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# Research for Tribal and Hill Regions

The ICAR research institutes such as Vivekananda Parvatiya Krishi Anusandhan Sansthan (VPKAS), Almora, the ICAR Research Complex for North-Eastern Hills Region, Umiam, Meghalaya and the Central Agricultural Research Institute, Port Blair, located in the North-west Himalayas, North-east Himalayas and Andaman and Nicobar Islands have evolved technologies to meet the need of the tribal and hill farmers. The technologies developed are intended to improve the socio-economic status of the target groups. Capacity building programmes to improve the skills of local farmers on traditional and non-traditional crops, agroforestry, water conservation and harvesting, apiculture, horticulture, animal husbandry, poultry and fisheries are being implemented.

### NORTH WEST HIMALAYAS

#### Vivekananda Parvatiya Krishi Anusandhan Sansthan

The VPKAS, Almora, caters to the agricultural research needs of the north-western Himalayan states of Uttarakhand, Himachal Pradesh and Jammu and Kashmir. Maize Hybrid 45, was notified for Uttarakhand, Himachal Pradesh and Jammu and Kashmir, while Vivek QPM 21 was released for Uttarakhand.



Maize Hybrid 45

Barley VLB 118, a high-yielding disease resistant barley strain was identified. With an average yield potential of 3,084 kg/ha, it is a 6-rowed hulled barley and has shown an overall significant yield superiority of 8.2 % over the latest 6-rowed hulled control UPB 1008 under rainfed timely sown conditions. This is also significantly superior by 33.2 % over 6-rowed hull-less control BHS 352 and 10.7 % over 2-rowed hulled control HBL 113. It has high degree of resistance



VLB 118 is a high-yieldig barley strain

against yellow rust under natural as well as artificial epiphytotic conditions.

VRB 3, a ricebean genotype, was identified for release. This is a medium-maturing (130-135 days) and high-yielding (17 q/ha) variety. With indeterminate growth habit and moderately resistance to seed shattering, it possesses field resistance to all major diseases. The seed colour is light greenish and 100-seed weight is 7.56 g. The protein content is 20.4 % compared to 19.7 % in the control. It is moderately tolerant to water stress conditions.

**VW 0826 - A genetic stock of wheat for high tillers/m:** A genetic stock VW 0826 (Raj 3777/ MV-EMESE) was identified for higher number of tillers/m. Three years of testing of VW 0826 showed that it possessed 84 tillers/m as compared to 81.7 in HD 200, the best check.

**Multiple disease resistant sources:** Maize cultivation in the North-Western Himalayan region is affected by Turcicum leaf blight (TLB), banded leaf and sheath blight (BLSB), Maydis leaf blight (MLB) and Curvularia leaf spot and brown leaf spot. VPKAS Experimental Farm, Hawalbagh (Almora) is a hot spot for TLB. About 35 promising inbred lines developed from VPKAS were screened for disease by artificial inoculation in *kharif* 2011. The same set of inbreds was also screened for TLB by artificial inoculation and MLB under natural condition. Five lines, V 334, V 336, V 400, V410 and V 414, exhibited moderate resistance to BLSB. The first four lines were also found resistant to TLB and MLB. In order to validate the results, these five promising inbreds along with susceptible control (CM 145 and CM 212) were again screened during *kharif* 2012 under artificial epiphytotic condition for BLSB. They were also evaluated for TLB under artificial condition and MLB under natural condition. The lines identified as resistant/tolerant to multiple diseases can directly be used as parental lines



for hybrid development and as donors in maize breeding programme.

**Gardenpea-french bean cropping system:** The application of organic manure influences sustainability by improving physical, chemical and biological properties of soils. An experiment was conducted for six years in view to find out the application rate of locally available organic manure (FYM) as a substitute to chemical fertilizer and Integrated Nutrient Management (INM), and to optimize the application rate of FYM in garden pea-French bean cropping system. The estimation with the help of quadratic response curve showed that the application of 20.0 tonnes FYM/ha provided the economic optimum garden pea equivalent pod yield (31.2 tonnes /ha) of garden pea-French bean cropping system and was 54 and 29% higher than the pod yield of recommended NPK and INM (50% recommended NPK+FYM @ 5 tonnes/ha), respectively. Application of 5.87 and 8.87 tonnes FYM/ha could substitute recommended NPK through chemical fertilizer and INM, respectively. The pod yield was more sustainable than application of recommended NPK.

