

## Island agriculture: Perspective and strategies

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Andaman and Nicobar is an Archipelago of 572 islands which stretch over 800 km<sup>2</sup> between 06° 5 and 14° 45' N Latitude and 92° and 94° E Longitude in the southern reaches of Bay of Bengal. The total geographical area of the Islands is 8249 km<sup>2</sup> of which Andaman group of Islands is 6408 km<sup>2</sup>, while that of Nicobar is 1841 km<sup>2</sup>. These Island groups are separated from each other by ten degree channel, an international navigation passage. Almost all regions in both groups of Islands are hilly with broken terrain except Car Nicobar. The total coastline of the Islands is 1962 km, which accounts for 25% of the country's coastline and encompasses 28% (0.6 million km<sup>2</sup>) of the total Indian Exclusive Economic Zone. There are about 106 protected areas in these Islands, in which 96 are designated as Wildlife sanctuaries, 9 declared as National parks and a biosphere reserve in Great Nicobar. Also termed as Bay Islands, these Islands are Indian subcontinent's richest rain forests and a coral reef ecosystem. About 88% of the Andaman

and Nicobar Islands total geographical area has been placed under reserved and protected forest. The island topography is hilly with small tracts of coastal fallow lands. Average annual rainfall is around 3100 mm. The pH of the soil varies between 3.5 and 6.5 and mostly acid sulphate soil. The texture is clayey and rarely loamy and sandy. Though the content of organic matter is high, the unbuffered cation exchange capacity is low. There is a lot of water runoff from the tropical rain forest of Andaman and Nicobar Islands, rich in organic humus that gets deposited as coastal sedimentation, making coastal lands rich in acid sulphate. The Andaman and Nicobar Islands are well known for their rich aquatic biodiversity. About 1434 fish species were reported from both marine and fresh water habitats in these islands. The rich ichthyofaunal diversity of these islands is due to the diversity of marine habitats which includes mangroves, creeks, lagoons, estuaries, muddy shores and coral reefs.

**The table shows the unique Marine diversity and significance of ANI**

| Fauna           | World | India | A&N Islands |
|-----------------|-------|-------|-------------|
| Sponges         | 8360  | 519   | 112         |
| Marine Molluscs | 56235 | 32751 | 1422        |
| Crustaceans     | 24375 | 2970  | 837         |
| Hard Corals     | 700   | 334   | 334         |
| Flat worms      | 400   | 19    | 19          |
| Polychaetes     | 8000  | 585   | 21          |
| Echinoderms     | 6226  | 765   | 430         |
| Fishes          | 31723 | 2546  | 1485        |



The Tsunami of 26<sup>th</sup> December 2004 inflicted a major impact on the Andaman and Nicobar Islands (ANI) by way of soil and water resources affected by physical damage, deposition of debris and salt. The coastal areas of A & N Islands present highly diversified human activities, from inland, freshwater, rice-based systems to mangrove and coastal strips used primarily for fishing. The cultivable land available before Tsunami was 50,000 ha which reduced to 43,339 ha after tsunami. The tsunami tidal waves have transported large volumes of sea water into inland water bodies and have also created large tidal pools of sea water. The tsunami, which unleashed great havoc on the island group; also created some permanent salt and brackish water bodies. This new water mass can be used for aquaculture to reciprocate the loss of livelihood faced by the land owners and farmers. The Andaman Sea is also potentially rich in marine fishery resources particularly grouper, snapper, lobster and shrimp resources that are having export potential. Out of the potential harvestable fishery resources of 1.48 lakh tons, the oceanic fisheries constitutes about 60,000 tonnes of which tuna constitutes 46,700 tonnes, i.e. 77.83% of the oceanic fisheries. Out of the projected, potential hardly 19% are presently utilized. The economic development of the Island, therefore, hinges on the development of tuna fisheries of the island and by optimally utilizing available water for coastal aquaculture and open sea mariculture. Infrastructure such as harbour, cold storage and processing facilities as well as vessels/fleet

composing of long liners are required. Since, the islands are lagging behind in comparison to other similar development areas, there is need for putting these islands in a speedy development track in the initial planning period and keep up the tempo in the subsequent plan periods with self generated support and sustainability. The farming and fisher families in Andaman and Nicobar Islands need special attention, including technology training, techno infrastructure and trade. Island fisheries have the problem of transport costs, particularly in the case of perishable commodities which may be sold in the mainland or neighbouring countries. Value addition Chain is therefore very important in context of Development of the Islands. The Andaman and Nicobar Islands and Lakshadweep group of Islands offer a great potential for improving the income of the fisher folk as well as the entrepreneurs related to Fisheries Industries. There is considerable scope for improving the income of fisher families on environmentally sustainable basis by introducing Integrated Coastal Zone Management and Scientific fish rearing, harvesting and fish processing. A glimpse at the present catch which stands at 35,000 tons per annum against the estimated potential indicates the extent of under-utilization of resources in ANI.

Although the Exclusive Economic Zone (EEZ) encompasses 0.60 million Km<sup>2</sup>. The levels of exploitation of marine fisheries are very less compared to neighbouring countries. The gross under exploitation of marine capture fisheries is depicted in the table given below.

| Parameter    | EEZ area                | Coast Length | Continental shelf area | Primary Productivity    | Marine Fish Production | Catch index (Catch/EEZ area ≤ 100) |
|--------------|-------------------------|--------------|------------------------|-------------------------|------------------------|------------------------------------|
| Units        | Million km <sup>2</sup> | km           | 000 km <sup>2</sup>    | mgC/m <sup>2</sup> /day | Million metric tonnes  |                                    |
| Indonesia    | 3.1                     | 81,000       | 1,713                  | 685                     | 4.51                   | 145.48                             |
| Thailand     | 3.63                    | 2,624        | 39                     | 702                     | 2.92                   | 80.44                              |
| Malaysia     | 0.45                    | 4,810        | 418                    | 1401                    | 1.28                   | 284.44                             |
| Sri Lanka    | 0.52                    | 1,770        | 28                     | 609                     | 0.3                    | 57.69                              |
| Maldives     | 0.92                    | 644          | 35                     | 387                     | 0.16                   | 17.39                              |
| India        | 2.02                    | 8,041        | 500                    | 979                     | 2.70                   | 133.66                             |
| A & N Island | 0.6                     | 1,192        | 32                     | 459                     | 0.03                   | 5.00                               |



A closer look on the catch composition would suggest that the gulf is widened more specifically due to the gross underutilization of the tuna resources, whose current annual landings linger around 800-1000 tones, as against the projected potential of 60000 tonnes. This is a clear indication of the scope available for sustainable exploitation of tuna fishery and development of cage culture industry in the Islands to facilitate establishment of subsidiary industries. It will not only boost export but will also generate employment avenues to the people of ANI. Apart from these, freshwater and brackish water aquaculture, marine ornamental fish breeding, farming and post-harvest technology are some of the thrust areas where emphasis need to be given for development. The Andaman and Nicobar Islands fall under the Agro ecological region 21 (Hot humid to per humid Island eco-region). The Islands have a true maritime climate with least variation in maximum and minimum temperatures throughout the year. Some of the important species as per their landings are of sardines, perches, silver bellies, carangids, mackerel, seer fish, mullets, prawns and other crustaceans. About 19 species of penaeid prawns belonging to six genera and 6 species of lobsters also occur here. Among the molluscs, the most important are Trochus, Turbo shells, Pearl oysters, Giant clams, mussels and oysters (ANDFISH 2005; Dam Roy *et.al* 2008; Dam Roy *et.al* 2009 and Dam Roy & George 2010)

A close study on the agricultural scenario of Andaman & Nicobar Islands depicts that agricultural activities started by the advent of penal settlement on the Islands. Prior to that the Nicobari tribes, who indulged in community farming under tubet system, wherein they practiced a sustainable type of coconut based farming in a traditional way (wherein the scientific method of cultivation was not practiced.) Coconuts are allowed to

grow and propagate in its own way forming a jungle of coconut forest. No spacing was followed neither fertilizers were given. The interspaces were utilized for growing tuber crops etc., The community with their wise wisdom did a type of shifting cultivation, wherein once the nutrient of the place of cultivation, is utilized they will go for a new area. This is unlike the Jhoom type of cultivation of the North East; wherein the jungle will be set on for fire. The Nicobarese also had the habit for rearing the livestock like pig, poultry and of recent cattle and goat etc. in a semi domesticated condition.

