



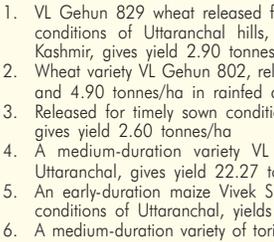
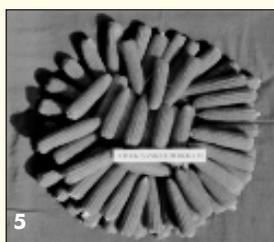
### 3. Research for Tribal and Hill Regions

The Indian Council of Agricultural Research (ICAR) through the Vivekananda Pravatiya Krishi Anusandhan Sansthan (VPKAS), Almora, the ICAR Research Complex for North-Eastern Hills Region, Umiam, Meghalaya, the Central Agricultural Research Institute (CARI), Port Blair, and evolves technologies to meet the needs of tribal farmers in hilly areas.

These technologies are intended to improve the socio-economic status of the target group, and will help them to acquire special skills through vocational training in traditional and non-traditional crops, agroforestry, apiculture, sericulture, horticulture, animal husbandry, poultry and fisheries.

#### New varieties released by VPKAS, Almora

Variety	Yield (tonnes/ha)	Duration	Adaptation region/Agro-ecology
<b>Wheat</b>			
VL Gehun 829	2.90	Long (206-218 days)	Rainfed, low fertility and early sown conditions of Uttaranchal hills, Himachal Pradesh and Jammu and Kashmir
VL Gehun 802	2.20 (rainfed) and 4.90 (irrigated)	Medium (158-170 days)	Timely sown for rainfed and irrigated conditions of Uttaranchal hills
<b>Barley</b>			
VL Barley 56	2.60	Medium (160 days)	Timely sown for rainfed conditions of Uttaranchal hills
<b>Maize</b>			
Vivek Sankul Makka 11	5.70	Early (95-100 days)	Rainfed conditions of Uttaranchal
<b>Pea</b>			
VL Matar 40	1.39	Medium (143 days)	Timely sown conditions of Uttaranchal hills
Vivek Matar 9	9.56	Medium (130-140 days)	Uttaranchal hills
<b>Toria</b>			
VL Toria 2	0.84	Medium (150 days)	Rainfed conditions of Uttaranchal hills
<b>Tomato</b>			
VL Tamatar 1	22.27	Medium (60-65 days)	Uttaranchal
<b>Okra</b>			
VL Bhindi 1	14.46	Early (50-60 days)	Uttaranchal hills



1. VL Gehun 829 wheat released for rainfed, low fertility and early-sown conditions of Uttaranchal hills, Himachal Pradesh and Jammu and Kashmir, gives yield 2.90 tonnes/ha
2. Wheat variety VL Gehun 802, released for Uttaranchal hills, yields 2.20 and 4.90 tonnes/ha in rainfed and irrigated conditions respectively
3. Released for timely sown conditions of Uttaranchal hills, VL Barley 56 gives yield 2.60 tonnes/ha
4. A medium-duration variety VL Tamatar 1 of tomato released for Uttaranchal, gives yield 22.27 tonnes/ha
5. An early-duration maize Vivek Sankul Makka 11, released for rainfed conditions of Uttaranchal, yields 5.70 tonnes/ha
6. A medium-duration variety of toria VL Toria 2 with yield of 0.84 tonne/ha, has been released for rainfed condition of Uttaranchal hills



## VIVEKANANDA PARVATIYA KRISHI ANUSANDHAN SANSTHAN, ALMORA

### Crop Improvement

Nine varieties of different crops were released for North-western hills.

In addition, three varieties, viz. VL Mandua 315 of finger millet, VL Chua 44 of amaranth and VL 832 of wheat, were identified for release in North-western hills.

**Promising disease-resistant rice genotypes:** Of the rice genotypes evaluated at various hot spot locations, eight genotypes of the institute exhibited multiple tolerance and showed low severity index (SI) to one or more diseases and insect pests of rice.

