



21.

## National Agricultural Innovation Project

The National Agricultural Innovation Project (NAIP), effective since September 2006, is the initiative of the Indian Council of Agricultural Research (ICAR), funded jointly by the Government of India and the World Bank to broadly identify and promote technology-led innovations in agriculture sector. The project continues to enhance multi-dimensional competence of the National Agricultural Research System (NARS) for steering-up agriculture R&D. The 13<sup>th</sup> Institutional Support Mission of the World Bank (ISM 13; 12-20 August 2013) has re-confirmed that the competitive consortia based funding through the NAIP has introduced a pragmatic pluralism in the NARS. A total of 91 public-private partnerships have been established in 203 sub-projects, approved with the NAIP financing, including 3 sub-projects with the additional financing from the Global Environment Facility (GEF).

Promising results emerging from the NAIP research and development activities as determined by select key performance indicators include, 72 patent/intellectual property protection applications filed; 319 research papers published in the high impact peer reviewed journals; 82 technologies/products commercialized based on the NAIP research; 51 new rural industries piloted, and over 3,800 hectares of farmers' agricultural land brought under sustainable land-management practices.

The first Agri Tech Investors meet (18-19 July 2013) conducted by the NAIP on the recommendations of

the ISM 12 came out successfully in catalyzing and managing change in the Indian NARS with a formal transfer of 58 technologies, including 30 technologies developed under the NAIP, to private entrepreneurs generating licence fees of ` 3.2 crore, besides deals worth another ` 1.50 crore in the pipeline.

The other components of the NAIP have focused on the three high-priority research themes— market-oriented collaborative research alliances; rural livelihood research alliances; and basic and strategic research alliances.

### ICAR as a catalyzing agent

In terms of harnessing the knowledge flow through information, communication and dissemination system, potential of information and communication technology (ICT) for enhancing quality of education has been augmented by developing e-courses for 7 bachelor degree-level programmes in agriculture, horticulture, veterinary science, home science, fishery science, dairy technology and agricultural engineering; deploying them on-line, and also making them available as off-line copies. Further, operation of an online e-publishing system for the ICAR research journals has increased their readership by 4-5 folds, and reduced article processing time from 2 years with conventional publishing to 2-4 months. And the Consortium for e-Resources in Agriculture (CeRA) has provided an on-line access of around 3,000 journals to 142 CeRA member-NARS institutions throughout India. The sustainability of such an access is being secured by the concerned institutes through XII-plan funding.

A knowledge management platform – Agropedia – for aggregation and dissemination of information; a rice knowledge management portal – RKMP – for a complete information package on rice; a group catalog “AgriCat” (<http://www.agricat.worldcat.org>) of 12 major libraries for online access by researchers and students; a new platform vKVK (<http://www.vkvk.in>) as a knowledge network for the Krishi Vigyan Kendras (Farm Science Centres); and a strengthened statistical computing platform in the NARS (<http://www.iasri.res.in/sscnars>) are some other achievements, which have been strengthened during the period. And e-Granth provides digital access to library resources of 39 partner institutes; 27 new partners have been included.

Over 85 lakh pages have been scanned and are being uploaded to the repository, Krishikosh, at four digitization centres. Over 4,900 post-graduate theses from 36 agricultural universities have been processed and uploaded. Improved library services have been provided in 12 KOHA-LMS partner institutions. A

### Success story

#### Management of change

The Agri-Tech Investors Meet organized in July 2013 in New Delhi was the first of its kind that brought inventors into direct contact with industry and investors. The investors meet was able to successfully commercialize 58 technologies, generate a license fee of ` 3.2 crore ( ` 2.28 crore from NAIP technologies and ` 0.9 crore from non-NAIP (ICAR technologies). The ten Business Planning and Development (BPD) units established under the project have generated total revenue of ` 14.6 crore through license fees from technology commercialization, training, consultancy assignments, membership fees, etc. Apart from technology commercialization, these units have played vital role in identifying and mobilizing agro-entrepreneurs and facilitating investments in agribusiness sector. Encouraged by the success, 12 more Business Planning and Development (BPD) units in different ICAR institutions have been established which will continue to be funded by the ICAR from Plan funds/other resources after the closure of NAIP.







### Sustainable-use-based revival of endangered *Kadaknath* poultry

A notable achievement is the restoration/revival of endangered *Kadaknath* poultry. The poultry birds are now commercially viable in Dhar and Jhabua districts of Madhya Pradesh.