Unlike the Nicobarese, the other Negrito tribes like Jarawas, Onges, and Sentinelese were basically hunters and gatherers, they seldom practiced agriculture. The advent of the Britishers in Andaman & Nicobar Islands which resulted in penal settlement. The convicts / settlers were given 15 ha land for agricultural land, this resulted in initiation of Agricultural practices in Andaman & Nicobar Islands. Some of the settlers who came from Erstwhile East Pakistan had the agrarian background and settled down in the Islands started practicing agriculture. With 6 % of land available for agriculture it will be only rational to expect that the food requirement of over 4 lakh population can be met from agriculture. Ideally we should not be aiming for self sufficiency in all the agricultural crops. But we may aim for self sufficiency in particular crops. Serious effort should be made to increase the productivity of coconut, arecanut etc.

With regard to Nicobar group of Island there is a lot of potential for cultivation of tuber crops. A list of tuber crops used by the tribals of Andaman & Nicobar Islands are *Dioscorea glabra*, *D. pentaphylla*, *D. bulbifera*, *Maranta arundinacea*, *Colocasia esculenta*, *Tacca leontopetaloides*, *Manihot esculenta* and *Ipomoea batatas* (Sankaran *et.al* 2013).



### CIARI's intervention on Homestead based integrated farming has brought out perceptible changes in Car Nicobar Island

Considering the remoteness, dietary intake, limited land availability and lack of market for the perishable produce, a small scale homestead based integrated farming system comprising home garden (400m<sup>2</sup>), backyard poultry (20 no's), goatary (2 no's) and composting were developed for improving nutritional security of the tribal household besides increasing the farm production and employment generation. The frequency of consumption of meat, poultry, egg, fruits and vegetables by the farm family increased to the extent of 71 to 380 % after the intervention. The vegetables including greens, fruits and egg consumption increased significantly due to on farm

production and there was a reduction in intake of tubers indicating a change in dietary pattern more towards balanced nutrition. A total of 95 man days were generated by the system viz., 52 man days in home garden, 40 man days in livestock rearing and 3 man days in composting spread throughout the year (Swarnam *et.al* 2014).

During pre tsunami period the area under rice production was 10,000 ha area, but under post tsunami scenario the area under paddy cultivation has come down drastically to 8000 ha, hence our aim should be increasing productivity by utilizing the varieties which give higher productivity. In this regard climate resilient rice varieties can be utilized, the salt tolerant rice varieties developed by Central Island Agricultural Research Institute can be utilized. The trial with regard to the rice varieties in A & N Islands is given in table 1.

### Specific varieties of various crops which are time tested through MLT in the Islands

Table 1. Field Crops

| S. No | Varieties   | Grain type     | Duration                       | Suitable for cropping system | Grain yield (t/ha) |
|-------|-------------|----------------|--------------------------------|------------------------------|--------------------|
| 1.    | CARI Dhan 1 | Medium slender | Medium duration (120-125 days) | Paddy-vegetables/<br>Pulses  | 4.0-4.5            |
| 2.    | CARI Dhan 2 | Medium slender | Medium duration (120-120 days) | Paddy-vegetables/<br>Pulses  | 5.0-5.5            |
| 3.    | CARI Dhan 3 | Long Slender   | Medium duration (120-130 days) | Paddy-vegetables/<br>Pulses  | 4.5-5.0            |
| 4.    | CARI Dhan 6 | Long Slender   | Medium duration (120-125 days) | Paddy-vegetables/<br>Pulses  | 5.0-5.5            |
| 5.    | CARI Dhan 7 | Medium slender | Medium duration (120-125 days) | Paddy-vegetables/<br>Pulses  | 5.0-5.50           |
| 6.    | CARI Dhan 4 | Medium bold    | Long duration (140 days)       | Paddy-fallow                 | 5.0-5.5            |
| 7.    | CARI Dhan 5 | Medium bold    | Long duration (140 days)       | Paddy-fallow                 | 5.0-5.5            |
| 8.    | CSR -36     | Long Slender   | Long duration (130 days)       | Paddy-vegetables/<br>Pulses  | 4.5-5.0            |
| 9.    | Gayatri     | Medium slender | Long duration (140 days)       | Paddy-fallow                 | 5.0-5.5            |



In case of vegetable production, over the year the island has shown lot of promise. Unfortunately, the mega earthquake of 2004 has changed the scenario. For instance a place called Methakhari, which was the vegetable bowl of Port Blair, got sub ducted to a level of 1.25 metre and the ingress of sea water during high tide has made the land unsuitable for agricultural purposes. At

present the vegetable cultivation are mainly done in island like Havelock & Neil Island. Here again the transportation and marketing facility is an issue. Of course vegetable are transported from far flung areas places like Billiground, Nimbudera, Diglipur etc. Vegetable are also produced in the neighboring villages of Port Blair. The crop suitable for vegetable and fruit production is given in table 2 & table 3.

**Table 2. Horticultural Crops**

| S.No                   | Crops       | Variety           | Description / specific features   |
|------------------------|-------------|-------------------|---|
| <b>Vegetable crops</b> |             |                   |   |
| 1                      | Okra        | Arkaanamika       | Public sector high yielding (9-12 t/ha) okra variety<br>Resistant to yellow vein mosaic virus<br>Suitable for organic farming system  |
| 2                      | Chilli      | KA-2              | Suitable for green chilli purpose<br>Tolerant to bacterial wilt<br>High yielding potential (7-9 t/ha)   |
| 3a                     | Tomato      | ArkaVikash        | Public sector high yielding (30-35t/ha)<br>Less bacterial wilt incidences (20-35 %)   |
| 3b                     | Tomato      | Laxmi             | High yielding (30-35 t/ha)<br>Bacterial wilt tolerant variety   |
| 3c                     | Tomato      | Ayush             | High yielding (35-40 t/ha)<br>Bacterial wilt tolerant variety   |
| 4a                     | French bean | ArkaAnoop         | Bush type French Bean variety with recorded yield of 6-8 t/ha   |
| 4b                     | French bean | ArkaSuvidha       | Bush type French Bean variety with recorded yield of 6-7 t/ha   |
| 4c                     | French bean | ArkaKomal         | Bush type French Bean variety with recorded yield of 6-9 t/ha   |
| 5                      | Cowpea      | ArkaGarima        | Recorded yield of 8-10 t/ha in Island condition   |
| 6a                     | Capsicum    | Indra             | High yielding variety of capsicum with recorded yield of 30-40t/ha in poly house in Islands condition<br>Suitable only for protected cultivation<br>Bacterial wilt susceptible so suitable protection measures required |
| 6b                     | Capsicum    | California Wonder | Suitable for open and poly house cultivation<br>Recorded yield is in the range of 28-32 t/ha in poly house in Island condition<br>Bacterial wilt susceptible so suitable protection measure required                    |