#### Promising rice genotypes with multiple tolerance

Strains	Disease/Insects
VSR 8*, VL 7045	Leaf blast, brown spot, stem-borer and leaf folder
VL 89-1190, VL 3964	Leaf blast and sheath rot
VL 4040	Leaf blast, sheath rot, stem-borer and leaf folder
VL 95-6389	Leaf blast and sheath blight
VL 90-1692	Brown spot and bacterial leaf blight
VL 3611	Brown spot, sheath blight and stem-borer

\*VSR 8 possesses good quality characters and can be a potential source of multiple tolerance in the medium aromatic background.

**Marker-aided breeding for quality protein maize (QPM):** Three BC-MAS and one generation of selfing have been successfully completed with respect to six non-QPM × QPM crosses. The converted BC<sub>3</sub>S<sub>2</sub> inbreds could be used to develop QPM hybrid combinations.

**Rapid DNA isolation protocol for marker-aided breeding in maize:** A rapid DNA isolation protocol suitable for PCR-MAS analysis was developed. The protocol can be worked with or without liquid nitrogen and needs only small amount of plant tissue from any of the developmental stages of the plant (young seedling to maturity). The DNA quality obtained from this protocol was satisfactory for PCR analysis. The results are reproducible and the protocol can be routinely used for PCR-based marker-assisted selection experiments in maize.

### Seed Production

About 12.4 tonnes breeder seed of 37 released varieties/inbred lines (15 varieties/5 inbreds of cereals, 2 of finger millet, 5 of pulses, 3 of oilseeds and 7 of vegetables) was produced. Breeder seed (11.5 tonnes) was supplied to different seed-producing agencies for further production. About 0.85 tonne nucleus seed of 30 released varieties was also produced. Besides, around 9.1 tonnes truthfully

- Released nine varieties (wheat 2, barley 1, maize 1, pea 2, toria 1, tomato 1 and okra 1) for North-western hills. One variety, each of wheat, finger millet and amaranth identified for release in North-western/Uttaranchal hills
- Eight rice genotypes identified for multiple disease tolerance
- A new strain of bacterium (*Yersinia* sp.) isolated from the infected white grub larvae
- Developed Vivek 1 Thresher-cum-Pearler for *mandua* and *madira*

labeled seed of 17 cereals, 8 of millets, 3 of pulses, 4 of oilseeds and 8 of vegetables was also produced.

### Crop Protection

**Isolation of a bacterium from diseased white grub:** In order to develop suitable biological control measure for white grub, a new strain of bacterium (*Yersinia* sp.) was isolated from the infected white grub larvae and was sent for identification and preservation.

**Fuscos blight in French bean:** The organism *Xanthomonas campestris* pv. *phaseoli* var. *fuscans* was the causal organism for fuscos blight in beans.

### Frontline Demonstration

A number of frontline demonstrations conducted involving 913 small and marginal farmers of this hilly regions have shown 24, 52, 34, 26 and 15% yield advantage with improved varieties of finger millet, amaranth, horsegram, buckwheat and barnyard millet, respectively, over their local varieties.

### SUCCESS STORY

#### Development of Vivek 1 Thresher-cum-Pearler for *Mandua* and *Madira*

*Mandua* and *madira* are the important traditional crops of Uttaranchal Hills. Traditional processes of de-husking and pearling of these require pre-treatment like moistening and drying to loose the glumes of grain. Threshing of these crops is difficult, as the grains are held firmly in the glumes and require considerable pressure coupled with repetitive impact and shears, which causes drudgery to the women folk. To reduce this drudgery of hill farmers, a prototype electro mechanical thresher (Vivek Thresher) having low capacity (10 kg/hr) and light weight was designed and developed at this institute. The same was demonstrated to the hill farmers and State Department officials. Based on the feedback received from the farmers, the institute finally designed the refined version of the thresher and got it fabricated with the help of private workshop. In the first phase, of the 25 units of the thresher fabricated, 20 were sold to Uttaranchal government for large-scale demonstrations and 5 were sold to different NGOs and private farmers @ Rs 7,000/machine. The machine has been appreciated by the farmers as well as State officials of Uttaranchal government. This thresher will not only add strength to post-harvest processing of the crops but will also help in reducing drudgery of the hill farmers.