Initiating with just 10 *Kadaknath* poultry sheds under the project, a total of 133 poultry sheds are at present functioning in the area. *Kadaknath* growers are getting a profit of Rs 0.95 to 1.00 lakh/year/shed. Thus, an annual income of around Rs 107.10 lakh is being generated by *Kadaknath* farming in Jhabua. The additional income generated is promoting tribal-farmers for better education of children, renovation of old houses, creation of transportation facilities, and for better management of their social functions.



road shows in Hyderabad. Over 12,000 farmers, rural-women, entrepreneurs, and self-help groups were made aware of sorghum value-added foods and nutrition by aggressive campaigning through *choupal haats*.

A novel fruit-grader for grading cylindrical fruits like *ber*, and a custard-apple extraction machine have been designed and developed. The latter was commercially manufactured in Pune, and is presently commercially used by two more industries in Udaipur and Bengaluru.

For production of barley-milk based probiotic drink containing indigenously isolated and characterized probiotic strain *Lactobacillus plantarum* NCDC-344, technological process has been optimized. The beverage possesses anti-microbial activity, excellent anti-oxidative activity, and is a good source of dietary fibres. An entrepreneurship development programme with women self-help group resulted in the establishment of two processing units in Karnal (Haryana).

### Research on sustainable rural livelihood security

About 143,000 farming families have been covered in poorer villages of 91 backward districts, sharpening poverty focus in the demonstrations. Adoption of a few high pay-off interventions is continuing in 28 on-going sub-projects.

Based on the adaptive on-farm technology assessment and refinement research carried out, 78 production models for crop, horticulture and livestock have been recommended for mainstreaming through

state-extension system. All the consortia have set up sustainability funds, and a corpus of ₹ 6.2 crore has been collected; guidelines for operation and maintenance of sustainability fund have also been issued.

Promotion of high-value watermelon and crop diversification from paddy to turmeric and ginger in Kalahandi and Kandhamal districts has been successful. River-bank watermelon cultivation, an intervention with high impact, is covered on 28.8 hectares by 100% of 72 households contacted. Subsequently, impressed by the economic benefits, 78 households not related to the project have also adopted this technology.

Ten technical support centres have been created in



Dungarpur district, Rajasthan, to provide advisory services to farmers. The consortium demonstrated potential of hybrid maize in 6,187.4 hectares, covering 21,006 beneficiaries. Average yield obtained showed 97.6% increase in hybrids (3.42 tonnes/ha) as against an average yield of 1.73 tonnes/ha from traditional varieties; there was an additional economic benefit of ₹ 8.8 crore. Observing the success of the hybrid maize demonstration in Udaipur, Banswara, Dungarpur and Sirohi districts, the Rajasthan Government has launched a Golden Rays Programme, and provided hybrid-maize seeds to 8 lakh farmers.

Creation of agribusiness producer companies in Rajasthan, West Bengal and Madhya Pradesh has been encouraging; more such initiatives on market linkages were reported, which altogether benefitted over 8,100 farmers.

Significant adoption and diffusion has been reported of interventions involving low-cost bio-enhancer for higher productivity; innovative drip irrigation technique for vegetable cultivation; modified system of trench farming in cucurbits; maize variety "Pragati" - a boon to farmers in Sonbhadra; mustard horizontal spread in Sahibganj and Pakur; ornamental fish farming in Keonjhar; and organic farming in Waynad.

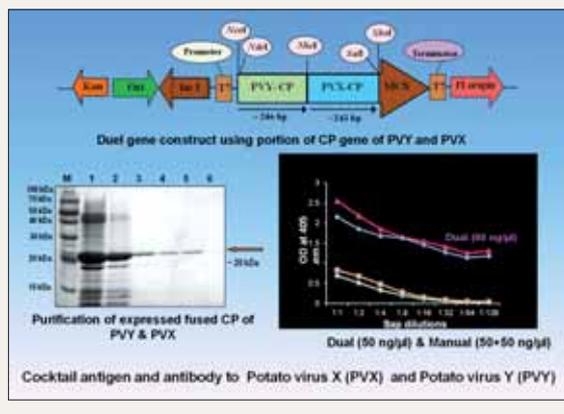
### Sustainable land and environment management (SLEM)

The GEF-financed SLEM project is another component of PIU-NAIP, consisting of three sub-projects. It was scheduled to close on 31 August 2013 but has been extended up to 30 June 2014 making it *co-terminus* with the NAIP. Among the successful practices supported, three activities are making visible impacts in their respective areas/states— (i) Land

### Cocktail polyclonal antibodies against Potato virus Y and Potato virus X

Cocktail polyclonal antibodies (PAb) against two most important potato viruses - Potato virus Y and Potato virus X - have been generated, which were found to efficiently detect mixed infection of PVY and PVX in infected potato samples.