|                     |               |   |   |
|---------------------|---------------|---|---|
| 7a                  | Cauliflower   | White Marble  | High yielding and suitable for early harvesting crop<br>Recorded yield in different locations ranges from 17-24 t/ha in islands<br>Suitable for cultivation in rain shelters and poly house during rainy season       |
| 7b                  | Cauliflower   | White Shot  | High yielding and suitable for early harvesting crops<br>Recorded yield in different locations ranges from 15-22 t/ha in islands<br>Suitable for cultivation in rain shelter and poly house during rainy season       |
| 8                   | Poi           | CARI Poi Selection                                    | Developed from local collections from Andaman Islands<br>Green colour, broad and attractive leaves<br>Yield ranges from 18 t/ha (for single harvest) to 50-54 t/ha (multi – harvest)<br>Rich in dietary micronutrient |
| 9                   | Broad Dhaniya | CARI Broad Dhaniya                                    | Developed from local collections from Andaman Islands.<br>Green colour, broad and attractive leaves<br>Yield ranges from 18 -13t/ha<br>Rich in dietary micronutrient  |
| 10                  | Palak         | All Green   | Fast growing and high yielding variety (18-22 t/ha) of Palak.<br>Suitable for cultivation in poly house/ shadenet   |
| 11                  | Ground Orchid | CARI Pretty Green Bay                                 | A variety with longest spike length<br>Suitable for cultivation in shade house conditions   |
| <b>Fruits Crops</b> |               |   |   |
| 1                   | Papaya        | Co3   | High yielding and suitable for table purpose and papain extraction  |
| 2                   | Banana        | Dwarf Cavendish Red Banana, Karpooravalli, Korangiand | Highly suitable for their yield and quality   |

**Table 3. Tuber Crops**

| S.No | Crops        | Variety  | Description / specific features   |
|------|--------------|--|---|
| 1    | Ginger       | Jorhat   | Recommended for cultivation in islands  |
| 2    | Potato       | Kurfi Surya, TPS 92-PT-27, KufriJyothi             | Suitable for cultivation in islands (has been grown in North Andaman in experiment scale) |
| 3    | Cassava      | H-226 SreeVisakham, SreeVijaya and Vellayanirishwa | Suitable for cultivation in islands   |
| 4    | Sweet potato | CARI-SP1 & CARI- SP2                               | Suitable for cultivation in islands   |
| 5    | Colocasia    | Sree Pallaviand, Sree Kirana                       | Suitable for Andaman islands  |





|   |                   |                                      |  |
|---|-------------------|--------------------------------------|--|
| 6 | Greater Yam       | Sree Roopa, Sree Shilpa and CARI-DA1 | Recommended for cultivation  |
| 7 | White Yam         | Sreepriyaand, SreeDhanya             | Suitable for cultivation   |
| 8 | Elephant Foot Yam | Gajendra                             | Found to be yielding 35-40t/ha in all 3 districts of A & N Islands |

There is a great scope for organic vegetable cultivation in this Island. Andaman & Nicobar Administration is considerable effort to bring into Neil Island under the ambit of organic cultivation.

Earlier efforts have been made to launch the coconut mission at Car Nicobar; which is an Island practicing de-facto organic cultivation. Other crops that have shown promising results are groundnut, Sesbania etc., (table-4).

**Table 4. Other Crops**

| S. No | Crop                       | Variety         | Year and location                        | Results / recommendation  |
|-------|----------------------------|-----------------|--|---|
| 1     | Ground nut (table purpose) | ICGS 76 & SG 99 | 2008-12<br>South and North Andaman       | Recorded higher pod yield of 1.7 kg /ha and 1.6 kg/ha, respectively during dry season. In the young coconut plantation interspaces it gave 275-300 kg/ha (diffused light)                 |
| 2     | Sesbania                   |                 | 2012-13<br>South Andaman and Car Nicobar | Performed better at farmer's field by producing higher biomass 0.6-0.7kg plant. Grown as biofence, used as feed for livestock, green for human consumption and can be used in composting. |

Another prospect is there for organic spice cultivation and selling the same in under the brand name of Andaman. The qualities of spices are very good over here and are comparable to mainland. Out of 50000 ha area available, roughly 50% of the area are under the plantation crops i.e. Coconut and arecanut. The inter space of the coconut plant can be fruitfully utilized for cultivation of spices like pepper, cinnamon, Bay leaf, nutmeg, turmeric, ginger etc. Premium spices can be obtained by selling the spices under the brand name of Andaman product.

Another avenue is there for utilizing the interspaces of coconut area for the fodder cultivation in Andaman & Nicobar Islands. It is a common knowledge that in Andaman and Nicobar Islands,

fodder are scarce; hence, a strategy can be adopted to cultivate the fodder in the interspaces of coconut & arecanut plant. Even under the joint forest management cultivation of tree fodder can be done.

In case of paddy in the salt affected areas, where the ingress of seawater has made the soil saline, the salt tolerant paddy varieties like CARI Dhan-4, CARI Dhan -5 etc., can be grown. In other areas we may aim for higher productivity wherein the tested varieties of paddy having greater potential for paddy production can be utilized.

In particular patches some of the farmers variety such as the varieties preserved by the Karen tribes, like Khushbuya, Black Burma rice etc., can



be encouraged to be grown. CIARI has made an attempt to register these varieties under Plant Protection Variety and Farmers Right Authority.

There is a great need to provide livelihood security through livestock and poultry. It has been our observation that, after the mega earthquake and Tsunami that struck Andaman & Nicobar Islands; livestock and particularly the poultry sectors provided the best possible alternative for livelihood option to the farmers of Andaman & Nicobar Islands.

Hence this sector has the potential to provide, not only an opportunity for livelihood but also to provide the much needed nutritional security. Various technologies have been standardized like backyard poultry farming utilizing the Nicobari birds; CIARI has developed varieties of black & white Nicobari from the original Nicobari bird which are brown in colour.

The rearing of Andaman local goat also provides better opportunity for the farmers. The Terressa goats which is a precious indigenous germplasm of Andaman & Nicobar Islands, have got good potential and have remarkable growth rate can grow to a size of 24 – 26 kg in 1<sup>st</sup> year, 35 – 40 kg in second year and to 65 - 70 kg in 4<sup>th</sup>

year. It is highly adapted to the Island condition. Propagation of this breed in island shall boost the meat production and farmers can get good remuneration (Personal communication from Animal Science Division, CIARI, Port Blair).

The Nicobari pigs have also got enormous potential; these are particularly liked by the Nicobari folk. They are almost culturally integrated with the way of life of Nicobari tribe. The pig has adapted to the island condition and thrives very well on coconut carnal, tuber crops and other vegetables. The reproductive and productive performances of Nicobar Pig under intensive system has also been studied by Animal science Division of CIARI, Port Blair.

It must also been mentioned that these Nicobari birds has already been registered in The National Bureau of Animal Genetic Resources, Karnal. Terressa goat, Nicobari pig etc is under the process of registration at NBAGR, Karnal.

