Volume 23 No. 4

ISSN 2394-3289
October-December 2017

हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद

Agrisearch with a human touch
ISO 9001:2008 Organization

भाकृअनुप
ICAR

ICAR NEWS

A SCIENCE AND TECHNOLOGY NEWSLETTER

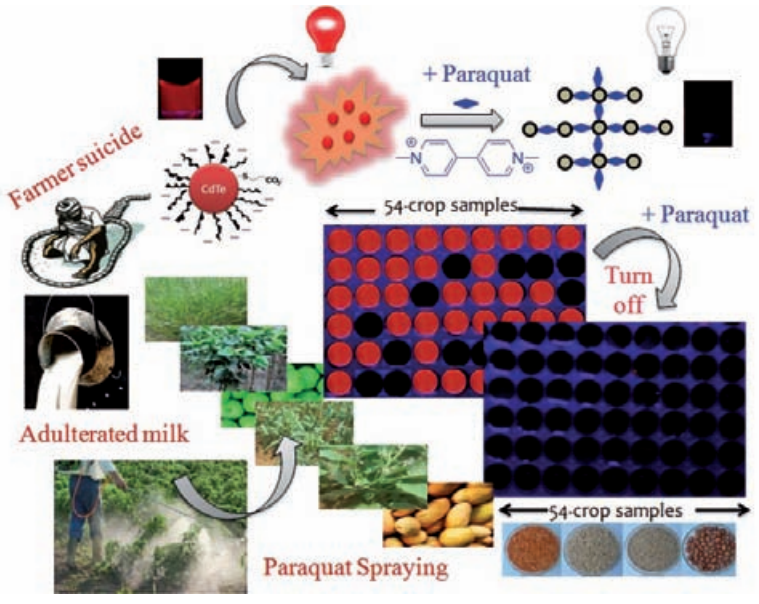
RESEARCH UPDATE

PROMISING TECHNOLOGIES

Detection of Toxic Herbicide in No-Time!!!

A low cost paper-based sensory system has been developed for rapid, onsite detection of paraquat (PQ) in agricultural samples. Paraquat is a quaternary herbicide, commonly used in landscape turf management to improve crop cultivation for selective removal or retardation the growth of weeds. However, presence of this toxic chemical in food items can induce severe health problems including renal disorder, acute respiratory distress, even cancer. In India, more than 70% of rural deaths are owing to the accidental consumption of PQ (gramoxone) and most occur before they receive a preliminary clinical diagnosis. However, the presently known methods for PQ detection mainly involve cumbersome procedures or expensive instruments, which limit their applicability in real-time sample analysis.

Considering this, a team of scientists including Dr Deepa Bhagat, Senior Scientist, ICAR-NBAII, Dr Nilanjan Dey and



Portable paper strips detect toxic chemicals

Indian Council of Agricultural Research
Krishi Bhavan, New Delhi 110 001, India
www.icar.org.in

Dr. D. Cherukaraveedu under the leadership of Professor Santanu Bhattacharya, Organic Chemistry, Indian Institute of Science (IISc), Bangalore have developed low-cost, portable paper strips for the detection of residual paraquat content in agricultural crops. Then the paper strips were used to screen a wide range of crops, including vegetables (18 samples), fruits (9 samples), cereals (16 samples), and fodders (7 samples) in order to determine the residual PQ contents. In most cases (37 out of 50 samples), the extract matrices had no interference on the emission signal of the dye-coated paper strips and quantitative estimation of PQ was possible without any prior treatment. In absence of PQ, the paper strips showed red luminescence under hand-held UV torch. A quenching in red-emission was observed upon addition of PQ contaminated aqueous extract. A concentration variation studies suggested that even the PQ, as low as of concentration 30 nM, can be effectively detected by this method. Soil samples were also collected from different places in Karnataka (India) for analysis. Therefore, as this procedure does not require any cumbersome sample preparation step or sophisticated instruments, people with very little knowledge in science or live in remote locations can also handle it easily. As these paper strips are small in size, the farmers can easily carry them to agriculture fields and use them whenever required. Moreover, these paper strips are highly robust (insensitive to weather change) and can be transported easily to any part of the country.

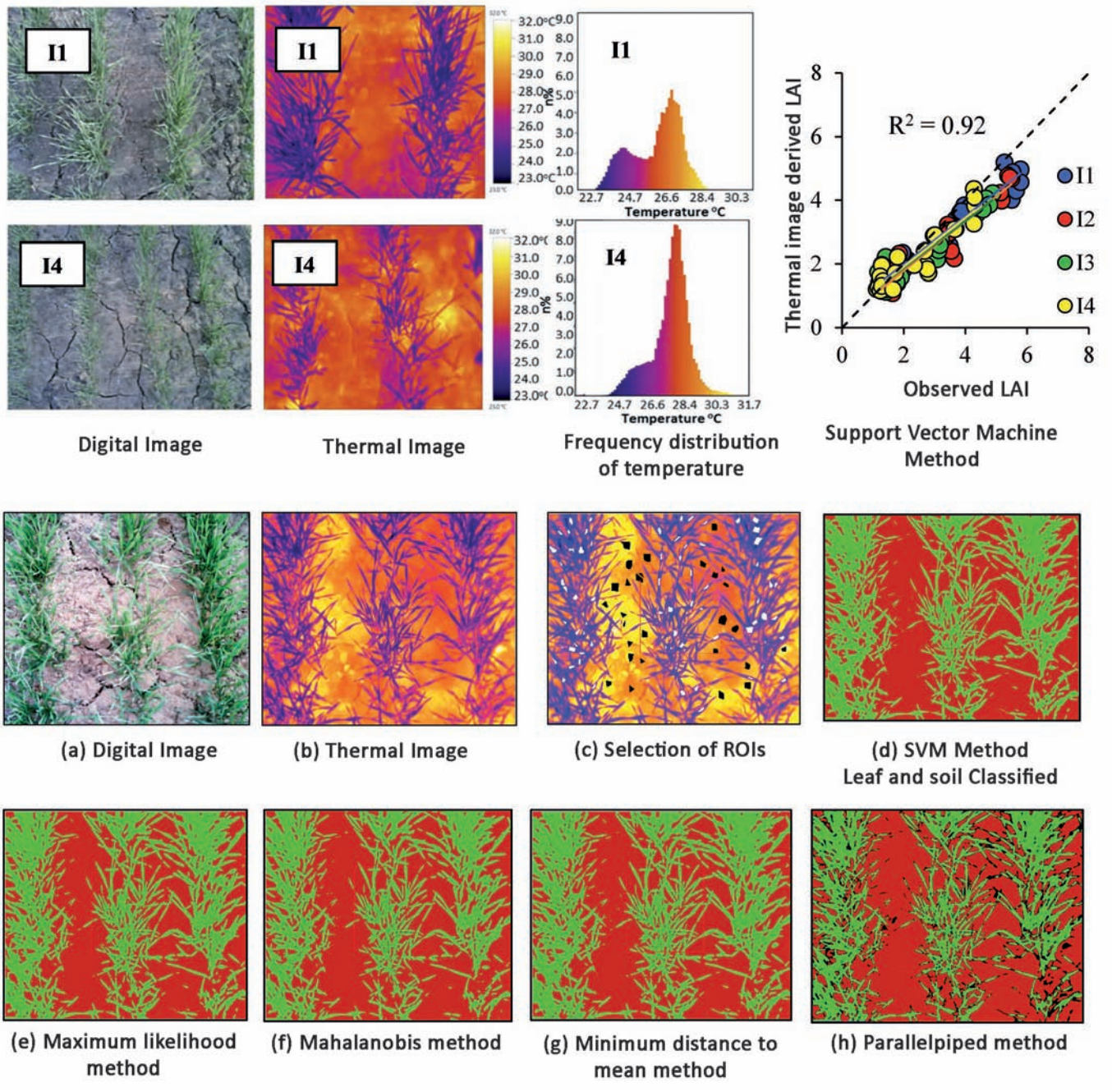
Dr Deepa Bhagat
ICAR-NBAIR, Bengaluru
email: deepabhagatbhagat@gmail.com