The Cocktail PAb showed better reaction compared to manual-mix of individual PVY and PVX PABs when validated on potato plant samples.



shaping activities in West Bengal coastal zone, which reclaims land parcels in saline-affected areas, (ii) Activities in the livestock sector, including characterization of local breeds of goat, sheep, and their genetic upgradation, nutrition and control of common diseases in Adilabad and Udaipur districts, and (iii) Activities undertaken on Potential Fishing Zone (PFZ) forecasting and promoting M-Krishi® through mobile network in Maharashtra and Odisha. Successful restoration of red rice landraces from the long term ( $-20^{\circ}\text{C}$ ) storage vaults of the National Gene Bank to farmers' fields in Chamba district of Himachal Pradesh has been another milestone achieved under this component.

### Basic and strategic research in the frontier areas of agricultural science

A total of 52 patent applications have been filed in India, including 15 published applications; also filed an international PCT application, and an Australian short patent has been granted; 246 research papers have been published, 149 in high impact journals with a NAAS rating of  $>6/10$ . More than 5.5 lakh molecular resources have been reported and documented at the GenBanks.

Twenty-four bench-scale technologies developed by the researchers have been commercialized in the recent Agri Tech Investors' Meet 2013. Scientific outputs and important developments include the following.

Conspicuous discoveries in molecular domain for abiotic stress tolerance in maize involve 'binding' and 'oxidation-reduction' related linkage (mapping) of genes induced under stress conditions in a waterlogging-tolerant genotype, and 'chloroplast', 'plastid' and 'transferase' gene-sets in a susceptible genotype. In

rice, stunted expression in homozygous transgenic lines expressing abiotic stress responsive *OsFBK1* gene was reported to be tagged with *myc* gene; this expression could be reversed by silencing *OsFBK1* gene using RNAi approach. Ten differentially expressed proteins that may impart tolerance to salinity stress have been identified from *Bacillus pumilus* SB49 cultured on 20% saline medium. Inheritance factor for Endosulfan tolerance in *Trichogramma chilonis* strains was reported to be 'recessive' to 'semi-dominant' whereas tolerance for  $\lambda$ -cyhalothrin was found 'dominant' one.

Allelic variants of dominant blast resistance rice gene *Pi54* have been searched from 92 Indian landraces and cultivars using diagnostic blast fungal isolate Mo-nwi-37'1. Allele-specific markers have been developed for marker-assisted blast resistance breeding Programme; 120 homozygous advanced backcross derived lines carrying genes *Pi54*, *Pi1*, *Pita*, *Pi9*, *Pi5*, *Pib*, *Piz5* and simultaneously having basmati-grain phenotype have been field evaluated in replicated trials.

A controller-based five-row seed-cum-fertilizer drill has been developed. With this, required quantity of seeds and fertilizers can be dropped by matching with the speed of the tractor, which is sensed by a proximity sensor, mounted on the front wheel of the tractor. Field validation of the drill along with software developed has been successfully done on soybean farms.

Micronutrient efficient and inefficient cultivars of rice, wheat, maize, pigeonpea and chickpea have been identified. The efficient cultivars can be grown in deficient soils without affecting yields. Micronutrient localization studies have showed deposition of Fe and Zn in epidermis of chickpea, and apical cortical regions of pigeonpea stems. In wheat, Zn concentration was more in aleurone layer and seed embryo. Mn application influences vessel size of vascular bundle, and thus enhances translocation to grains.

An integrated ICT model, involving toll-free Interactive Voice Response System (IVRS), Smart Phone Application and Web-based agri-advisory system, has been developed to address farmers' information needs on important aspects in a location-specific manner. The model is under field validation in Andhra Pradesh through Krishi Vigyan Kendras ANGRAU.

In-silico modeling of the leucine-rich repeat domain (LRR) of the TLR of farm animals and their docking with different ligands indicate potential of structural variations contributing to differences in the downstream cytokine levels across species and different breeds. A simple PCR-based DNA test has been developed for differentiating cattle and buffalo meat and milk.

Two herbal acaricides products developed for control of tick infestations in animals have been found 50-75% effective against resistant-tick lines; and 60-80% against lice, dog tick (*R. sanguineous*) and *Hyalomma anatolicum*. They were safe with no adverse reaction on animals (OECD guideline-410 followed), and were stable in storage for more than a year at room temperature.

□