As land is a limiting factor for agriculture in our land, high density planting is one of the solutions to increase the productivity. High density planting standards to be communicated for the major crops grown in the islands. Table shows the possibility of high density planting in Andaman and Nicobar Islands

|    | Name of the Crops/<br>Technology           | Variety/ Crops  | Recommended<br>spacing              |
|----|--|---|-------------------------------------|
| 1  | High density multi-storied cropping system | Coconut based cropping system involving fruits, spices & Tuber Crops<br>Arecanut based cropping system involving fruits, spices & Tuber Crops | -                                   |
| 2. | Coconut                                    | Andaman dwarfs and CARI-Annapurna   | 6 x 6 M                             |
| 3. | Pineapple                                  | Giant Kew & Queen   | 30 x 60 x 90cm<br>Double row system |
| 4. | Mango                                      | Amrapalli   | 5 x 5 M                             |
| 5. | Banana                                     | Dwarf Cavendish   | 1.8 x 1.8 M                         |
| 6. | Papaya                                     | PusaNanha   | 1.8 x 1.8 M                         |
| 7. | Noni                                       | CARI Sanjivini<br>CARI Samridhi   | 3 x 3                               |
| 8. | Noni                                       | CARI Rakshak  | 2 x 2                               |



### Strategies adopted by CIARI, Port Blair for Island Agriculture

Central Agricultural Research Institute (CARI) has been conducting research for providing livelihood security to the island farmers through development of technologies and their implementation in the farmers' field. The major goal of the institute is to provide a research base to improve the productivity of important agriculture, horticulture, livestock and fishery sector of A & N Islands through adaptive, basic and strategic research. For socioeconomic amelioration of the tribal communities and the farm women it is envisioned to provide livelihood opportunity through sustainable technological intervention and capacity building under "Tribal Sub Plan and NEH Plan".

Integrated Agriculture System for Tropical Island" is being taken up as the flagship programme of this institute to enhance the adaptive capacity of the island farmers and fishers in order to build disaster and climate resilient islands through frontier research. In order to protect the precious flora and faunal diversity of the islands, it is envisioned to develop facilities for "Composite Bio-security and Quarantine Facility" in the XII Plan. With the accumulated experience and expertise in Island agriculture, the institute shall become model for tropical island agriculture research to the South East Asian countries in short term and entire world, in long term.

#### Status and Future Strategies for Horticulture Development in the Islands

The agricultural development in inhabited islands requires, proper planning with consideration of fragile ecosystem. The geographical isolation and import depending phenomena further attract more attention of policy makers to upgrade local production base with suitable technological interventions. The primary concern in these territories is towards proper use

of resource base in sustainable manner. Most of Islands have climatic conditions favouring rich biodiversity of flora and fauna. Therefore, efforts need to make for sustainable exploitation of this resource. The islands economy and livelihood is mainly depending on horticultural based farming system since habitation. Encouraging hi-tech interventions with ensured supply of inputs and post harvest management is potential quarter for enhancing island agricultural productivity. For this proper planning for infrastructure development, integrated farming system, crop diversification, pest management and improvement of existing plantations are required. This is high time to promote low input requiring crops such as indigenous orchids and ferns, underutilized fruits and vegetables. Besides, there is urgency to promote such systems which input requirements can be met with locally driven materials.

Further, in the Intellectual Property Rights regime it becomes imperative to conserve the existing germplasm through establishing gene banks, registering germplasm for benefit of Island community.

#### Development of Island Fisheries

Andaman and Nicobar Islands are known for their pristine beauty and enigmatic history. The seas of Andaman have been the home for a wide variety of species of pelagic, demersal and oceanic fishes. The pelagic resources include anchovies, sardines, mackerels, carangids, ribbon fishes, seer fishes, neritic tunas, barracuda, etc. The demersal resources constitute perches, silver bellies, pomfrets, scads, scianids, nemipterids, shrimps, lobsters, etc. The oceanic resources are skipjack tuna, big eye tuna, bill fishes (sail fish, marlin and sword fish), pelagic sharks, etc. They also include high value species like prawns, crabs and lobsters. As such, fisheries continued to be one of the major natural resources of the Islands. The Andaman & Nicobar Islands has a coastline of 1,912 km (24% of the coast line of India) with a continental shelf



of 35,000sq.km. The Exclusive Economic Zone (EEZ) of the Islands constitutes about 28 per cent of Indian EEZ.

There are 97 fishermen villages in the A & N Islands with a population of 15,320. Around 5,617 full-time fishermen and 718 part-time fishermen are engaged in marine fishing activities in the Islands. They operate about 2,808 fishing crafts of which 1,524 are non- motorized/traditional crafts, 1,279 motorized crafts and 10 mechanized boats. The main fishing gear used is drift gillnet, which contributes to over 40 % of marine fish landings. The other fishing gears commonly used are shore shine, hook and line, long line, cast nets, etc. There are 57 beach landing centres and 8 fish markets.

### **Biodiversity Conservation and Environmental Biotechnology**

The Andaman and Nicobar group of islands is considered to be a veritable storehouse of plant biodiversity. Situated between two major biodiversity hotspot, namely the Indian subcontinent and the Malaysian-Indonesian region, it is hardly surprising that the Islands manifest biodiversity of extraordinary range within a limited geographical area.

The flora of the Andaman group of islands shows closer affinity to the Indo-Myanmarese-Thai flora, while the Nicobar groups of islands are closer to the flora of Malaysia-Indonesia. Nearly 2100 species of Angiosperms have been reported from the islands, of which 11% are strictly endemic to the islands. The diversity of plant forms have been documented, initially in British days and more recently by the Botanical Survey of India. In view of the rich biodiversity of the islands, several Indian crop-based research institutes have surveyed the islands and collected valuable germplasm.

Andaman and Nicobar Islands represents one of the richest repositories of biodiversity in the whole of south and south East Asia. These

islands are a virtual bio reserve, which is unique both in terms of biodiversity and abundance. Situated between two major biodiversity hot spots, namely the Indian sub continent and the Malaysia-Indonesia region, it is hardly surprising that the islands manifest biodiversity of extraordinary range with in a limited geographical area. The biodiversity of thee islands ranges from medicinal plant resources, indigenous Orchid, agro biodiversity and economically important plant species like timber yielding plants.

### **Livestock Production Policy for A & N Islands**

India has vast resource of livestock and poultry, which play a vital role in improving the socioeconomic condition and National economy. The island agriculture and animal husbandry activities are barely 150 years old. Till late 18<sup>th</sup> century islands were inhabited by only native tribal and the major food animals was pigs and birds. With the settlement of penal colony by Britishers, livestock farming came in existence to meet out the demand of meat and milk.

The island is endowed with rich faunal diversity and among them the farm animal genetic resources comprises of cattle, goat, buffalo, pig and poultry. Among them the Nicobari fowl, Teresa goat, Nicobari pigs are the important indigenous germplasm of the island. The challenges ahead for the institute and the administration to address the major issues keeping in mind the growing population and the tourism sector. Now it is high time to redesign the livestock and poultry production strategies to meet out the requirement of meat, milk and egg.

### **Human Resource Development in Agriculture and allied areas**

For providing opportunities to the Island youth for higher education in agriculture and allied field an attempt has been made with the involvement of the A & N Administration, Educational Institute IGNOU and CARI to plan out



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### & N Islands

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a strategy for bringing up high standard education Institute in the Island so that the youths can get an opportunity to study and also open doors for the mainland students.

### Transfer of Technology of Central Agricultural Research Institute, Port Blair in earlier period (1978 – 2000):

- Lab to Land and National Demonstration Programme were the tools used in the early years for its technology dissemination. Taking advantage CARI introduced many new varieties such as winged bean, sisal hemp, Queen variety of pineapple and Khaki Campbell ducks in the early 80's.
- Institute Village Linkage Programme (IVLP) through bottom up approach during the 90's led to the productivity and profitability enhancement of farming systems in the islands. Ograbraj and Namunagarh villages were adopted.
- As plantation crops were the major horticultural crops of the Islands emphasis was given to develop multistoried cropping system to maximize the productivity and efforts were made to utilize the sloppy land to develop spices through technology intervention, inputs and training in collaboration with line departments. Black pepper cultivation on hedge rows and *Gliricidia* standards between the coconut trees have been standardized and widely disseminated to the farmers. Multi-tier cropping system with coconut and arecanut were developed in Tusnabad, Burmanallah, Humphrigunj, Aniket and Wandoor.
- Cultivation of mushroom on agricultural wastes and byproducts available in the islands was standardized and disseminated through KVK which provided not only employment opportunities to the farm

women but supported in achieving nutritional security.