**Plant growth-promoting bacteria:** The quantitative estimation of Zn solubilization revealed that isolate Z1 (NVMRs-1) solubilized all the insoluble zinc sources ZnO, ZnCO<sub>3</sub> and ZnPO<sub>4</sub> up to 280.5, 272.64 and 266.22 µg/ml, respectively, followed by Z10 (NSarEn-3). Amongst the potential zinc-solubilizing isolates tested for plant growth promotion, Z4 (NVMEn-1) produced highest amount of IAA (19.23µg/ml). The isolates Z2 (CbNRp-5) and Z8 (NVMRs-3) showed strong HCN production and Z10 was strongly positive for siderophore production.

## NORTH EAST HIMALAYAS

**Characterization of colocasia germplasm in Nagaland:** A total of 126 indigenous germplasm were evaluated, of which, 110 were characterized using IPGRI morphological descriptors. Among these, 9 lines were dwarf (< 50 cm height), 68 medium (50 - 100 cm) and 33 tall (>100 cm). Ten lines recorded no suckers, 99 lines had 1-5 suckers, while one showed more than six suckers. Twenty-six lines flowered, while the remaining ones were non-flowering types. Significant variations were observed for yield/plant



Indigenous colocasia germplasm

## Seed production

About 236.55 q breeder seed of 67 released varieties/genotypes and 53.82 q truthfully labeled (TL) seed was produced. Under farmers' participatory seed production programme, 109.26 q seed of various crops was produced at farmers' fields at different places. Vivek QPM 9 developed through MAS was licensed to a commercial firm for commercial production and marketing. They are producing more than 1,000 q of hybrid seed in West Bengal.

(51- 1318 g) (line 60). Starch content was 10.9 - 45 g /100 g fresh weight and total sugar content 1.6 g - 8.6 g /100 g fresh weight. Most varieties evaluated against *Phytophthora* were susceptible while a few lines showed tolerance to this disease.

**Zero till furrow opener:** A manual zero-till furrow opener was designed which opens furrows of 2-3 cm width and 3-4 cm depth on untilled soil. A long pulling handle and a guiding handle have been provided for ease of operation. Two labourers can operate this implement and it is suitable for making furrows for paddy, mustard, pea and lentil for sowing under zero till conditions. Its capacity is 0.06 - 0.2 ha/hour depending on the row width.

**Genome characterization of banana bunchy top virus (BBTV):** Preliminary characterization of Banana Bunchy Top Virus (BBTV) from Meghalaya (Umsning and Umiam isolates) on the basis of DNA R segment showed similarity to "Pacific-Indian Oceans" group. The six genomic DNA components of Meghalaya (Umiam) isolate of BBTV were amplified by polymerase chain reaction (PCR) with specific primers using total DNA extracted from infected banana leaves. The resulting ~1.0 Kb amplicons were cloned and sequenced. Analysis of sequence data revealed the presence of six full-length components of BBTV: DNA-R (NCBI Acc. No. KC119098), DNA-U3 (KC466373), DNA-S (KC466374), DNA-M (KC466375), DNA-C (KC466376), and DNA-N (KC466377).

**Disease management of King chilli:** A survey was carried out in the localities around Imphal to assess the incidence of different fungal and viral diseases on King chilli. The fungi isolated and identified were *Cercospora capsici*, *Colletotrichum capsici*, *Glomerella cingulata*, *Corynespora cassicola* and *Phoma destructiva*.

There was sporadic occurrence of virus diseases in the field. The symptoms consisted of inward rolling of leaves, shoestring, yellow mosaic and necrotic rings on leaves. The King chilli samples in wells B3-B10, C3-C10, D3-D10 had pepper veinal mottle virus (PVMoV) infection. The crude virus extract of PVMoV infected samples subjected to Transmission Electron Microscopy revealed the presence of flexuous virus particles, implying that the virus belonged to genus Potyvirus of family Potyviridae.