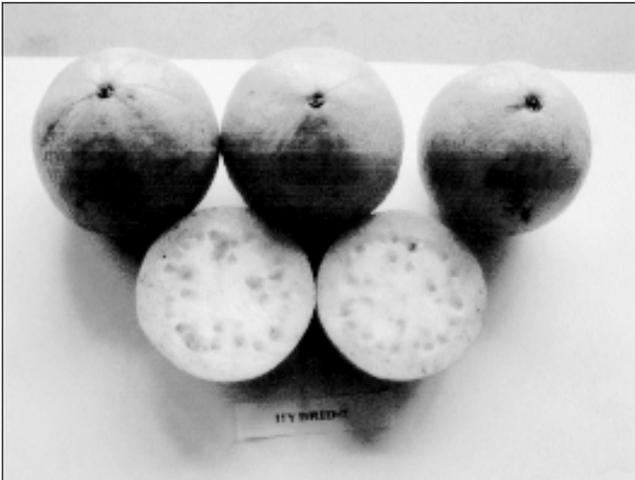


Vivek thresher 1

## ICAR RESEARCH COMPLEX FOR NEH REGION, UMIAM

### Horticulture

The institute has developed 10 guava hybrids. The performance of two hybrids in terms of yield and quality was better than that of the other hybrids. Hybrid 7 showed yield, total soluble solids, total sugar and ascorbic acid 28.17 kg/tree, 10.03%, 7.39% and 215.10 mg/100 g, respectively, compared with Hybrid 1 (30.93 kg/tree, 10.90%, 6.72% and 299.63 mg/100 g).



Guava hybrids developed for cultivation in mid-hills of North-Eastern Hills region. Hybrid 7 possesses white and soft flesh with greenish-yellow skin and smooth surface

### SUCCESS STORY

#### Vegetable Production

In order to increase the cropping intensity, the institute encouraged the farmers in the adopted villages to cultivate winter vegetables, viz. tomato and capsicum. Intervention was made on an average of one ha area each under tomato and capsicum. A farmer Ms Klansis Manthoh of Mawlasni village could get a net profit of Rs 40,000/ha from tomato and Rs 35,000/ha from capsicum. This profit was an additional income during the *rabi* season. Such practices were not followed earlier. Seeing the economic benefit from this system, other farmers have now adopted similar approaches.

### Preservation of Boar Semen at Ambient Temperature

To popularize artificial insemination (A.I.) in pig, a methodology for preservation of boar semen was standardized. Out of 8 semen diluents tested, BTS was found to be the best in preserving semen up to 96 hr at 18-24°C. The institute is supplying the preserved semen to pig farmers and also carrying out A.I. in pigs.



Preservation of boar semen

### Pig and Rabbit Feed

Supplementation of maize-rice polish-based feeding practices by the farmer with soybean @ 25-30% could increase growth rate from 80-90 g/day to 180 g/day in pigs. Substitution of rabbit feed with soybean/rice bean fodder (60%) could maintain a growth rate of 17 g/day.

### Agricultural Mechanization and Training Programmes

The institute is constantly developing efficient and easy to operate farm tools and machineries to remove drudgery. The institute took up an extensive programme to train artisans and village youths in manufacturing such tools and machineries in their specified locations, to help mass production of these tools supported by prototype-manufacturing manuals. Besides these activities, the institute developed dies and fixtures for the fabrication of wheel hand hoe, octagonal maize sheller and other improved tools.