- Green mussel culture technology brackish water creeks was standard and disseminated to the fishers entrepreneurs.
- To control the rhinoceros beetle menace the coconut gardens of A&N Islands, C. has evaluated different IPM module Adoption of IPM module against rhinoceros beetle such as release of rhinoceros beetle infected with baculovirus @ 15 no during May-August and treatment breeding grounds like dead palm, sawdust cowdung heaps with spores of *Green muscardine fungus (Metarhizium anisoplia)* @ 1012 spores/sq. mt during May-June could give higher cost benefit ratio of 2.47 as compared to 1: 1.97 by conventional pest management practices.

### Farmers Field School (FFS) on IPM on Paddy and Vegetables

FFS, a collaborative programme with Central Institute of Pest Management centre, Port Blair was started with an objective to reduce the use of chemical pesticide and to increase the use of bio-intensive pest management methods for control of insect pest and diseases in Rice and Vegetable. 14 week long programme on various aspects of identification and management of various insects pests diseases, use of bio-intensive pest management using *Trichoderma*, *Pseudomonas*, NPV, neem oil cake, neem oil were done in farmer field in the villages selected. The programmes were conducted among 30 farmers each for paddy and vegetables in cluster of villages viz. Bharatpur, Sitapur and Laxmanpur in Neil Island and Manjery, New Manglutan, Guptapara and Indiranagar of South Andaman.



### Farm School on AIR

With a view to disseminate the technologies to the far-flung area of the island farm school on AIR a thirteen weeks programme was conducted in collaboration with Akash Vani and Doordarshan Port Blair on the subject viz., package of practices for rice, nutrition kitchen gardening, poultry farming and fresh water fish culture for the benefit of the stakeholders of the island. Beside daily broad cast in the Gramin Jaghat Programme is supplemented by the scientists of CARI on agriculture and allied subjects.

### Transfer of Technology (ToT) Programme of CIARI, Port Blair at a latter period (2000– 2015)

The research findings generated at the Institute's farm and laboratories are being translated into practice through well organized Transfer of Technology programmes of the Institute. For the successful implementation of the village development programmes, all the research sections of CARI have been linked with the State Development Departments like Agriculture, Animal Husbandry and Veterinary Services, Fisheries, Rural Development, Health services, Social Welfare Advisory Board and Nationalized Banks and the NGO's for bringing about all round development and also to reach the unreached in the far-flanged islands of this territory.

The ToT programmes has been quite remarkable in terms of demonstration of latest technologies, quality of the training programme imparted to practicing farmers, farm women, rural youth, weaker sections, extension functionaries, field days organized and information/ message broadcasted through AIR and press media, were found to be appreciable and reflected a wide coverage and representation to the local requirements.

### Front Line Transfer of Technology Programme of CARI

In order to transfer the technologies developed by CARI and to reach out the farmers of different Islands the Institute has established three KVKs, one each at Sippighat, South Andaman (1993), Car Nicobar, Nicobar (2010) and Nimbudera, Middle Andaman (2012). Besides, an Out Reach Centre funded by NABARD was established at Diglipur (2009) to cater to the technological needs of farmers of North Andaman.

### Krishi Vigyan Kendra

To further the technology transfer program the institute has got 3 KVK's for all the three districts, located at Sippighat, Car Nicobar and Nimbudera respectively.

With the establishment of KVK in 1993 at Sippighat, South Andaman, for the first time 'village adoption' programme for the **Integrated Development of Villages in holistic** manner was introduced at Guptapara in collaboration with line department, lead bank and PRI's. The model was replicated in Manglutan and Manpur villages of South Andaman. Other cluster of villages namely, Dhanikhari, Lalpahad and Hathitappu in South Andaman also got benefitted from TOT programmes from 1993 to 2003.

The KVKs of CARI have undertaken activities in the form of vocational trainings, front line demonstrations, on farm test, on farm trials, extension activities, SHGs and Farmer's Club promotion and functional linkages. It functions as change agents to bring about desirable improvement in productivity of agriculture, animal husbandry and fisheries and enhance the income of farmers apart from creating employment opportunities. As one of the innovative methodology, one or two villages are adopted at a time and 'Transfer of Technology (TOT) programmes, in an integrated manner is implemented ,so that a holistic development is

| Sl. No. |
|---------|
| 1.      |
| 2.      |





**Programme**

ushered in with an overall upliftment in socio-economical status of farming community as well as in production of food and profitability.

The technologies popularized in the districts are Integrated fish farming system, Composite fish culture, Fish seed production, Piggery, Backyard poultry, Quail farming, Improved vegetables, cereals, pulses, Azolla cultivation & Grafting techniques in floriculture etc. The villages namely; Guptapara, Manpur, Manglutan, Makkapahar, Chouldari, Ferrargunj, Burmanallah, Hathitappu, Rangat, Diglipur, Lalpahar are some of the villages, wherein the intervention has been done in the mode of single village or cluster village adoption programme and benefitted the farmers.

**National Initiative on Climate Resilient Agriculture (NICRA) through KVK, South Andaman**

Two villages i.e. Badmaspahar and Portmout at South Andaman have been adopted, where major thrust is given for Natural Resource Management like rain water harvesting, Mulching in plantation and vegetable crops, improved shelter for poultry and dairy animals, Aerial vegetable cultivation to reduce soil erosion in sloppy land. Beside, Ridge and furrow cultivation for vegetables in fallow land to save the crops from unpredicted rain during post monsoon period and fodder cultivation in the village are been introduced.

**Out Reach Centre of CARI at Diglipur, supported by NABARD**

For Technology transfer and imparting knowledge to the stakeholders in North Andaman CARI established an Out Reach Centre with the support of NABARD at Keralapuram, Diglipur, from July, 2009. Fifty one field level training programmes including customized in the field of Crop production, Horticulture, Livestock, Fisheries, Natural Resource Management, Plant protection, Post Harvest/ processing and other fields have been conducted for the stakeholders. Front line demonstrations (FLD) using seeds of high yielding varieties and advanced package of practices are been demonstrated at the farmers field to popularize cultivation of high yielding varieties of field crops, plantation crops, backyard poultry, fish culture and others with the overall participation of the farmers. 1500 farmers have been benefitted and around 796 farmers have been linked with the ORC.

Technologies such as, Seed village production of rice in participatory mode, Goat, Pig, Duck (Peking cross under backyard), Model satellite nurseries of fresh water fish, Mini Dhal Mill for SHGs, Coconut dehusker, Tuber crops (Elephant foot yam, tapioca, sweet potato), Pheromone traps for control of rhinoceros beetle and rodent management are popularised for adoption. The villages covered are Khudirampur, R.K. Gram, Shubash Gram, Sita Nagar, V.S. Pally, Laxmipur, Madhupur, Milangram, Krishnapuri, Deshbandu Gram, Ganesh Nagar and Kalipur.