Thermal imaging as a tool for estimating LAI of wheat

Thermal imaging is a promising technology for characterizing temperature changes in an object. Two atmospheric windows ranging from 3-5 µm and 8-14 µm, allow the thermal imaging to visualize the differences in the surface in a non-invasive way, by sensing the infrared radiation emitted by it in proportion to its kinetic temperature. Dutorchet in 1840 was the first to measure the temperature of the plant and its organs like leaves. Later, many studies showed that the temperature of the plant canopy is different from its surrounding. Crop canopy temperature is important to characterise the moisture stress in plants because moisture stress results in the stomatal closure which increases leaf temperature. The proximal sensing of plant canopy by the thermal imaging to derive LAI (leaf area index) can be one of the most meaningful applications in the precision agriculture.

This study was conducted at IARI. The four moisture stress treatments (I1, I2, I3 and I4) were employed with different ratios of Irrigation Water/Cumulative Pan Evaporation (IW/ CPE) of 1.0, 0.8, 0.6 and 0.4, respectively continuously for 2 years. The crop grown under the I1 treatment was under the optimum irrigation with irrigation condition at the crown root initiation (CRI), tillering, jointing, boot leaf, and flowering stages, which is recommended for the North-West plain zone of India. The crop grown under the I4 treatment was under the maximum moisture stress as it received only a single irrigation at the CRI stage. Both the thermal and digital images were taken by using hand held thermal camera (Testo 890-1), which supports high-quality wide angle lens of 42° × 32°, and detector of 640 × 480 pixels. Images were taken around mid-day when the plant is supposed to be under high stress condition for the two years of study. Simultaneous measurement of LAI was also taken using the Canopy analyzer (LAI-2200, LICOR Inc., Nebraska) of wheat crop under different stress condition. At first pixel wise temperature distribution pattern of wheat crop was done for different moisture stress treatment. A bimodal peak clearly distinguished the crop and soil temperatures in the thermal image. This showed the ability of the thermal image to distinguish crop and soil pixels. Further estimation of LAI was done using ENVI Supervised image classification method by selecting suitable region of interest. Five different supervised image classification methods namely maximum likelihood method, support vector machine (SVM) method, Mahalanobis method, minimum distance to mean method and parallelepiped method were used in the present study to classify both the thermal and digital images. Classified image gave the area covered by soil and crop separately. Thereafter the LAI was obtained by dividing the leaf area to land area. LAI measured using the plant canopy analyser (measured LAI) and those estimated from the thermal images by all the five image classification methods were then statistically analysed (modelling efficiency, mean biased error, and R^2) for getting best method for estimating LAI.

Result showed that the support vector machine method was performing the best for predicting LAI for thermal image (with Modelling Efficiency 84%, R^2 0.92). Parallelepiped method was found to be worst performer for predicting LAI for both cases. The presence of



unclassified area in the form of black spots may be a reason for its poor prediction efficiency. Thus the support vector machine method, a non-parametric classifier which segments the plant cover on the basis of hyper plane position, was identified as the best method for the thermal image classification. The main advantage of the SVM method for segmenting plant cover is that it separates two distinct classes by locating the best boundary in the features. Image classification accuracy like Producer's Accuracy (%), User's Accuracy (%), Overall Accuracy (%), Kappa, K were also found to be the highest for the SVM method. Thus thermal imaging is an effective method of monitoring the LAI of crop canopy, even under the moisture stress conditions.

ICAR NEWS wishes all readers and contributors

A Very Happy New Year

2018

Koushik Banerjee, P. Krishnan* and **Nilemesh Mridha**
Division of Agricultural Physics,
IARI, New Delhi 110012,
email: prameelakrishnan@yahoo.com

Cowpathy: A new version of ancient science

Cowpathy is just like any other system of medicine such as homeopathy, allopathy or naturopathy. In this, the human or animal ailments are treated with products of cow also known as *Panchgavya* means five things derived from cows i.e. milk, ghee, dahi, urine and dung. In our ancient literature of Ayurveda it is described as *Panchgavya Chikitsa*. In recent years, interest has been generated among scientific community of the world to develop or scientifically validate the Indigenous Technical Knowledge (ITK) as an alternate therapeutic or preventive approach. As is evident from the trends of modern allopathic treatments particularly the development of resistance in microorganisms and side effects, the alternative system of medicine is gaining momentum not only in India but WHO has also established recognition to such systems.

In fact in the western world also, scientists/ clinicians are facing problem in handling the multiple drug resistance in microorganisms, presence of antibiotic residues in food chain and/or associated allergies and autoimmune disorders in man. As per WHO, the twentieth century wonder drugs "antibiotics" will not remain useful and become almost ineffective by the year 2020, then one has to think over the alternative therapeutic approaches to control the infections. In fact most of the antibiotic drugs are bacteriostatic in nature and as such they do not kill the bacteria rather they stop or check their growth and bacteria have to be destroyed by the body's own defence mechanism known as "Phagocytic System" through macrophages (monocytes of the blood).