Development of fixtures for manufacture of wheel hoe handle and wheel (top); batch production of wheel hoe seed drill (middle), demonstration of improved implement at farmer's field (bottom)



## SUCCESS STORY

### Watershed Management

In order to check huge soil erosion and water loss from shifting cultivation (bun system) areas, watershed-management approach for Shipra Watershed was undertaken, comprising 925.64 ha area under Umsning Development block in Ri-Bhoi district of Meghalaya. Data on watershed were collected through remote sensing and imagery of the watershed was made. Ground truthing or verification was done on different aspects. Based on the information so collected, six sub-watersheds were identified. A sub-watershed of 57 ha was selected in Mawpon village for integrated development as a model project. Interventions in the form of slow conversion of hill slope into terraces, cultivation of ricebean to control sun grass, congo grass on terrace riser, replacement of local cultivars with high-yielding varieties of raddish, French bean, maize, tomato, brinjal etc. were made. In the steep slope areas, horticultural crops like Khasi mandarin, Assam lemon, guava, plum etc. were planted. In the valley areas, cultivation of rice and conversion of waterlogged areas into fish ponds were adopted, where fishes like catla, rohu, mrigal, silver carp and common carp were grown @ 8,000 fingerlings/ha. The system was also integrated with pig, duck and poultry. High-yielding varieties of rice developed at the institute were grown by replacing the local ones. Gadging stations were put to monitor water flow and soil loss. The system was also supplemented by mushroom production unit.



Dugout ponds for fisheries-cum-ducks, fisheries-cum-pigs and fisheries-cum-poultry

Training programmes were organized on processing of soybean for food uses (70), preservation and processing of fruits and vegetables (20), scientific storage of foodgrains (3), manufacturing of foodgrains storage bins (2), household production and processing of honey (3), and household production of mushroom (4). Total 2,634 persons were trained under the NATP project on Household Food and Nutritional Security for Tribal, Backward and Hilly Areas.

### Bamboo Shoots for Consumption

Out of 25 edible species of bamboo, 16 were found to be of commercial importance in this region. Of the 16 species, *Dandrocalamus hamiltonii* recorded the maximum productivity, contributing up to 32.70% of total consumption followed by *D. giganteus* and *D. sikkimensis*. Consumption of fermented bamboo shoots was the highest in Manipur (41.63%), followed by Nagaland (21.72%), Arunachal Pradesh (17.34%) and Meghalaya (14.74%). Young bamboo shoots showed rich content of vitamins and minerals.



Young bamboo shoots are rich source of vitamins and mineral. Edible bamboo shoots in market (left) and pickle for sale in market made from bamboo shoots (right)

### Integrated Agro-aquaculture Model

The region has substantial area under marshy land which by and large is left unattended. The institute has developed Integrated Agro-aquaculture (IAA) model in

such to lands utilize the same. After converting the marshy land into fish ponds for composite fish culture, the same has been integrated with pig, poultry including duck and goat besides high-value horticultural crops.

## CENTRAL AGRICULTURAL RESEARCH INSTITUTE, PORT BLAIR

### Field Crops

In rice, Quing Livan No.1, Nanjing 57161, Taichung Sen Yu, MTL 113 and Milyang 55 varieties were found promising (5 tonnes yield/ha) for large-scale cultivation under the humid tropics of Bay Islands. A new plant type rice IR 67964-46-1-3-2 showed the largest panicle and highest yield in *kharif*. Pokkali somaclones BTS 24, BTS 18, BTS 14-2-1 and BTS 10-5 were found promising, with yield potential of 3 tonnes/ha under saline soil.

Basmati 370 and Pusa Basmati were found to be efficient recipient varieties displaying optimum transgene expression. The protocol developed across varieties deems compatible for other *indica* varieties in developing transgenic plants with economically important genes.