**Other Extension Programmes conducted /in progress**

| Sl. No. | Activity   | Intervention  | Location                                | Year      |
|---------|--|---|---|-----------|
| 1       | Farmers participatory Action Research Program – 1  | 25 on farm demonstrations on technologies like BBF, IFS, ground nut cultivation under plantations.  | South Andaman, Havelock, Little Andaman | 2008-2010 |
| 2       | Farmers Participatory Action Research Programme-II | 100 on farm demonstrations on technologies like BBF, IFS, ground nut cultivation under plantations. | South Andaman, Havelock, Little Andaman | 2010-12   |



|    |  |   |                                 |              |
|----|--|---|---------------------------------|--------------|
| 3. | AICRP on IFS                             | 10 on farm participatory research for developing IFS models for homestead farming in tribal areas of Nicobar Islands.   | Kinmai, Kimios, Car Nicobar     | 2012-13      |
| 4. | National Agricultural Innovation Project | On farm demonstration of technologies like BBF, three tier system, Rice – fish culture, IFS, introduction of CSR 36 in degraded coastal areas. A total of 500 farmers have been directly benefited. | North, Middle and South Andaman | 2010-2014    |
| 5. | AP Cess Fund – on IFS                    | On farm participatory Research on IFS for different micro farming situations in 4 farmers field.  | Calicut, Guptapara, Chouldhari  | 2003-2007    |
| 6. | Agro Advisory services                   | Issue district wise weather based agro advisories twice in a week for the benefit of farmers of A & N Islands, which is being disseminated through print and electronic media.                      | A & N Islands                   | Since 2008   |
| 7. | AICRP on tuber crops                     | Demonstration of tuber crops technologies   | Harminder Bay                   | 2013 onwards |
|    |  | Demonstration of Elephant foot yam in collaboration with KVK, Car Nicobar & South Andaman   | Car Nicobar /South Andaman      | 2013 onwards |
|    |  | Demonstration on Sweet Potato CARI-SP1 & CARI SP2 in collaboration with KVK, Car Nicobar & South Andaman  | Car Nicobar/ Mayabundar         | Since 2012   |
| 8. | CSS-NHM on spices                        | Demonstration on ginger   | Car Nicobar & South Andaman     | 2013 onwards |

### Technological interventions post Tsunami

➤ Immediately after the devastating Tsunami in December 2004, CARI has carried out *Tsunami* damage assessment in collaboration with NRSA (ISRO). Later, technology supported rehabilitation programme was initiated in Manjeri village of South Andaman. This included peripheral bunding with one way sluice gates which arrested the ingress of seawater. Engineering and agronomic measures combined together led to restoration of

agricultural activities in the intervention areas.

- **Rehabilitation Model and restoration of agriculture** with need based intervention of suitable technologies under different situations of the inundations after *Tsunami* has been developed to provide decent livelihood to the affected farmers of these island.
- **Economic rehabilitation of Tsunami affected community:** Instant assessment of the extent of damage has been made by



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2010-2014

2003-2007

December 2008

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various Government agencies, particularly CARI and efforts were opportunity. As per the request made by Andaman and Nicobar Island Administration and on the instruction of Ministry of Agriculture, Government of India, CARI, Port Blair constituted expert committees to assess the impact of tsunami on agricultural lands and made to chalk out action plan which was approved by the Ministry of Agriculture, Government of India to overcome this crisis and to convert this hardship into suggest suitable technologies for rehabilitation of affected farmers in various groups of islands such as Campbell Bay, Nancowry, Car Nicobar, Little Andaman and South Andaman separately.

- Under **National Agricultural Innovation Project**, agriculture has been restored in 200 acres of degraded coastal land and provided livelihood support to more than 500 farmers through technological intervention in Andaman Islands. The farmers of the villages like Chouldari, Tusnabad, Manpur, Collinpur, Bengali Basti, Dashratpur, Sabri, D.B. Gram, Madhupur, Laxhmipur and Badmaspahar have been covered.
- Developed and released five varieties of medium duration rice, (CARI Dhan 1, 2 & 3) out of which two (CARI Dhan 4 & 5) are salt tolerant, four varieties of coconut (CARI-Annapurna, CARI-Surya, CARI-Omkar & CARI-Chandan) specific for copra, coconut water, and ornamental purposes, two varieties of sweet potato (CARI-SP1 & SP2), one each of ground orchid (CARI-Pretty Green Bay), broad dhaniya (CARI-Broad Dhaniya) and greater yam (CARI-Yamini).
- Developed technology for crop diversification to grow vegetables, fish and fodder round the year in low land areas using broad bed furrow system. An

average net return of Rs. 1,17,532/- per hectare was achieved against Rs.9,000-10,000 from cultivation of paddy crop alone. Under Rashtriya Krishi Vikas Yojna (RKVY) 100 acres of land have been identified for demonstration by A & N Administration. The places like Chouldari, Mamyo, Tusnabad, Calicut, Makkapahar, Temple mayo, Collinpur and Hutbay were selected for demonstration of technology in participatory mode.

- Under the Public Private Partnership (PPP), contract farming for *M. citrifolia* (Noni) was initiated in 2006 by signing a tripartite agreement between farmers, Health India limited (HIL) and CARI, with an assured market of Rs. 10 per kg of fruits for a period of 10 years. A total of 350 farmers covering 170 acres was covered. Four tonnes of fruits have been sold by the farmer to buyers. In the pockets of South Andaman and Plantation of Andaman Plantation Development Corporation at Mithakhari.
- Under post tsunami scenario, provided alternative livelihood plan through shrimp culture in the permanently inundated agricultural land to A & N Administration.
- On aquaculture front, standardized technology for induced breeding of feral Tiger prawns, developed captive breeding technology for marine ornamental clown anemone fish and standardized the technology for culture of mud crab in tidefed brackish water ponds as livelihood option.
- In addition to popularise and facilitate the technologies developed by CARI to reach the beneficiaries we have entered into MoU with private entrepreneur certified by small scale industry, A&N Administration on a Public Private Partnership (PPP) mode.



## Technology Dissemination

- **Island Kisan Mela** is conducted every year in the month of Jan- Feb for the benefit of the Island farmers during which new technologies are showcased, practices are explained and farmers' doubts are attended. In addition, line departments of A&N Islands are also invited to participate. More than 1500 farmers participate in the Mela. Since last two years CARI has been organizing Farm Innovators Day in which farmers display their innovations and products.
- Four identified technologies namely Broad Bed and Furrow System, Pond based Integrated Farming System, Tank cum Well System and Micro Irrigation System have been demonstrated in 100 farmers' fields through participatory mode.
- Need based integrated land improvement approach comprising of six different methods viz. broad bed and furrow, rice-fish, three tier farming, farm pond, paired bed and furrow and pond-nursery systems were implemented in degraded coastal areas of Andaman Islands covering 200 acres benefiting more than 500 farmers which led to the crop diversification and livelihood security.
- Location specific integrated farming system is adopted in two villages covering 100 tribal farm families in Car Nicobar in on farm research mode.
- Through seed village concept, production of High Yielding Varieties of paddy was conducted in an area of 4.13 ha in farmers participatory mode. Around 10 ton of truthfully labelled rice seed was produced and distributed among the farmers. In addition 250 kg of Breeder seed was also produced to meet the demand of the stakeholders.
- To meet the need of the quality fresh water fish seeds, the community based nurseries rearing system was introduced successfully under satellite system in South and North & Middle Andaman districts in collaboration with Department of Fisheries, A& N Administration.
- Water Users Association (WUA) promoted by CARI for the development and efficient utilization of water was the first of its kind in the Manjeri village of South Andaman. Total memberships has increased from initial sixteen farm families to forty five at present besides the area under the cultivation of the crops also increased from 29% to 71%.
- Weather based Agromet advisories are issued on every week through print and electronic media for better crop planning in the Islands. Also Potential Fishing Zone forecasts are periodically issued for the benefit of fishers of the islands resulting in 34.35% increase in catch per unit effort and reduction in scouting time by 50%.
- Convergence of technologies as micro business modules has been developed in association with NABARD so as to retain farm youth in agriculture and allied fields for providing decent livelihood options to the youths of the island.
- Success stories of five farmers technologically supported by CARI has found place among 101 farmers selected from all over country and published in the book "Harvest of Hope" by Union Ministry of Agriculture.