Bayleton was most effective in reducing *Colletotrichum* fruit rot and increasing crop yield by





167% and 54% decrease in disease incidence, followed by Derosal with 22.22% increase in yield and 44.79% decrease in disease incidence over the control.

The sawfly, *Arge xanthogaster*, has recently emerged as a major pest of roses in Meghalaya, causing around 80% damage to wild and cultivated roses. This appears to be the first report of *A. xanthogaster* as a pest of roses. Crucially, *A. xanthogaster* in Meghalaya is somewhat morphologically different from that of the previously reported specimens of Manipur and Sikkim, indicating that *A. xanthogaster* in Meghalaya could be a new subspecies or race. The species-specific DNA barcode based on standard barcoding cytochrome oxidase I (COI) gene of mitochondrial DNA was developed.

**Low-cost pigpen:** A low-cost improved pigpen with locally available materials was designed for high rainfall in mid and high altitude temperate regions. The saw dust-floor of the new pen provided warm and comfortable environment to pigs, while low temperatures in the conventional concrete pens caused stress and energy loss to animals during winter. Further, during the rainy and summer season, floor of conventional pens remained wet and it recorded significantly higher humidity and temperature-humidity index (THI), compared to the improved pens. Similarly, the stress hormone, cortisol level was within the normal range in the improved pigpen, as against significantly higher levels in the conventional pigpen. Daily body weight gain and feed conservation efficiency of pigs reared in the improved pen were also significantly higher compared to the conventional pens. The crossbred pigs reared in the new pens attained 148-157 kg body weight within one year. In conventional pens, leg lesion, incidence of diarrhoea and respiratory diseases were common problems. Since there was no washing of the newly developed pens, water requirement dropped substantially.

**Screening for porcine viruses:** For the first time, ICAR Research Complex for NEH Region, Barapani, identified the presence of PRRS (porcine respiratory and reproductive syndrome) virus in India. The virus was detected in September 2011 from Meghalaya as confirmed by the High Security Animal Diseases Laboratory (HSADL), Bhopal. A total of 3,590 serum samples were screened for the disease. Of 3,590 serum samples, 569 samples tested positive. Apart from this, 154 serum samples were also screened for porcine parvo virus and porcine circo viruses. Full length genome cloning of PCV-2 (12 isolates) and CSFV (4 isolates) were completed.

**Phylogenetic relations of *Babesia* spp.:** Cloning and sequencing of PCR product generated from *Babesia bigemina* was done. The BLAST analysis showed that sequence of PCR product generated with *B. bigemina* primers had 99% nucleotide identity with many sequences of 18 S ribosomal gene of *B. bigemina* (EF458191, EF458200, and DQ785311). The Indian isolate (Umiam) of *B. bigemina* showed close relation with Argentinian isolate and distinctly placed away

#### Improving living standards of tribal farmers through technological intervention

Tribal Sub Plan programme was implemented in Bali, a small Island within Sundarban inhabited by tribal and SC populations which was ravaged by the strong cyclonic storm "Aila" in 2009, causing heavy damage to the livestock and biodiversity, resulting in severe food crisis. In this area, carp breeding in FRP hatchery and subsequent rearing of Indian major carps by polycultural technique was successfully demonstrated and established in Adivasipara in 22 ponds, covering the water area of about 3.0 ha. A growth of fish from fingerling size to about 300-400 g within just 3-4 months was achieved. The local inhabitants are encouraged to adopt fish culture as means of livelihood.



from the isolates of the neighbouring country, China.

**Endocrine markers:** Identifying prolificacy potential and determination of foetal number during pregnancy are essential for ensuring proper care and management of pregnant goats bearing multiple foetuses and achieving the benefits of multiple births. Multivariate step-wise discriminant analysis recognized that one blood sampling at 220 min after GnRH administration can be used to distinguish prolificacy potential in goats. Plasma progesterone levels were significantly higher in goats bearing triplet vs. twin vs. single foetus between day 84 and 21 prior to parturition.