- Ten guava hybrids developed for cultivation in mid-hills of NEH
- A methodology developed for preservation of boar semen
- Supplementation of pig feed with soybean increased the growth of pig and substitution of rabbit feed with soybean or rice bean fodder maintained growth of rabbit
- Dies and fixtures developed for fabrication of wheel hand hoe, octagonal maize sheller and other tools
- Young shoots of edible bamboo showed rich contents of vitamins and minerals
- Integrated Agro-Aquaculture model developed for utilizing marshy lands
- Interventions in the sub-watershed of Shipra watershed of Ri-Bhoi district of Meghalaya, proved beneficial in checking soil erosion and water loss from shifting cultivation



## SUCCESS STORY

### Integrated Management of Paddy Yellow Stem-borer

In Andaman and Nicobar Islands, paddy is cultivated over an area of 12,000 ha. The paddy production is constrained by yellow stem-borer, *Scirpophaga incertulas*. The pest has been found to be severe in the second season crop, causing damage 5.44 – 20.25 %. The use of pesticides is not viable, as the sprayed pesticide gets washed away due to sudden rainfall leading to water bodies.

In this context, an integrated pest management module was developed which comprises application of carbofuran 3G @ 15 kg/ha at the time of transplanting followed by six releases of *Trichogramma japonicum* (Local) @ 50,000/ha at fortnightly intervals from 45 days after transplanting. The local strain has been found to be more efficient in parasitization than mainland strain. Adoption of this technology led to 75 % and 59 % reduction in white ear heads compared to the control and conventional pesticide application respectively. This resulted in higher benefit:cost ratio of 2.17 compared to 1.83 in conventional pesticide application.

This technology has been transferred to State Bio-control Laboratory, which is multiplying and supplying to farmers during cropping season.

### Fruits

Custard apple, Sel. 1 gave the highest yield (6.175 kg/tree). Kaveri passion fruit produced maximum height (3.10 m), followed by Andaman local (2.88 m). Dwarf Cavendish banana gave the highest yield followed by Red banana. Neelam and Arka Puneet mango showed the maximum canopy spread, height and girth.

### Vegetables

Maximum yield was recorded in Pusa Nasdar ridge gourd, Laffa cowpea and CO 2 amaranth. Cultivation of high-value capsicum, beans, tomato was feasible and economically viable under protected cultivation. Nutritional requirement was standardized for okra and amaranth, suitable dose being 75:120 kg N:P/ha.

KS 118 tomato gave higher yield with Kinetin. However, with increasing salinity, better yield was obtained with GA<sub>3</sub> treatment in PP II.

Bacterial wilt-resistant lines were found in tomato [BT 1, BT 105, BT 116-8-1 and BT 118-4-1-1 (CHDT 1)], brinjal (BB 93C, BB 64 and BB 40) and chilli (LCA 334, Pant C 3 BC 14-2, Surakta and AC 92-4). Crop rotation of *palak-okra-poi* gave maximum yield (78.2 tonnes/ha).

### Floriculture

Red Gold gerbera gave the maximum flowers/plant/year (155) and Nilima had the maximum flower diameter (12.5 cm).

Native orchid *Eulophia andamanensis* had the maximum vase-life (49.5 days). Among the shade-loving plants, *Euphorbia epiphylloids* was the best indoor plant.

Among germplasm collection of coconut, indigenous Rangath Sweet gave the highest yield (125 nuts/palm/year) and exotic Niulekha, a dwarf cultivar, the highest copra content (245 g/nut). Elite palm arecanut G 215 was the highest yielder (1,468 nuts/palm/year).

*Gliricidia* was found suitable standard for black pepper cultivation in the island, as 4 years old pepper vines produced 2 kg berries on a *Gliricidia* shrub.

### Natural Resource Management

The beds of 4.5 m and furrows of 6-7 m width were found suitable for BBF system. Amaranth-okra-ratoon okra was found most profitable cropping sequence for beds with higher net returns and benefit : cost ratio. Chilli-cauliflower-brinjal and chilli-cowpea-raddish sequences were also recommended for beds. In furrow, Quing Livan No.1 – ratoon was most promising cropping sequence.

Of the 11 rice varieties tested for anaerobic water seeding, 6 responded positively to water seeding at a depth of 5 cm.