During the last few years it has been observed that the efficiency of these macrophages reduced drastically as a result of the environmental pollution and presence of pesticides, heavy metals, fungal toxins etc. in the food chain. That is attributed to the heavy use of agrochemicals in agriculture and poor storage conditions of food grains. Any how deficient functioning of macrophages leads to inefficacy of antibiotic drugs, development of resistance in bacteria, recurrent infections, and / or decreased immune status of an individual. Recent researches showed that cow urine enhances the immune status of an individual through activating the macrophages and augmenting their engulfment power as well as bactericidal activity. This research opened a new era in medical science and India has got a patent from US on cow urine for its bio-enhancing properties and its use in tuberculous patients. Along with traditional therapy of tuberculous drugs, if one also consumes cow urine, the anti-tuberculous drugs act faster even in low doses and thereby reducing the cost of treatment and its duration. Very recently, researches have found that use of cow urine along with the antibiotics prevents the development of resistance in microorganisms against the antibiotics. The cow urine blocks the R-factor, a part of plasmid genome of bacteria responsible for the development of anti-bacterial resistance. Several scientists from different laboratories including G.B. Pant University Pantnagar, and IVRI, besides NGOs are working on different medicinal properties of cow urine. In fact there are several medicinal preparations available with NGOs who are also marketing cowpathy drugs under FDA license and some of the NGOs are even not able to cope up with the demand of the public. Several students of M.Sc., M.V.Sc., M.D. and/or Ph.D. are working on the medicinal properties of cow urine and other products of cows. It has been found to enhance the body's immunity and resistance power to fight with infections. Cow urine has antioxidant properties and thus it neutralizes the oxidative stress produced in body through action on free radicals. It has been found to repair the damaged DNA and thus is effective for the cancer therapy. Scientists proved that the pesticides even at very low doses cause apoptosis (cell suicide) in lymphocytes of blood and tissues through fragmentation of DNA and cow urine helps the lymphocytes to survive and not to commit suicide. It also repairs the damaged DNA. Besides, in poultry, cow urine enhances the immuno-competence of birds and provides better protection along with vaccination. It also increases egg production, egg shell quality and egg weight.

Moreover, by using cow urine in poultry ration one can enhance the productivity that too without using antibiotics and the fear of antibiotic residues in poultry products.

There are several NGOs working in Kanpur, Nagpur, Jaipur, Rishikesh, Haridwar and other parts of the country who are in this business. Mostly they prepare Ark of cow urine i.e. 60-70% distillation of cow urine. But, on the basis of chemical fingerprinting through modern equipments like HPLC, it has also been observed during the scientific research that the urine of Indian cows are highly effective and almost nil or few medicinal properties are present in the urine of crossbred, exotic cows, buffaloes, etc. The Indigenous cow urine contains *"Rasayan" tatva*, which is responsible to modulate immune system and acts as bio-enhancer. It is not only the cow urine which is a wonder product by cow but other products like dung, milk, ghee and curd are also equally effective for various ailments and other operations. Cow urine as such and/or after addition of neem leaves is a wonderful bio pest repellent. Such bio pest repellents are safe to use, do not accumulate in the food chain and as such do not have the harmful effects like chemical pesticides. Cow dung is an excellent farm yard manure and if processed and prepared vermi-compost, a very small amount of vermi-compost is sufficient for a large field. Similarly, many medicines are prepared from the cow milk, ghee and curd. However, on scientific validation of these products is required. Frustrated from the heavy medication of allopathy people are using cowpathy drugs. It has been observed that the sick individuals first try allopathic doctors and medicine for cure but when there is no hope in modern medicine then they switch over to either Ayurveda/ homeopathy/ naturopathy or cowpathy. The Ayurvedic Vaidyas practicing cowpathy are getting handsome income now a days as they claim to cure renal failure, leucoderma, arthritis, skin disorders, early stage cancer and several other ailments which are not so curable by use of allopathic medicines.

In the time to come, the field of cowpathy will come up with strong scientific facts and hopefully dominate or other systems of medicine. Hence, this old system of *Panchgavya* medicine at present known as cowpathy may get popularity and provide relief to the ailing people and give them life without pain.

Professor R S Chauhan
Department of Pathology
College of Veterinary and Animal Sciences
G B Pant University of Agri. & Tech.
Pantnagar 263 145 (Uttarakhand)
email: profchauhan58@gmail.com

Mobile app for sugarcane

ICAR-Sugarcane Breeding Institute, Coimbatore has developed an 'institution without walls' with its activities taking place at a wide range of institutions as well as at the sugar mill / village level. Though new sugarcane varieties and relevant crop management technologies are evolved, sugarcane productivity in India remains stagnated for the past two decades. The information and communication support for sugarcane crop has been mainly conventional. This approach has not been able to reach majority of the sugarcane farmers who are spread across the whole country. The diversity of agro ecological situations in the sugarcane growing states, varied technologies recommended and needs of sugarcane farmers further mount to this challenge. Information and Communication Technology (ICT) and in particular mobile technologies are often seen as a game changer in agriculture. Hence, an attempt was made to harness the potentialities of information technology through the development of a mobile app for technology dissemination bridging the barriers of time and space.

Importance of Mobile App

The increasing penetration of the mobile phones and mobile enabled information services can reduce information asymmetry and complement the role of extension services in making useful information more widely and swiftly available to the sugarcane growers. M-app is an application-software designed to take advantage of mobile technology and has many key advantages like affordability, wide ownership, voice communications, and instant and convenient service delivery. The app envisaged in this endeavor targets to provide farmers, cane staff and line department officials timely access to extension services such as advancements on scientific sugarcane production, advice on appropriate technology, and other related services.

What is 'Cane Adviser'?

Cane Adviser is a computer program designed to run on mobile devices such as smart phones and tablet computers and is accessible for anybody interested to know about scientific sugarcane cultivation.

This mobile app is the result of a 12 months research project entitled 'Developing a mobile app on sugarcane: An initiative towards digital India' funded by Extramural Project, Division of Agricultural Extension, Indian Council of Agricultural Research, New Delhi, during 2016-17.

How to use 'Cane Adviser'?