#### Islands and coastal region

##### Management of degraded coastal land and water:

A systematic, need based integrated approach was followed in which land improvement activities comprising six different methods, viz. broad bed and furrow, rice-fish, three-tier farming, farm pond, paired bed and furrow, and pond-nursery systems were made as a means of reclamation of these areas and bring them under cultivation. Nearly 200 acres of degraded land spread over several villages were brought under intensive cultivation of rice, vegetables, plantation crops and fish culture.

**Farmers' participatory rice seed production at North Andaman:** Every year about 40 quintal seed of high-yielding rice varieties like CARI Dhan 3, 4, 5, CSR36 and Ranjeet is being produced through farmers' participation in association with Out Reach Centre of CARI and distributed to stakeholders and farmers in the islands.



### Bypass fat for dairy animals

A simple technology was developed at ICAR Research Complex for Goa for the preparation of bypass fat which is best choice 'energy rich feed supplement' for sustainable milk production. The technology is simple, cost-effective, user-friendly, and does not need sophisticated equipments; and hence is suitable for small and marginal farmers. The product remains in solid form, can be easily mixed with other feed ingredients, easily transportable and can be kept in airtight containers in cool places. Supplementation of indigenously prepared bypass fat to dairy animals @ 15 - 20 g/kg increases milk yield by 7 - 20%, giving additional profit of Rs 12 - 40/ cow/ day and improving the reproductive capacity and health of animals.

**Boosting fruits and vegetables availability in Minicoy Island, Lakshadweep:** As a result of concerted effort by Regional Research Station of CPCRI, approximately 4,536 kg vegetables and 602 kg fruits were produced and distributed among the islanders. The successive production in the demonstration area resulted in revenue generation of over ₹ 130,000 over a period of 12 months in natural resource deficient and fragile ecosystems of Minicoy islands, which ensured sustainable livelihood and nutritional security to the island dwellers.

**Impact assessment of technological intervention in Andaman:** Economic feasibility analysis of five technological interventions at South, Middle and North Andaman indicated that adoption of composite fish culture with CRM in the ratio of 4:3:3 could give a net return of ₹ 22,950 against farmers' practices of stocking multiple species of fish (₹ 3,500) which fetched an additional return of ₹ 19,450/0.08 ha of pond.

**Marine faunal diversity of Nicobar Group of Islands:** A total of 200 marine specimens were collected, of which molluscs accounted for majority (84%). The other phyla were *Porifera*, *Polycladia*, *Cnidaria*, *Annelida*, *Crustacea*, *Mollusca*, *Echinodermata*, *Chordata*, *Vertebrata* and others. Fifty-six molluscan species were identified and catalogued. Assessment of benthic cover revealed 72% live coral cover at Nancowry Islands. Of which, *Acropora* spp. accounted for 66%, followed by *Porites solida* (3.7%) and *Favidae* (2.6%).

**Cataloguing and conservation of marine sponges:** Sponge species diversity and distribution at 43 new locations in Andaman was catalogued of which 25 records are new to India. Barcodes of 14 marine sponges were generated using cytochrome oxidase subunit 1 (COI 1) and ribosomal ITS region. Seven marine sponges were submitted to the Global Sponge Barcoding project database under reference category with full taxonomic description. A digital database of marine sponge diversity and a GIS-based resource map of the marine sponges diversity of Andaman was developed.

### Sustainable Management of Degraded Coastal Land and Water

Land improvement activities comprising broad bed and furrow, rice-fish, three-tier farming, farm pond, paired bed and furrow and pond-nursery systems were made as a means of reclamation and nearly 200 acres of degraded land spread over several villages was brought under intensive cultivation of rice, vegetables, plantation crops or fish culture.