### Fisheries

The clown fish, *Amphiprion percula* was successfully bred in captivity. The larvae could be raised to juveniles with 90% survival. For the first time, *Amphiprion sandarocinos* could be successfully bred by giving formulated feed. Walne's medium resulted in the highest population growth of cultured microalgae in 6-9 days. Edible oysters (*Crassostrea rivularis* and *Saccostrea*

## SUCCESS STORY

### Integrated Management of Coconut Rhinoceros Beetle

Integrated package developed at the CARI, Port Blair, was demonstrated to farmers under IVLP. It could reduce damage by 51 % showing higher benefit : cost ratio of 2.98 compared to 1.97 in conventional plant-protection measures in Andaman and Nicobar Islands. The baculovirus prevalence in local population stabilized at 62 % by 36th month of application of baculovirus. Thus, this technology is long lasting, self-perpetuating and labour-saving. This technology has been transferred to state agricultural department, which is multiplying virus for supply to farmers.

- Protocol developed in rice varieties compatible for other *indica* varieties in developing transgenic plants with economically important genes
- Promising 5 rice varieties identified for large-scale cultivation under humid tropics of Bay Islands
- Cultivation of capsicum, beans and tomato proved economically viable under protected conditions
- In tomato (4), brinjal (3) and chilli (5) lines were found resistant to bacterial wilt
- *Euphorbia epiphylloids* proved a best indoor plant
- Amaranth-okra-ratoon proved most profitable cropping sequence on beds



- Clown fish (*Amphiprion percula*) successfully bred in captivity
- For the first time, *A. sandarocinos* bred successfully on giving formulated feed
- Mastitis, enteritis and hump sore controlled successfully in cattle
- Management of dairy calves standardized for hot and humid climate
- Synthetic layer developed, suitable for backyard farming in Bay Islands
- Vaccine prepared for IBD
- Japanese quail reared successfully in deep litter with optimum fertility with 1:1 or 1:2 male and female in islands

## SUCCESS STORY

### Freshwater Fish Culture

Freshwater fish culture in the islands was challenging for the farmers during eighties, as the seed required for stocking in the ponds was to be procured from Kolkata by air. The farmers had limited knowledge in management of ponds for getting a tangible fish production. Mostly rohu (*Labeo rohita*) was cultured in the ponds and sparsely catla (*Catla catla*) for indefinite period, yielding few kilograms of fishes for occasional domestic consumption.

The first landmark achievement of the CARI was to make the islands self-sufficient in fish seed of carp (catla, rohu and mrigal) and proper demonstration of the techniques for its percolation to user level, followed by its adoption by the farmers of remote villages of South, Middle, North and Little Andamans. The technology of induced breeding of carps and seed production standardized by the CARI for Andaman environment could create an impact on the farmers for additional income generation and to meet the fish seed requirement of the locality as well as of the Andaman Islands. The availability of fish seed of the three species of carps opened the scope for freshwater aquaculture in the islands and the pond fishes which were treated as pets of farmers earlier started making their appearance in the fish market of Andamans as priced commodity.

The most important aspects of the work has been in terms of its wide acceptance not only by the farmers but also by the local development departments and defence personnel, and provided scope for self-employment.

In a nutshell, the technology of carp induced breeding and seed production has improved the freshwater fish cultures activity of the islands. Now the island environment could be kept free from the threat of introduction of fish pathogens from mainland through fish seed transport. And it also saves the cost incurred every year by the Fisheries Department for procurement of fish seed for distribution to the farmers.

*cucullata*) were found dominant and have culture potential in Andaman waters. Grouper catches indicated the dominance of *Plectropomus pesuliferus* and *Veriola louti*, as these were targeted owing to export value. The culture of tilapia, *Oriochromis urolepis* in brackishwater gave a production of 1 tonne/ha in six months.

Giant freshwater prawn, *Macrobrachium rosenbergii*, along with Indian major carps with a stocking density of 8,000 prawn seeds/ha gave a production of 500 kg prawn/ha in seven months. Mullet, *Liza tade* from South and Middle Andamans, showed consistent polymorphism.

