET, Garacharma on 2nd February, 2008.
- Dr. S.E. Ali, 122, Rajapur, Allahabad on 20th February, 2008.
- Dr. P. Pramod, SACON Anaileathypis, Coimbatore on 22nd February, 2008.
- Lt. Gen(Retd.) Bhopinder Singh, PVSM, AVSM, Lt. Governor, A & N Islands on 29th February, 2008.
- Dr. M. Swaminatha, GTT, K. Natarajan, GTT, GSS school, Bhatu Basti on 26th March, 2008.
- Dr. Raman Kapur, Pr. Scientist & Head, Crop Improvement, IISR, Lucknow on 26th March 2008.

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 & Fisheries & Sciences	Dr. S. Dam Roy
Head, Division of Natural Resource Management	Dr. S.K. Ambast
Head, Division of Animal Science	Dr. B.R. Singh
Head i/c, Division of Horticulture & Forestry	Dr. C.B. Pandey
Incharge, Social Science Section	Dr. Subhash Chand
Incharge, Planning, Monitoring & Coordination Cell	Dr. S.K. Zamir Ahmed
Incharge, Computer Cell	Dr. M. Balakrishnan
Incharge, Library	Sh. 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, Estate Section	Er. S.L.Paik
Incharge, Guest House	Dr. V.B. Pandey
Administrative Officer	Shri. Abhishek Srivastava
Finance & Accounts Officer I/c	Dr. Jaisunder
Assistant Director, Official Language	Smt. Sulochana
Security Officer	Sh. N.K. Pushp
Incharge, Krishi Vigyan Kendra	Dr. M.S. Kundu
Co-ordinator, Bio-Informatics Centre	Dr. M. Balakrishnan

LIST OF SCIENTIFIC STAFF

DIVISION OF NATURAL RESOURCE MANAGEMENT

Dr. S.K. Ambast, Head

Dr. S. Ghoshal Chaudhuri, Principal Scientist (Soil Science: SP&WC)

Dr. M. Din, Senior Scientist (Farm Machinery & Power)

Dr. N. Ravisankar, Senior Scientist (Agronomy)

Dr. R. Raja, Scientist Sr. Scale (Agronomy)

Er. Deshmukh Prashant, Scientist (Farm Machinery & Power)

Dr. T.P. Swarnam, Scientist Sr. Scale (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)

Dr. Someshwar Bhagat, Scientist (Plant Pathology) on study leave

Dr. V. Jayakumar, Scientist (Plant Pathology)

DIVISION OF HORTICULTURE

Dr. C.B. Pandey, Senior Scientist (Forestry) & I/c Head

Dr. D.R. Singh, Senior Scientist (Horticulture)

Dr. T. Damodaran, Scientist Sr. Scale (Horticulture)

Dr. R. Sudha ? Scientist (Hort.)

DIVISION OF FISH & 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. B.R. Singh, Head

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. S.K. Zamir Ahmed, Sr. Scientist (Agriculture Extension)

Dr. M. Balakrishnan, Scientist Sr. Scale (Computer Applications)

KRISHI VIGYAN KENDRA

Dr. M.S. Kundu, In-charge

Sh. Nagesh Ram, Subject Matter Specialist (Fisheries) – on study leave

Dr. Kanak Lata, Subject Matter Specialist (Home Science)

Sh. L. Brojendra Singh, Subject Matter Specialist (Horticulture)

Dr.Abhay Kumar Singh, (T6) Subject Matter Specialist (Animal Science)

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. Gangopadhayay	Member
Smt. Sulochana	Member Secretary

INSTITUTE JOINT STAFF COUNCIL

Staff Side

Technical Staff

Shri K. Babu Rao - Secretary IJSC (Staff side)

Shri K. Babu Rao - Member CJSC

Shri V. Damodaran - Member

Administrative Staff

Shri P.K. Roy - Member

Smt. Flourence Toppo - Member

Supporting Staff

Shri K. Ali - Member

Shri Dominic Ekka - Member

Official Side (Nominated by Director)

Administrative Officer

Finance & Accounts Officer

Er. S.L. Paik, Estate Officer

Dr. T.V.R.S. Sharma

Dr. S. Dam Roy

Dr. S.K. Ambast

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

PURCHASE ADVISORY COMMITTEE

Dr. T.V.R.S. Sharma	Chairman
Administrative Officer	Member Secretary
Finance & Accounts Officer	Member
Dr. Jai Sunder,	Member
Dr. N. Ravisankar,	Member
Dr. T. Damodaran,	Member

Works Committee

Dr. M. Din	Chairman
Administrative Officer	Member Secretary
Finance & Accounts Officer	Member
Er. S.L. Paik, E.O.	Member

Price Fixation Committee

Dr. A. Kundu	Chairman
Administrative Officer	Member
Finance & Accounts Officer	Member
Dr. C.B. Pandey	Member
Dr. Kamal Sarma	Member
Mr. A.K. Tripathi Secretary	Member

NEW ENTRANTS / TRANSER / PROMOTION

NEW ENTRANTS

- Miss R. Sudha joined as Scientist in Division of Horticulture and Forestry on 18th May, 2007.
- Dr. S.K. Zamir Ahmed, Subject Matter Specialist, KVK joined as Senior Scientist in Social Science Section on 13th July, 2007.
- Dr. B.R. Singh joined as Head of Division, Animal Science on 15th October, 2007.
- Dr. Jai Sunder, joined as Senior Scientist in Division of Animal Science on 16th July, 2007.