## Policy documents developed for A & N Administration

Based on the feedback and the need, of the stakeholders CARI has organized a number of brainstorming sessions on different aspects





concerning island agriculture and consequently six following policy documents have been formulated which is presented below with gist.

### Water Policy for Union Territory of Andaman & Nicobar Islands

Although India as a whole has reached to threshold level of stress in terms of per capita water availability, but the eastern and north eastern region are surplus in water. The Andaman and Nicobar (A&N) Islands are even more lucky as they receive an average annual rainfall of about 3000 mm. About 95 percent of annual rainfall is received during May-December of which nearly 75 percent is lost as runoff to the sea due to undulated terrain and steep slopes. The Islands have a width of 15 to 40 km east to west and the slopes are from centre to either towards east or west due to which the length of drainage line to the sea is short. Because of this, there is only one perennial river Kalpong in North Andaman Island.

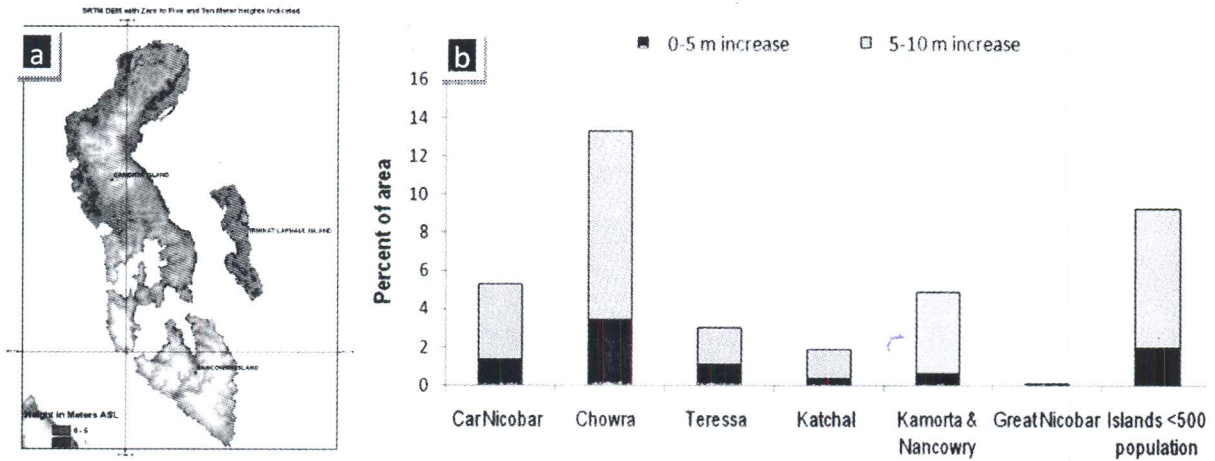
Thus the actual water availability is much less and Islands faces severe problem of water scarcity even for drinking water. The Islands have become a major tourist destination not only for the national but also international tourists. However, the irrigation potential created is just 3% and actual irrigated area is about 1%. Therefore, the need of water development should be irrigation for crops apart from drinking water. As rainwater is the only source of the fresh water availability in these Islands, its harvesting, storage and recycling is the most important strategy for water resource management. Studies at CARI has shown that if only 3% of the water which flows out is stored in surface and underground storage, the requirement of domestic and agriculture can be met.

### Impact on Climate change and Climate proofing Agriculture in Andaman & Nicobar Islands

A study has been conducted in the context of climate change, what would be its impact on agriculture in A&N Islands, especially on yield of crops, pests and disease outbreak and how to adjust the management practices towards achieving better harvest. The Intergovernmental Panel on Climate Change reported that global surface temperature has increased 0.74 °C during the hundred years ending in 2005 (IPCC, 4th assessment report). Global Climate Models project a rise in global temperature by 1.8 to 4°C by the year 2100 due to the increase in greenhouse gases in the atmosphere. This is expected to have significant consequences for suitability and productivity of current agriculture in specific agro-ecological zones, as well as on the incidence and severity of diseases affecting agricultural crops.

Andaman & Nicobar Islands constitutes the most vulnerable regions in our country to climate associated eventualities due to their geographical isolation, topography and limited physical size rendering coastal retreat impossible. These islands lie in the most severe seismic zone (zone V) and hence the adaptation strategies need to be evolved not only for the gradual sea level rise but also for storm surges, tsunamis and flooding due to land subduction. An increase in sea level due to global climate change produces greater waves and flooding leading to higher erosion and amplified impact of storm. The estimation of extent of area likely to be affected with increase in sea level, as estimated using Shuttle Radar Topography Mission (SRTM) digital elevation maps (DEM) shows that the loss of land would be maximum (13.34%) in Chowra where over 13% of island will be inundated with a 0-10m high surge (Velmurugan *et.al.* 2006).

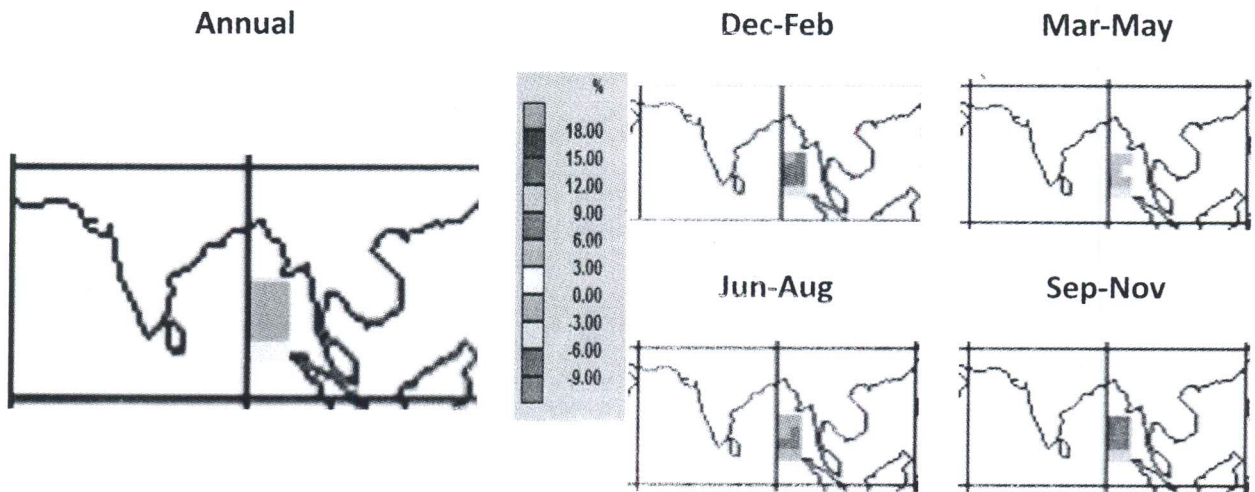




SRTM DEMs showing area affected by sea level rise in Kamorta and Nan Cowry (a) and estimated area affected (%) in Nicobar group of islands (b)

The projected changes in mean temperature and precipitation for Nicobar region assessed based on the recent GCMs using the MAGICC/SCENGEN software indicate that the rainfall pattern is all set to change significantly ( $P < 0.05$ ) during different seasons and the pattern of change in Nicobar would

be different from that in Andaman. However, mean temperature is expected to follow similar pattern in both the group of islands. There is a chance for submergence of more areas close to the seashore due to the high rainfall sea level rise and SST in Nicobar as compared to Andaman Island