'Cane Adviser' is available in Google play store, an international online software store for free download. This app would fit in any android-based smart phone irrespective of the configuration, which is a stand-alone module. It has been made in a way that one-time internet connection alone is required for downloading the app. Further query mode needs to be internet based so as to function on real time basis.

Requirement Analysis

As an initial step, the requirement of the sugarcane growers / cane staff was analyzed through focus group discussions conducted in the villages as well as during other interface meetings. The information was collected in terms of the type of mobile phones used, pattern of mobile use, content needs in the app, services required through the app, format of the messages, preferred medium of communication etc. The information gathered was analyzed and accordingly the app was developed.

Project Architecture

The development process included conducting baseline survey, digitization of data, content management in terms of sugarcane varieties, production and protection on technologies, developing the mobile app in android platform, provision for digital flow for sending messages, facilities for mobile transmission, pilot study, performance analysis and finalize the module.

Modules in 'Cane Adviser'

The features of the app developed include static as well as dynamic platforms embedded in the app.

Login dialogue: This go-ahead user-interface is the first step towards registration. The particulars needed comprise name, mobile number, address and email (optional).

Downloader: This static downloadable display of knowledge base contains information on sugarcance agriculture right from planting to harvesting, otherwise referred as technical part. The content involves mainly text and graphics in the form of still pictures. The text runs to around 220 pages with more than 650 digital stills describing the content depicted. The information is given as state-wise varieties, crop production technologies, pest identification and management, disease identification and management and ratoon management. The general contents include history of the institute, mandate, Sugarcane Research Stations etc.

Scheduler app: This is a unique feature of the mobile app. Ingrained in the module is a scheduler app, which is tailor-made for each individual registered user. The basic inputs for registration include date of planting, choice of crop (plant / ratoon) and option of season (autumn / spring). Corresponding to the date of planting, continued advice and reminder messages on the calendar of cultural operations to be carried out are popped up on real-time mode.

Fertilizer schedule: Apart from the information on nutrient management detailed in the knowledge base, the app contains information on recommended dose of fertilizer for all the sugarcane growing states.

Query handler: As the eventual dialogue window, user has the option to raise queries either as text messages or in graphic form, be it as live images or from the gallery. The queries are then replied by the administrator via message sorting, short message service, email etc.

Languages

The entire matter was developed in English and then translated to Hindi and Tamil so as to have the app in trilingual. The app was named as 'Cane Adviser' in English in accord with ICAR norms and 'Ganna Salahkar' in Hindi and 'Karumbu Aalosakar' in Tamil.

Why Mobile App?

The mobile internet application developed would be a digital compendium of sugarcane related vocabulary,

and the English version was released by Shri Subhashish Panda, IAS, Joint Secretary, Sugar, Food & Civil Supply Ministry, Government of India on 21 September 2017.

The Tamil version 'Karumbu Aalosakar' was released by Padma Bhushan Dr R.S. Paroda, Former Director General, ICAR and Secretary, DARE on 4 November 2017 during the Research Advisory Committee of the Institute.

comprising all details on sugarcane agriculture and can serve as a ready reckoner for sugarcane growers and cane development personnel working with sugarcane knowledge.

The Finale

The Hindi version of the app 'Ganna Salahkar' was released by Shri Radha Mohan Singh, Honourable Minister for Agriculture and Farmers Welfare in the presence of Dr T. Mohapatra, Secretary, DARE and Director General, ICAR on 29 August 2017 at New Delhi

Financial support from ICAR Extramural Research Project, Division of Agricultural Extension, Indian Council of Agricultural Research, New Delhi is gratefully acknowledged.

T Rajula Shanthy*, S Alarmelu, C Jayabose, P. Malathi and **Bakshi Ram,**
ICAR-Sugarcane Breeding Institute,
Coimbatore 641007, Tamil Nadu
email: rajula.shanthy@icar.gov.in

Mobile app for fisheries

In an effort to leverage the potential of Information and Communication Technologies for disseminating the research outputs to stakeholders, the ICAR-Central Institute of Fisheries Technology, Kochi has developed a Mobile App, which will provide easy and quick access to information related to harvest and post-harvest aspects in fisheries.

Dr J K Jena, Deputy Director General (Fisheries), launched the mobile app on 25 November 2017 at Kochi, and lauded the efforts of ICAR-CIFT scientists for undertaking the need based research in harvest and post-harvest fisheries sector and following innovative digital mechanisms for disseminating the research outputs to the end users.

Dr Ravishankar C N, Director, ICAR-CIFT, that said this mobile based advisory system is users friendly and will be regularly updated regarding the different kinds of training programmes and other important events.

Besides fishing technologies and post-harvest technologies, the application provides information on quality assurance and management, biochemistry, nutrition, microbiology and engineering aspects. The information related to various trainings and other programmes of ICAR-CIFT will also be available in the application. The application can be freely downloaded from the Google play store.

Dr Ravi Shankar CN
ICAR-Central Institute of Fisheries Technology,
Kochi 682 029, Kerala
email: cift@ciftmail.org

Agroforestry solutions to address climate change challenges

Central Agroforestry Research Institute, Jhansi, has been working on climate change mitigation as NICRA partner since 2011-12, and assessed the carbon sequestration potential (CSP) of agroforestry system existing on farmers' field in 16 states (Uttar Pradesh, Gujarat, Bihar, West Bengal, Rajasthan, Punjab, Haryana, Himachal Pradesh, Maharashtra, Tamil Nadu, Andhra Pradesh, Karnataka, Madhya Pradesh, Chhattisgarh, Odisha and Telangana) covering 51 districts. The achievement made so far indicated that some of the promising trees like *Eucalyptus* spp., *Populus* spp., *Acacia auriculiformis*, *Prosopis juliflora*, *Gliricidia sepium*, *Acacia tortilis*, *Leucaena leucocephala, Pinus* spp., *Acacia nilotica, Dalbergia sissoo, Tectona grandis, Azadirachta indica, Cocos nucifera, Mangifera indica* and *Albizia lebbek, etc.* grow either on field bunds or in agricultural fields with crops. In most of the farmers' field, mixed plantation of various tree species are available in scattered way. But in some of the states of the country the farmers have adopted very systematic agro-forestry system for commercial uses. For example – Poplar, eucalyptus, eilanthus, teak, casuarina, black wattle, leucaena, aonla, ber, bael, mango based agroforestry are promising system under different agro-climatic regions.