### TRIBAL SUB PLAN

Under the Tribal Sub Plan (TSP), ICAR has been closely working with tribal farmers with main focus on enhancing livelihood security of the tribal farmers in different parts of the country. Emphasis is being laid on imparting the technical know-how to the tribal farming community by providing farm inputs, machineries, field demonstrations, quality planting material, seeds, and producing planting material and seed of their own. These activities mainly envisage the overall improvement in farm income and nutritional security and living standards of the tribal farmers.

#### Crop Sciences

All India Coordinated Research Project on Soil Test Crop Response (AICRP on STCR) is implementing TSP across the country in various tribal belts from 2012-13. Trials were conducted on tribal farmers' fields to demonstrate the value of soil test based nutrient recommendations.

Under tribal sub project, two districts of Jabalpur division, viz. Dindori and Mandla were selected which are dominated by the tribals. Under TSP, four varieties of gram (JG-11, JG-315, JG-16 and JG-130) were taken, seed treatment with rhizobium, and *Trichoderma* was applied as soil treatment of three villages Palhera, Chaugan and Jhina. Some of the farmers have also used NPV treatment. The result was very much enthusiastic as the yield increased up to 54.5%, ranging from 8.69 to 54.5 %. This indicated that there is a great venue of using biofertilizers for bagging higher yields under low input. STCR technology was tested on tribal farmers' fields successfully with wheat, mustard, maize and chickpea crops. Hundred field demonstrations (one acre each) for tribal farmers in five tribal districts (Kanker, Jagdalpur, Dantewada, Korba and Ambikapur) of Chhattisgarh were selected for four major crops. The tribal beneficiaries were given seed, fertilizers, plant-protection measures and benefited with increased yields over their traditional practices. Training programmes on soil testing and balanced fertilizer application were also organized at each district level.

Under TSP programme, 564 field demonstrations on sorghum were organized during *kharif* 2012-13 at farmers' fields for socio-economic upliftment of tribals in 18 districts of Madhya Pradesh, Rajasthan, Andhra Pradesh, Gujarat and Maharashtra. The seeds





of high-yielding cultivars, fertilizers, agro-chemicals and small implements were supplied along with technical information through literature and demonstrations.

**Jute:** Frontline demonstrations on soil test and targeted yield based fertilizer application in mustard in jute-rice-mustard cropping sequence were conducted at farmers' fields in Bankura, Purulia and Nadia districts of West Bengal. Jute seed (6.83 q) of improved varieties (JRO 8432, JRO 524 and JRO 128) was provided to 96 tribal farmers in Purulia and Bankura districts for seed production of jute, rice and mustard. Modern tools (96 knapsack sprayers and 26 CRIJAF, Nail weeders) were also distributed to farmers.

**Ramie:** Planting material of ramie was supplied to Assam Ramie Fibre Cultivation Cooperative Ltd, for plantating in 26.0 ha area of farmers' fields in Lakhimpur, Dhemaji and Sonitpur districts of Asom and West Siang district of Arunachal Pradesh. Use of alternate planting material (plantlets and stem cuttings) was encouraged. Use of ridge and furrow system protected the emerging small plants from rotting in high rainfall periods. These technologies have been well accepted by the tribal farmers.

### Horticulture

**Himachal Pradesh:** Frontline Demonstrations (20) were conducted at farmers' fields at Udaipur in tribal district of Lahaul Spiti (Himachal Pradesh); 10 quintal of breeder seed of new potato variety, Kufri Himalini, was supplied. A training programme was organized at Udaipur and Lahaul Spiti on modern techniques of seed potato cultivation in which about 127 tribal farmers participated.

**Jammu and Kashmir:** The tribal families from Leh, Kargil, Bandipora, Ganderbal, Ramban, Anantnag, Rajouri and Poonch were selected under phase-I of this scheme. Keeping in view the climatic conditions, technologies like high-value fruit crops like apple, walnut, apricot, almond, cherry and strawberry, and nutritionally rich vegetables were included in the programme.

**Odisha:** Eight villages of Kashipur block of Rayagada were selected for mango plantation on 443 ha sloppy land with 1.77 lakh plants involving 550

households. The farmers were given training in soil and *in-situ* moisture conservation in sloppy lands, and demonstrations on fertilizer application technique were also organized. Fertilizers (1,053 bags of urea + DAP + MOP) were distributed among farmers.