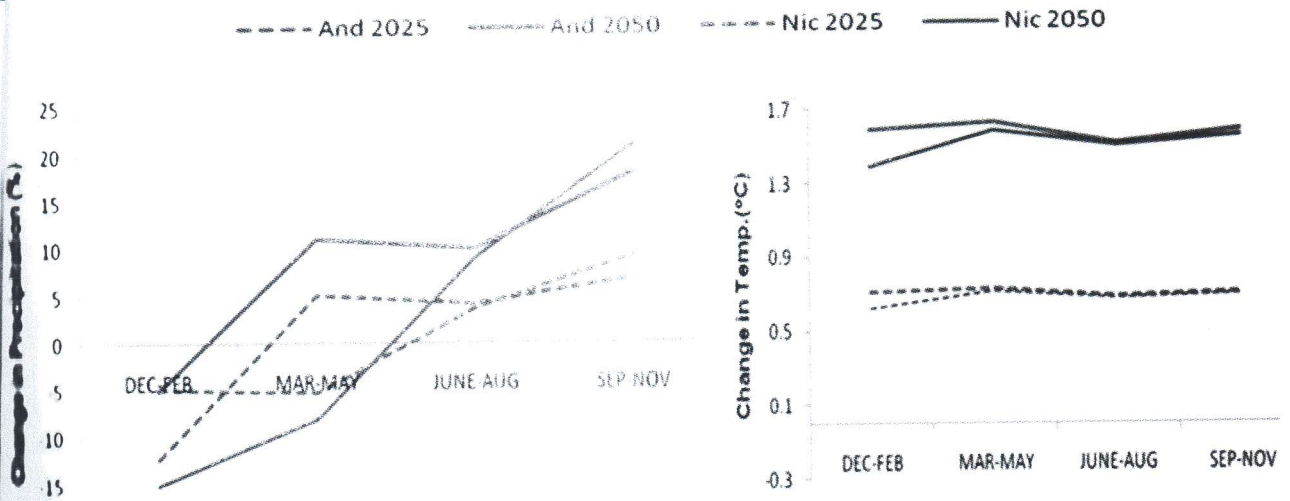
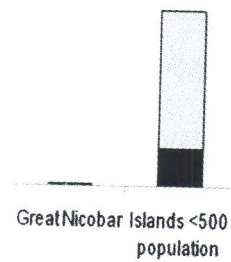


Projected change in rainfall (%) in Andaman and Nicobar under A1BAIM scenario for projected year 2025 by MAGICC/SCENGEN software





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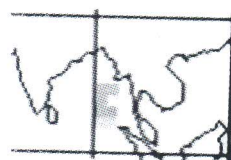
Change in temperature (°C) and precipitation (%) in Andaman and Nicobar districts during 2025 and 2050 as projected by MAGICC/SCENGEN software

ndaman. However, cted to follow sim of islands. There more areas close to nfall sea level rise l to Andaman Islan

The intensity of cyclones in a region has a direct correlation with the sea surface temperature (SST). Using the satellite derived sea surface temperature (SST) data, the SST maps from the NASA JPL-PODAAC site with 4.63 km spatial resolution covering the area surrounding the A&N Islands were accessed and processed using ERDAS-IMAGINE and ARC-GIS software. The increase in SST (0.75-1.25°C) during April to July 2010 resulted in mass bleaching of corals in Nicobar district and its long term impact is yet to be assessed.

maximum brunt of climate associated disasters which calls for an adaptation-centric, development climate policy for the islands against the conventional approach of responding to climate change as an environmental problem. Preparation of detailed island-specific vulnerability maps and adaptation strategies are very much required. With the available climate change prediction models, it is really difficult to predict the pests and diseases which will emerge as a major threat due to climate change (Velmurugan *et.al.* 2014 and Velmurugan *et.al.* 2015).

Mar-May



Sep-Nov



nario for project

Though the contribution of islands to global climate change is insignificant, they bear the

Some of the viable technologies for climate change resilience

| S.No | Name of technology                | Description  | Uses  |
|------|-----------------------------------|--|---|
| 1    | Raised bed technology             | The raised bed of 80 cm width and 15-30 cm height are made. Double rows of tomato, chilli, brinjal, beans, cowpea are sown/planted   | Protect crops from immediate water logging stress and also use irrigate water efficiently |
| 2    | Noni in salinity challenged lands | Developed salinity tolerant variety CARI Rakshak of Noni. The soil mounts of 1 x 1 x 1 m size are made and Noni seedlings are transplanted on 30 x 30 x 30 x cm holes in these soil mounts | Suitable for salinity affected areas  |



|    |   |  |   |
|----|---|--|---|
| 3. | Protected cultivation technology for vegetables | Suitable structure like poly house, shadenet and insect proof nets and rain shelter were designed to vegetables production in stressful climatic situation.<br><br>Suitable vegetables crops and their varieties are identified for poly house cultivation | Off season production of vegetable in the islands |
|----|---|--|---|

Study conducted on the development of climate change resilient varieties which are higher yielding, resistant to biotic/abiotic stresses, unpredictable weather conditions and climate with nutritional value of crops.

**a. Horticultural Crops for climate change resilience**

| S.No | Name of the crops | Varieties   | Description  |
|------|-------------------|---|--|
| 1.   | Poi               | CARI Poi Selection  | Water stress situations  |
| 2.   | Broad Dhaniya     | CARI Broad Dhaniya  | Suitable for shade condition and tolerant to limited of water logging conditions |
| 3.   | Noti              | CARI-Rakshak  | Suitable for salinity affected lands   |
| 4.   | Brinjal           | CARI Brinjal 1  | Bacterial wilt disease and drought tolerant with the yield of 25-35 t/ha.        |
| 5.   | Coconut           | Identified and evaluated the Non viviparous dwarf coconut varieties (CARI-Surya, CARI-Omkar & CARI-Chandan) where as the Andaman dwarfs possess the viviparous trait which is undesirable for the high rainfall areas |  |
| 6.   | Tuber crops       | The tuber crops such as Cassava, Sweet Potato, Colocasia, Elephant foot yam, Swamp taro, Greater Yam and other aroids are considered as climate resilient crops due to their wide adaptability and multiple uses.     |  |

**b. High yielding improved rice varieties developed for climate change resilience**

| S.No                            | Varieties   | Grain type     | Duration                       | Resistant                   | Grain yield (t/ha) |
|---------------------------------|-------------|----------------|--------------------------------|-----------------------------|--------------------|
| <b>Biotic stress resistant</b>  |             |                |                                |                             |                    |
| 1.                              | CARI Dhan 6 | Long slender   | Medium duration (120-125 days) | Bacterial leaf blight (BLB) | 5.0 - 5.5          |
| 2.                              | CARI Dhan 7 | Medium slender | Medium duration (120-130 days) | Bacterial leaf blight (BLB) | 5.0 - 5.5          |
| <b>Abiotic stress resistant</b> |             |                |                                |                             |                    |
| 1.                              | CARI Dhan 5 | Medium bold    | Long duration (140 days)       | Salt tolerant               | 3.0 - 3.5          |
| 2.                              | CSR 36      | Long slender   | Long duration (140 days)       | Salt tolerant               | 3.5 - 4.0          |
| 3.                              | CARI Dhan 4 | Medium bold    | Long duration (140 days)       | Salt tolerant               | 3.1 - 3.3          |





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| 3.0 - 3.5              |
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| 3.1 - 3.3              |

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