Teak based agroforestry


Aonla based agroforestry


Poplar based agroforestry


Eucalyptus based agroforestry


Shisham based agroforestry


Cocount based agroforestry


Anjan based agroforestry

The tree density varied in different districts of a particular states on farmer's field. Similarly, the tree species also varied from state to state. The maximum tree density was observed for Odisha having 55.93 tree/ha, while the lowest tree density was recorded in Chhattisgarh with a value of 3.27 tree/ha. The trends of tree density observed on farmer's field are in order of Odisha > Maharashtra > Himachal Pradesh > Karnataka > Tamil Nadu > Andhra Pradesh >Punjab > Uttar Pradesh > Bihar > Madhya Pradesh > Rajasthan > Telangana > West Bengal > Haryana > Gujarat >Chhattisgarh.

Agroforestry contributes to the resilience of agriculture by adaptation and mitigation of climate change by offsetting carbon dioxide from atmosphere. In India, evidence is now emerging that agroforestry systems are promising land use system to increase and conserve above ground and soil carbon stocks to mitigate climate change.

Ram Newaj and **O.P. Chaturvedi**
ICAR-Central Agroforestry Research Institute,
Jhansi, Uttar Pardesh-284003
email: ramnewaj@gmail.com

Improved onion and garlic enhance incomes

Onion and garlic are important commercial crops which can improve livelihood of farmers. They also play a crucial role in food and nutritional security of tribals. The tribal belt of Nandurbar in Maharashtra has congenial climatic conditions for production of onion and garlic at commercial level.

Cultivation of these crops was limited to the kitchen garden in this area before the initiation of Tribal Sub-Plan (TSP) by ICAR-Directorate of Onion and Garlic Research, Rajgurunagar (ICAR-DOGR). Under TSP, systematic effort was undertaken to improve the area and production of onion and garlic by careful application of improved technologies. Thus, focus was given in conduct of field demonstrations of improved technologies at farmers' fields through improved seed/ bulb distribution, knowledge dissemination, capacity building and entrepreneurship building.

About 550 tribal farmers were selected in the form of 55 groups under this scheme. Each group comprised 10 selected farmers with one acre of land for conducting field demonstrations, training and input distribution. Thirty-two tribal villages were selected from three Talukas, *viz.* Navapur, Akalkua and Dhadgoan of Nandurbar for implementation of TSP on onion and garlic. In total, 124 demonstrations on newly improved varieties of onion and garlic and improved production technologies were undertaken. All the selected 32 tribal villages benefited from commercial cultivation of onion and garlic. More than 2,000 tribal farmers have been trained by organizing 22 field day/ trainings by ICAR-DOGR. Most of the farmers from selected areas are now cultivating onion and garlic on commercial scale. Onion and garlic are giving more profit than traditionally grown crops in these areas

and even achieved the highest price of onion produced in Indore market.

Technological Interventions

Improved production and post-harvest technologies were demonstrated in the selected tribal areas of Nandurbar. For the first time, cultivation of garlic at commercial level was initiated in the Navapur Taluka of Nandurbar. By garlic cultivation, ₹ 0.80-1.00 lakh per acre was earned through production of about 35 q bulbs per acre of Bhima Purple. For the first time, *kharif* onion production was initiated at commercial level in Navapur taluka of Nandurbar. Farmers have earned a net income of ₹ 0.70-0.80 lakh per acre by production of about 85 q bulbs of onion variety Bhima Super during *kharif* season and earned same net income by production of about 110 q bulbs of Bhima Shakti/ Bhima Kiran in *rabi* season. Nandurbar areas also have favorable climatic conditions for onion seed production. Vast availability of honey bees which are main pollinators of onion, further enhance the potential of seed production in this area. Farmers have

Performance of demonstrations and returns from onion and garlic

Activities	No. of Demonstrations	Av. Marketable yield (q/acre)	Net Return (` in lakh/acre)	Farmer's Benefited
Production of onion during *kharif*	25	85	0.70-0.80	250
Production of onion during *rabi*	60	110	0.70-0.80	600
Quality seed production of onion	29	2	0.60-0.80	290
Production of garlic	10	35	0.80-1.00	100

earned ₹0.60-0.80 lakh per acre net income by production of about 200 kg quality seeds per acre of Bhima Kiran/ Bhima Super. Installation of drip irrigation and fertigation in the selected farmer's fields which enhanced water and fertilizer use efficiency in onion and garlic cultivation. Integrated Pest and Disease Management (IPDM) and Integrated Nutrient Management (INM) in onion and garlic were demonstrated. Support was given to develop storage structures to selected farmers for storage of onion bulbs of *rabi* harvest.

Impact of TSP

The area and production of onion in Nandurbar has increased more than three times after initiation of TSP. The area under onion cultivation in Nandurbar district increased from 2,232 ha (2012-13) to 7,469 ha (2015-16) whereas production of onion increased from 40538 t (2012-13) to 127,228 t (2015-16). Initially cultivation of garlic in Nandurbar was negligible whereas at present cultivation of garlic initiated at commercial level (250 ha). Buy-back of onion seed was taken by ICAR-DOGR to insure net income from onion seed production to the selected tribal farmers. After increase in income level due to ICAR-DOGR initiatives, the tribal farmers established NESU Parisar Farmers Producer Company at Nimboni, Nandurbar and registered with Ministry of Corporate Affairs, GOI with the support of ICAR-DOGR through Tribal Sub-Plan. Socio-economic status of selected farmers under TSP have been significantly improved due to the intervention of ICAR-DOGR through TSP scheme.

Low cost onion storage structure

Amar Jeet Gupta, S S Gadge and **Major Singh**
ICAR-Directorate of Onion and Garlic Research,
Rajgurunagar 410 505
Pune (Maharashtra)
email: guptaaj75@yahoo.com.in

Basmati CSR-30: Doubling farmer's income in sodic soils

ICAR-CSSRI, Karnal, adopted five villages (Naultha, Karad, Alupur, Shahpur and Jonadhan Kalan) in Panipat district of Haryana under the MGMG program of the Government of India. The primary objectives were to educate, demonstrate and promote land reclamation technologies and cultivation of suitable (tolerant) rice and wheat crops for degraded areas of salt affected soils and poor quality ground water. A survey was conducted to understand soil chemical properties, water quality and socio-economic status of the area. Five progressive farmers were selected in five villages for distribution of salt tolerant rice (Basmati CSR 30) in *kharif* and wheat (KRL 210) in *rabi* season. This year, rice var. Basmati CSR 30 seeds (10 kg) were distributed to Mr Rup Ram (S/O Nait Ram, AADHAR card No. 742769411223) of Naultha village on 17 May 2017. The seeds were sown in nursery seed beds (0.01 ha) on 20 May 2017 and 40 days old seedlings were transplanted in the prepared farm land on 1 July 2017 covering 1.25 ha. During the land preparation, gypsum amendment (80 kg/acre) was broadcast for soil reclamation and 50 kg DAP was applied as basal dose before transplanting in soil. Urea (50 kg)