Improved tuber crop production and processing technologies were demonstrated to 360 tribal farmers from Chhattisgarh (Narayanpur district), Jharkhand (Ranchi) and Odisha (Kandhamal and Koraput districts). Planting material of improved varieties of elephant-foot yam (Gajendra), colocasia (Muktakeshi), yam (Orissa Elite), cassava stems (Sree Vijaya, Sree Jaya and Vellayani Hruswa), yam bean seeds (RM-1) and sweet potato (Kishan and ST14) were supplied to farmers to cover 15 ha area, and 665 demonstrations on technologies of tuber crops were laid out.

**Goa:** Establishment of frontline demonstration on cashew and mango production technology and intercropping of turmeric were taken up involving members of 'Taleshir Group' (39 Tribal farmers) of Cancona Taluka. Cashew grafts of improved varieties (Goa-1, Tiswadi-3, Ganje-2 and KN 2/98), mango grafts (Mankurad, Amrapali and Kesar), and rhizomes of turmeric (Pratibha) were provided along with training in integrated nutrient management and productivity maximization practices. Quality planting material of acid lime (Sahi Sharabati, 750 nos) and Guava (Lalit and Shweta, 650 grafts) was provided to farmers from Gaondongruim village (Goa) for planting in homestead gardens.

### Animal Science

**North-east region:** The NRC on Yak organised training programme on Integrated Farming System; 65 tribal farmers from 13 villages of Namsai district of Arunachal Pradesh participated in the training programme. Scientists and technical officers of NRC on Yak interacted with yak farmers (*Brokpa*) of Arunachal Pradesh in remote areas (*Nagaggi*). Farmers were informed of management and disease control of yak. Subsequently, five yak farmers were provided with micronutrient to enhance productivity of yaks under transhumance pastoralist system of yak rearing.

The NRC on Mithun took up activities under TSP in Nagaland, Arunachal Pradesh, Manipur and Mizoram. These included Technology Injection Programme in remote villages of Manipur for Marh tribes; in the Ezengo village of Idu Mishmi tribe of Arunachal Pradesh showcasing various technologies followed by health camps for mithuns and other livestock in Nagaland throughout the year. Apart from these, a mithun conservation and ONBS programme was started in Khonoma and Thevopisu villages of Nagaland for genetic improvement of mithuns.

**Minicoy island:** A poultry unit having 'White Leghorn' and 'Gramalakshmi' was established at the island for demonstration. Eggs and layers were distributed to Minicoy islanders.



*In-situ* soil management





## National Resource Management

**AICRP on Agroforestry:** The TSP scheme under AICRP on Agroforestry was carried out at 13 coordinating centres of the project. The agroforestry interventions promoted for tribal farmers included plantation of MPTS; distribution of planting material and other inputs; nursery development and capacity building of tribal farmers. Under the TSP, tribal farmers were provided nursery material (polybags, irrigation pipe, storage tank, seeds) and small agricultural tools, sprinkler sets for enhancing the productivity and small polyhouses. Tribal farmers were provided trainings in agroforestry and trained to designed eco-friendly bamboo tree guards and other valuable items. The farmers appreciated the efforts and found new avenues for livelihood support.



**Odisha:** Tribal sisal planters in Sambalpur and Jharsuguda districts were provided with 81,272 healthy suckers of sisal. Thirty-one tribal farmers planted the material in 20.36 ha area using double-row planting geometry, accommodating 4,300 ( $\pm 200$ ) suckers/ha.

**CARI, Port Blair:** To maximize the benefit to tribal farmers through technological interventions and knowledge support, some of the livelihood options were identified.

Training programmes (28) in the field of fisheries, horticulture, field crops, animal husbandry, post-harvest, crop protection and value-addition technologies were conducted in Nicobar District and Little Andaman. About 1,515 tribal farmers attended the trainings.