## Animal Science

In genetic upgradation and evaluation of indigenous cattle of Andaman, F<sub>2</sub> generation with 50% exotic inheritance of Holstein-Friesian and 62.5% exotic inheritance of Jersey (with local cattle) was produced after selection and culling in F<sub>1</sub> generation on the basis of their phenotypic performance, disease tolerance and adaptation in this climate. Mastitis, enteritis and hump sore were successfully controlled. Calf mortality was nil. Management of dairy calves was standardized under hot and humid climate.

## SUCCESS STORY

### Infertility Control in Bovines

Infertility, a major factor limiting the production, was as high as 70% of population at a given time mainly due to inadequate feeding in Andaman and Nicobar Islands. Mineral (mainly P) supplementation resulted in a success rate up to 85%. One village with no dairy activity earlier was converted into a dairy village with per day average supply, promoted milk co-operative to the tune of more than 300 litres.

Synthetic layer was developed, suitable for backyard farming in Bay islands. Progenies of White Nicobari × ILI 80, Black Nicobari × ILI 80 and Brown Nicobari × ILI 80 were produced. The body weight of the progeny of Black Nicobari crosses was more in the young ones than of other crosses. The feed-conversion efficiency of ILI 80 × White Nicobari was better than that of ILI 80 × Black Nicobari at young age under intensive management. The egg production was better in White Nicobari than Black Nicobari crosses.

Sera samples screened for *Salmonella pullorum*, *Mycoplasma gallisepticum*, Chicken Anemia virus, Reo virus and avian encephalomyelitis showed varied positive

## SUCCESS STORY

### Rural Poultry Production

The poultry production in the Andaman and Nicobar Islands was unsystematic and prices varied from Rs 90 to 130/kg and there was routine import from mainland. A technology was developed based on dual-purpose breed, broilers and Nicobari fowl and got implemented in a systematic way. Since late 1998 not a single kg meat has been imported and market prices stabilized between Rs 60 and 70/kg (retail), with variation between Rs 55 and 70/kg. This technology is very popular as self-employment venture owing to non-dependence on balance feed.



cases. Among the caprine species, 13.3% of cases were positive for *Brucella melitensis*. Out of 32 sera samples of swine, 43.75% cases were seropositive for swine fever, the maximum number of cases in the Car Nicobar Islands. ELISA and SAT screened cattle samples indicated 20.47% positive cases for *Brucella* by ELISA and 20.79% by SAT. Similarly, 23.56% cases were positive for IBR using ELISA.

Bovines (26) were found positive for TB (42.3%) and JD (46.15%). Mastitis due to streptococcal group of organisms was the main causative agent.

Vaccine against IBD was prepared. The vaccinated birds did not show any clinical symptoms during the subsequent outbreaks.

Mycotoxin in feed or food when ingested by the livestock and human being leads to reduced production, growth and immunity and also may cause mutagenic and carcinogenic effects. Chick embryos were the most susceptible followed by rabbits and ducklings, and guinea-pigs were the least susceptible. Sources rich in protein had a higher incidence of fungi infestation and thus recorded higher level of aflatoxin in the feed ingredients.

Cage and deep litter system revealed that cage-reared Japanese quail (*Coturnix coturnix japonica*) excelled deep litter-reared birds for earlier laying of eggs, early reaching the age at 50% egg production, higher egg production and significantly higher hatchability.

Blue and green lights were found better for overall production performance in Japanese quails. Garlic powder or extract @ 1% along with the diet in the bird significantly reduced plasma cholesterol.

Japanese quail could be reared successfully with optimum fertility with the male and female ratio of 1:1 or 1:2 in the hot and humid climate of the islands in deep litter. Birds with higher body weight showed decreased humoral immunity than those with lower body weight.

### **Social Science**

Sixteen technologies in agriculture and allied fields were intervened in more than 330 farmers' fields in 8 villages in South and Middle Andaman Islands. Some of the achievements were the successful rice cultivation in saline sulphate soils, important participatory water stress management in vegetables through construction of check dam on the *nallah*, commercial cultivation of cut-flowers by the farmers and backward farming of improved Nicobari birds for higher income.