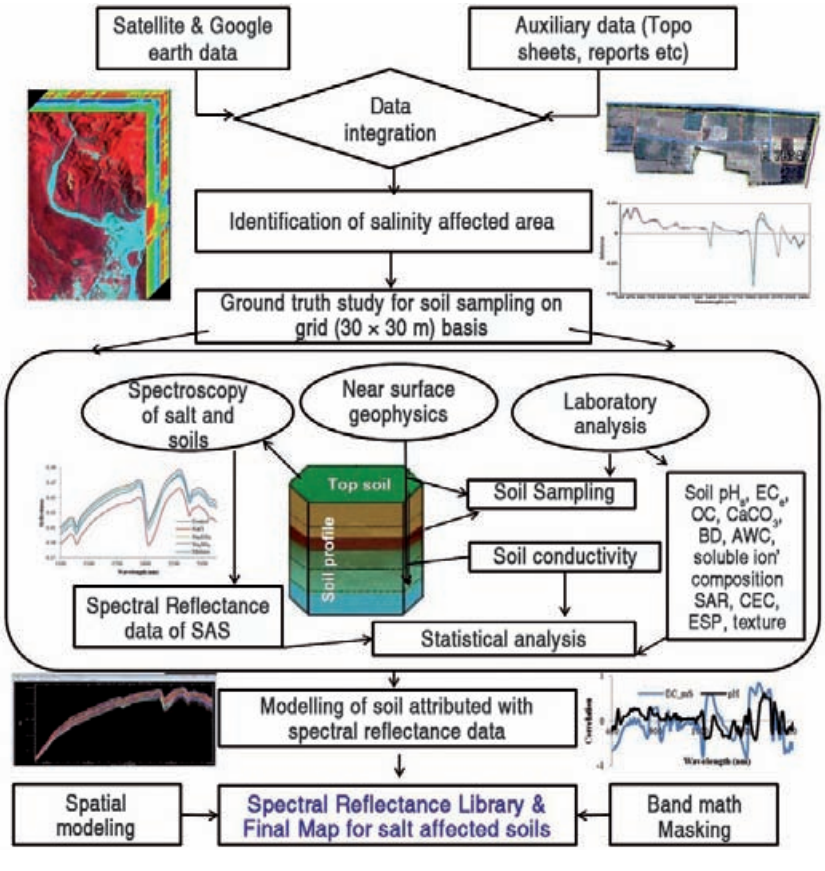
Performance of rice var. Basmati CSR 30 in Naultha village during October 2017.

was also broadcast on standing rice crop at 16-17 DAS. During the entire growth period of rice, pesticides (Machan™: Buprofezin 25% SC and Bhuchal™: Acephate 75% SP) were sprayed at 90 and 110 DAS. Good quality of irrigation water was applied in the nursery beds and the tube well (180 ft) water was used for subsequent irrigation purposes. The soil analytical data showed that initial pH_s was 7.8 and EC_e was 0.90 dS m^{-1} and the water quality studies showed pH_{iw} 6.9, EC_{iw} 0.92 dS m^{-1}, and the presence of CO_3^{2-}+ HCO_3^- 10 me L^{-1}, Cl^- 10 me L^{-1} and Ca^{2+}+ Mg^{2+} 10 me L^{-1} were also noted. Crop was harvested on 4 November 2017 and recorded yield was 4.5 t ha^{-1}. A part of the harvested crop was protected as seeds for the subsequent years. The farmer, Mr Rup Ram, is quite happy with the consistent performances of rice crop (Basmati CSR 30) in his farm land for two successive cropping seasons. As per his opinion, such crop yield is an exceptional instance in sodic soils underlain by alkali water. He demonstrated such result to other farmers of the village for motivation and suggested to proceed for acquiring and cultivating rice var. Basmati CSR 30 from ICAR-CSSRI, Karnal, for degraded soils in similar areas in Panipat and its adjoining district.

A. K. Mandal, Ashim Datta, Manish Kumar, Jogendra Singh, Vijayata Singh and **R K Singh**
email: ccsridirector@gmail.com

Soil salinity characterization using hyper-spectral remote sensing data

The complexity of salinization processes, spatial and temporal variability caused soil salinity mapping a difficult proposition. Severely salt affected soils (SAS) can be easily detected due to high reflectance from salt crust on soil surface, whereas, detection of low and medium SAS is difficult due to intricate association of salt, soil, water and vegetation. An attempt was made to characterize such SAS using hyper-spectral remote sensing data. A methodology was developed at CSSRI, Karnal, integrating hyper-spectral (HRS) data with limited ground truth and further quantifying through a statistical model. The variability of salinity and sodicity attributes such as EC_e, Na^+, Cl^-, CO_3^{2-} and HCO_3^- (me/L) of the saturated soil extract was related quantitatively (r^2=>90%) by hyper-spectral data. The spectral regions of 1400, 1900 and 2200 nm showed prominent peak due to the changes in soil salinity. At 1900 nm prominent shifting facilitated in establishing a significant correlation with



Soil salinity characterization using hyper-spectral remote sensing data

salt concentration. A methodology was developed for characterizing salt affected soils as mentioned below using hyper-spectral data and is found useful for delineating salt affected soils right from the space platform.

i) Study area (10.8 ha of CSSRI Experimental farm) is divided in regular grid (30 × 30 m) to collect surface soil samples and spectroradiometer data
ii) Soil samples were collected from the surface layers (0-30 cm) during the post monsoon season and were analyzed for physico-chemical properties such as EC_e (dS/m), pHs, Na^+, K^+, Ca^{2+}, Mg^{2+}, CO_3^{2-}, HCO_3^-, Cl^- and SO_4^{2-}. The following approach was followed:

- Hyper-spectral data was collected from a spectroradiometer in different wave length regions and standardized using a statistical model to find prominent absorption region between 1,420 to 2,020 nm
- Salinity model was developed integrating hyper-spectral data with soil physico-chemical properties by multivariate statistical data analysis and was validated using band math techniques
- A spectral library was developed for further mapping of salt affected soils with limited ground truth data.