Seeds and planting material of improved varieties, livestock and farm tools were provided, besides, support to properly utilize soil and water resources to improve the farm productivity. Tribal Captains from Nicobar also visited CPCRI, Kasargod and CTCRI, Thiruvananthapuram, to have a glimpse of technologies for improved coconut-based farming system, intercropping with spices, pineapple and tuber crops along with value-addition.

## Fish

**Pen culture in wetlands:** A pen culture demonstration carried out in Takmu *pat* of Bishnupur district, Manipur indicated suitability of culturing *Osteobrama belangeri*, a high-demand indigenous minor carp, in pen enclosure in the *pats* of Manipur. Grass

## High density planting system for cotton in Vidarbha

The plant population with hybrid cotton in India ranges from 6,000 to 15,000/ha. The HDPS system requires dwarf varieties with compact stature bearing 6-8 bolls per plant.

Early-maturing compact plant types with short sympodia were identified for high density planting system during 2009-2011. Non-Bt varieties-AKH 081, NH 615 and Suraj, though not for high density planting, were found amenable to planting at 150,000–200,000 plants/ha at a spacing of 60cm  $\times$  10 cm or 45cm  $\times$  10 cm. By increasing plant population, yields of 1.8-2.0 tonnes/ha were achieved with these varieties on the marginal soils. Production costs were lowered and crop matured a fortnight earlier than the crop sown at normal density. The yields could further be improved by dry sowing (just after the onset of first monsoon rains), using 25% higher rate of fertilizers over the recommended rate and also by using established moisture conservation agro-techniques.

Encouraged with the three-year experimental farm results, CICR initiated a farmer participatory trial of HDPS in marginal soils in rainfed conditions of one-acre (0.4 ha) fields of 155 farmers in eight cotton-growing districts of Vidarbha during the *kharif* 2012. Suraj, NH 615 and AKH 081 were planted at 45cm  $\times$  10 cm or 60 cm  $\times$  10 cm spacing with the early onset of the monsoon. The seed rate used was 12 kg/ha. Despite delayed onset and erratic monsoon during 2012, high yields of 2.5–3.0 tonnes of seed-cotton /ha were obtained by several farmers. Across the trial, yields averaged at 1.5–1.8 tonnes, which was double the average of Vidarbha. Highest yields were obtained in Chandrapur, Amaravati, Nagpur, Yavatmal and Akola districts. Severe drought in Buldhana, Washim and some parts of Wardha resulted in yields of 0.8–1.0 tonne/ha. The increase in yields was estimated at least 35-40% above the yields normally obtained by the farmers. The cost of cultivation was ₹ 20,000–25,000/ha. Net profit ranged from ₹ 12,000–90,000 / ha. A few farmers tested HDPS under organic conditions and obtained yields in the range of 2.5 to 2.8 tonnes/ha

carp and catla were also found suitable for culturing in pen enclosures in Manipur.

A pen of approximately 0.1 ha was constructed using nylon net supported with bamboo poles and stocked with stunted yearlings of Indian major carps, a minor carp pengba (*O. belangeri*) and exotic carps @ 5 fingerlings/ m<sup>2</sup>. After 180 days of rearing using commercially available feed, the highest average weight gain and highest specific growth rate were recorded for pengba, followed by grass carp and Indian major carps. The benefit:cost ratio obtained in the demonstration was 1.29. The demonstration showed that net pen enclosures can be used for culturing different fish species having local demand.

## Knowledge Sharing Meet (KSM) at ICAR Complex NEH, Barapani

Knowledge Sharing Meet was held at ICAR NEH, Barapani. The scientists were urged to make use of the portal “KIRAN” for sharing the technologies



available so that the information is disseminated to a larger audience. The diversity of North-Eastern States both in terms of agro and cultural biodiversity is enormous, perhaps the largest congregation of tribal India, hence, this meet was an opportunity to intervene through capacity building.

### Publications

*Shaya utpadant dastar bhumika* (Assamese), *Shasya utpadanat boronar proyujaniyata aru iyar proyug* (Assamese); and *A Guide for Identification and Management of Nutrient Disorder in Crops*, were published for the benefit of local farmers.