TRANSFER

- Shri Rajesh Sahay, Finance & Accounts Officer was transferred to Central Lac Research Institute, Ranchi on 13th April, 2007.
- Dr. B. Ganesh Kumar, Scientist was selected as Senior Scientist to NCAP *Economics and Policy Research*, New Delhi on 13th April, 2007.

PROMOTION

- Dr. N. Ravisankar, Scientist Sr. Scale promoted as Senior Scientist w.e.f. 5th October, 2007.
- Dr. V. Jayakumar, Scientist promoted as Scientist Sr. Scale w.e.f 29th November, 2007.
- Dr. (Mrs.) T.P. Swarnam, Scientist promoted as Scientist Sr. Scale w.e.f. 14th November, 2007.
- Dr. S. Ghoshal Chaudhuri, Sr. Scientist promoted as Pr. Scientist w.e.f. 29th April, 2007.
- Shri V. Damodaran, T-5 has been promoted to T-6 w.e.f. 25th July, 2007.
- Shri M. Alagar, T-4 has been promoted to T-5 w.e.f. 14th March, 2005.
- Shri A.K. Tripathi, T-4 has been promoted to T-5 w.e.f. 1st May, 2008.
- Smt. Ani Dath, T-4 has been promoted to T-5 w.e.f. 3rd October, 2006.
- Shri Ambika Singh, T-4 has been promoted to T-5 w.e.f. 2nd July, 2006.
- Shri S. Murugesan, T-4 has been promoted to T-5 w.e.f. 4th November, 2004.
- Shri Arul Selvam, T-4 has been promoted to T-5 w.e.f. 1st November, 2004.
- Shri N.K.D. Pillai, T-3 has been promoted to T-4 w.e.f. 3rd February, 2005.
- Late N. Veeran Kutty, T-3 has been promoted to T-4 w.e.f. 3rd February, 2005.
- Shri A.K. Betal, T-3 has been promoted to T-4 w.e.f. 3rd February, 2005.
- Shri R. Kondaiah, T-3 has been promoted to T-4 w.e.f. 3rd, February, 2005.
- Shri S. Alvi, T-3 has been promoted to T-4 w.e.f. 3rd, February, 2005.
- Shri P. Gopalan Nair, T-3 has been promoted to T-4 w.e.f. 3rd, February, 2005.

- Shri Anjan Sengupta, T- 3 has been promoted to T-4 w.e.f. 3rd, February, 2005.
- Shri Abdul Majeed, T-II-3 has been promoted to T-4 w.e.f. 3rd, February, 2005.
- Shri Derrick, T-2 has been promoted to T-3 w.e.f. 5th September, 2003.
- Shri David, T-2 has been promoted to T-3 w.e.f. 5th September, 2003.
- Shri Harishankar Prasad T-2 has been promoted to T-3 w.e.f. 5th September, 2003.
- Shri R.C. Das, T-2 has been promoted to T-3 w.e.f. 20th January, 2005.
- Shri Theophil Gidh, T-2 has been promoted to T-3 w.e.f. 15th March, 2005.
- Shri Ram Chander, T-1 has been promoted to T-2 w.e.f. 2nd September, 2008.
- Shri Kishore Tete, T-1 has been promoted to T-2 w.e.f. 1st May, 2003.
- Shri T. Ravi, T-1 has been promoted to T-2 w.e.f. 29th June, 2001.

LEFT TO HEAVENLY ABODE

Late Adaikkan, SS Grade II on 16th May, 2007.

Late Sushil Kullu on 29th January, 2008.

Late Rafail Xalxo on 24th March, 2008.

INFRASTRUCTURE DEVELOPMENT

SEED STORE CUM FIELD LABORATORY AT BLOOMSDALE FARM INAUGURATED

Seed Store cum field laboratory of CARI was inaugurated by Dr H.P. Singh, DDG (Hort.), ICAR on 01 December, 2007 at Bloomsdale Farm in presence of Dr R.C. Srivastava, Director, CARI alongwith Dr R.V. Nair, Head Crop Improvement, CPCRI, Kasaragod, Dr Mathura Rai, Director, IIVR, Varanasi, Dr K.E. Lawande, Director, NRC Onion & Garlic, Dr B.M.C. Reddy, Director, CISH, Lucknow, Dr M.G. Bhat, Director, NRC Cashew, Dr R.P. Tiwari, Director, NRC Mushroom, Solan and Dr T.A. More, Director, CIAH, Bikaner.