Arijit Barman, A K Mandal, R Srivastava, R K Yadav and **P C Sharma**
email: ccsridirector@gmail.com

Inducing tolerance to biotic and abiotic stresses in banana

Banana is a sustainable medium duration cash crop with high returns in irrigated lands. Though, it is one of the high income providers it is more susceptible to natural vagaries like salinity, frost, wind, storm, drought etc. The reclaimed sodic soils and the wastelands form the bulk of land that could be effectively harnessed for banana cultivation in the Northern plains. The profitability of small land holders can enhance up to 60 % with the inclusion of banana in cultivation of reclaimed sodic soils of North India, where the quality and quantity of water is optimum for banana cultivation. Cultivation of commercial Grand Naine tissue culture plantlets was not possible in the reclaimed sodic soil even after application of gypsum and bio-formulations. ICAR-Central Soil Salinity Research Institute, Regional Research Station, Lucknow, has taken an initiative of developing eco-friendly technologies for cultivation of banana in reclaimed sodic soils whose pH ranged from 8.8 at the surface to 9.3 at 30-60 cm depth. The approach of acquired systemic resistance was utilized to impart tolerance to abiotic stress with the help of biological hardening. Protocol for 3 tier *in-vitro* biopriming of multiple shoots in tissue culture banana plantlets var. Grand Naine with the potential salt tolerant bacterial isolates CSR-A-16 (*Lysinibacillus sphaericus*), CSR-A-11 (*Lysinibacillus fusiformis*) and CSR-M-16 (*Bacillus licheniformis*) was standardized and patented. The bio-primed plants were assessed for the efficacy in the field with a complete package of application (PoA) protocol of the bio-formulation using the above isolates in CSR-BIO media. Treated plantlets produced more plant height, girth with an average bunch weight of 32.00 kg compared to 6.00 kg obtained in untreated controls. Multi location trials using the technology conducted at farmers' fields of Barabanki district in Uttar Pradesh and Tiruchirapalli district of Tamil Nadu revealed that the treated plantlets produced an 18-22 % yield increase in normal soils and also prevented the occurrence of soil-borne diseases. Thus the technology can enable the cultivation of banana in the reclaimed sodic soils up to soil pH 9.0 in the surface and also can be utilized for inducing tolerance against soil-borne diseases in banana.

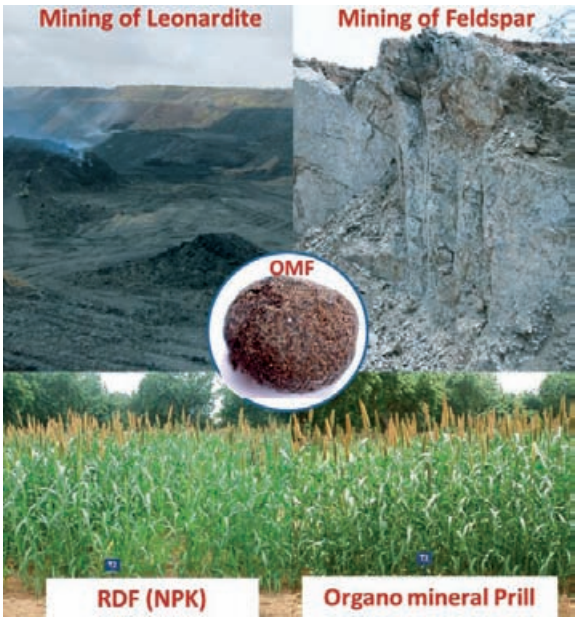
T Damodaran, V K Mishra and **S K Jha**
email: ccsridirector@gmail.com

Synthesis of new potassic organo mineral fertilizer

Imports of potassic fertilizers cost the nation about ₹20,000 crores per annum (Indian Mineral Yearbook 2015) as reserves of potassium minerals in our country being few and of poor quality are unsuitable for synthesis of potassic fertilizers. Feldspar is one such mineral with huge deposits (87.12 million tons) in Rajasthan (Annual Report 2015-16, Indian Potash Limited).

A new method has been developed to convert low grade feldspar, into organo-mineral fertilizes by mixing it with chemically treated leonardite which is an oxidized form of lignite and found abundantly in the country (estimated reserves 2.05 billion tons). The response of pearl millet, wheat and mung bean to potassium through this organo-mineral fertilizer (OMF) in pots as well as in the field experiments has been better than that with equivalent amount of muriate of potash (conventional potassium fertilizer).

Encouraged with the performance of this organo-mineral fertilizer in field and considering its large scale production potential Dr T. Mohapatra, DG, ICAR and Secretary, DARE and Dr S. Bhaskar, ADG (AAF&CC) desired its testing on various K requiring crops (tuber and tobacco) through AICRPs prior to its commercialization.



Raw material for organo-mineral fertilizer (OMF) and its response on pearl millet in field

Praveen Kumar, NR Panwar, RC Kasana and **U Burman**
Division of Integrated Farming Systems
ICAR-Central Arid Zone Research Institute, Jodhpur
email: Praveen.Kumar@icar.gov.in

Announcement

NATIONAL ACADEMY OF AGRICULTURAL SCIENCES

Invites Nominations for different Awards for the Biennium 2017-2018

I. MEMORIAL AWARD (6 Nos.)
The nominee should be a distinguished Scientist above 55 years in age. The period of assessing the contributions would be life time up to the year of nomination. Each Award consists of a citation and a silver plaque.

II. ENDOWMENT AWARD (3 Nos.)
The awards will be given to outstanding scientists for their contributions towards ensuring *(i)* food and nutritional security, *(ii)* overall contributions to agriculture, and *(iii)* contributions in the area of crop sciences. The nominees can be from any branch of science relevant to agriculture. The awards comprise a citation and a silver plaque.

III. RECOGNITION AWARD (6 Nos.)
The awards would be given to distinguished scientists, in the age group of 35-55 years, who are Fellows of the National Academy of Agricultural Sciences. Each award consists of a citation and a silver plaque.

IV. YOUNG SCIENTIST AWARD (6 Nos.)
Scientists below the age of 35 years are eligible for this award. Each award consists of a citation and gold plated silver medal.

For details, please visit Academy website at www.naasindia.org or write to:
Executive Director, National Academy of Agricultural Sciences
NASC, DPS Marg, New Delhi 110 012.
Tel.: (011) 25846051, *Fax:* (011) 25846054, *Email:* naas@vsnl.com

Last date for receipt of nominations in the Academy is March 31, 2018

NOTE: Self Nominations are not acceptable.

ICAR-Indian Institute of Soil and Water Conservation, Dehradun

Developing technologies for controlling land degradation and enhancing productivity

India was among the first few countries to have taken timely cognizance of the enormity of the soil erosion problems. Established as a regional centre in 1954, the Central Soil and Water Conservation Research and Training Institute (CSWCRTI) was re-organized into Central Institute of the Indian Council of Agricultural Research (ICAR) in 1974. It has now eight Regional Centres at Agra, Bellary, Chandigarh, Datia, Koraput, Kota, Udhagamandalam and Vasad, which along with its headquarters at Dehradun caters to the location-specific needs of different regions. The Institute has four divisions – Soil Science and Agronomy; Hydrology and Engineering; Plant Sciences; and Human Resource Development and Social Sciences. The Institute was renamed as Indian Institute of Soil and Water Conservation (ICAR-IISWC) by ICAR on 7 April, 2014. The principal mandate of the Institute is conservation of natural resources, especially soil and water, dovetailed with production from arable as well as non-arable lands. The Institute has been identified as a nodal agency to impart long duration specialized training programmes to Central and State Government Officers and Graduate Assistants in the field of Soil and Water Conservation and Watershed Management as per specific demands of the organizations.

MANDATE

- Research for management of land degradation in primary production systems and rehabilitation of degraded lands in different agro-ecological regions of the country.
- Co-ordinate research network for developing location-specific technologies in the area of soil and water conservation.
- Centre for training in research methodologies and updated technology in soil and water conservation and watershed management.

VISION

Conservation and management of soil and water resources of the country for sustainable production.

MISSION

To develop technologies for controlling land degradation and enhancing productivity on sustainable basis for ensuring food, environmental, economic and livelihood security of stakeholders.

MAJOR ACHIEVEMENTS

Research

The Institute has evolved strategies for resolving problems of ravines, landslides, mine spoils and torrents, Reclamation technologies for torrents, gullies, landslides, mine spoils, gravelly / bouldery soils, sloping lands, watershed restoration, runoff harvesting, alternate land uses, diversification, biodiversity (ecological successions), bioremediation, management of common property resources and community participation were demonstrated successfully.

- Estimated production and monetary losses due to water erosion in rainfed areas of India.
- Prioritized erosion risk areas for effective planning and implementation of conservation programmes.
- Assessed status of soil erosion in coastal belt of India.
- Computed Soil Loss Tolerance Limits (T value) for different agro-ecological regions of India.
- Developed silvipastoral system under various management practices for degraded lands.
- Identified conservation measures for new tea plantation areas.
- Identified different nutrient management systems for soil health, productivity and conservation under export oriented vegetable crops in the Nilgiris.
- Methodology standardized for design of staggered contour trenches in degraded areas.
- Assessed effect of conservation structures on ground water recharge.
- Designed and developed site specific artificial groundwater recharge filters.
- Developed rainwater harvesting and recycling model for Shivalik foothills.
- Developed technology for rehabilitation of minespoil affected areas.
- Developed bio-engineering technology for torrent training.
- Developed geotextile based technology for slope stabilization and erosion control.
- Developed cost effective technology for treatment of *choe* in Shivaliks.
- Combated land degradation through cycling of organic matter under different land use systems.
- Developed indicators for assessing impact of watershed interventions in different regions.
- Developed Multi-Objective Decision Support System (MODSS) for watershed development programmes.
- Developed efficient and innovative blue and green water harvesting techniques for enhancing land and water productivity of semi-arid districts of Gujarat.
- Assessed effect of climate change on hydrology of small watersheds vis-à-vis soil and water conservation measures.
- Devised economic frame work for ecosystem services payment and farmers' livelihood in Mahi and Chambal ravine ecosystems.
- Created ICT network to disseminate knowledge about soil and water conservation technologies to farmers in Himalayan region.
- Delineated area under ravines (1.037 m ha) in four states; district maps prepared; technological packages for ravine land reclamation developed and documented; and a macro plan for ravine rehabilitation prepared.
- Assessed vulnerability to climate change impacts in Karnataka.
- Prepared six District Irrigation Plans (DIP) under PMKSY for Odisha State.

Technologies Generated

The Institute has developed a number of resource conserving technologies, both for arable and non-arable lands, which have the potential to check land degradation, minimize soil erosion, preserve soil's fertility,

Cost Effective Plastic Check Dams for Water Harvesting in Rainfed Regions

Jhola Kundi – a low cost water harvesting technique for augmenting production of *jhola* lands

sustain productivity in the long run, conserve in-situ rainwater, harvest and recycle inevitable runoff, mitigate droughts, moderate floods downstream, and ensure environmental security. In the process of development, the Institute kept up the efforts for the transfer of technologies through its various outreach programmes, namely Operational Research Projects on Watershed Management, Lab-to-Land Programmes, Model Watersheds under Macro-Management of Agriculture (Ministry of Agriculture), Integrated Wasteland Development Programme (Ministry of Rural Development), Farmer's Participatory Action Research Programme (Ministry of Water Resources), Sustainable Livelihood Security Programme (under National Innovative Agriculture Project, ICAR), National Bamboo Mission (Ministry of Agriculture) and other programmes directly benefitting farmers. Some important technologies generated are as follows:

Rejuvenation of dry streams at mined watershed after treatment

- Bio-engineering technology for treatment of torrents in Shivaliks
- Vegetative barriers for erosion control in western Himalayan region
- Compartmental bunding for *in-situ* rainwater conservation in medium to deep black soils
- Improved design of mechanical spurs for control of torrents in lower Himalayas
- Technology for rehabilitation of mine spoil areas in hilly regions
- Utilization of degraded lands by mango based agricultural system in north western Himalayas
- Utilization of degraded lands for peach based agri-horti system in north-western Himalayas through micro soil improvement.
- *Jhola Kundi*: a low cost water harvesting technique for augmenting production of *jhola* lands in Eastern Ghats High Land Region of Odisha
- Contour furrows for enhancing productivity in medium to deep black soils of south-eastern Rajasthan
- Stabilization of bench terrace risers with tea crop
- Recharge filter – a cost effective technology for augmenting groundwater
- Developed cost effective plastic check dams for water harvesting in rainfed regions.
- Formulated online software for design of straight drop spillway
- Formulated online software for design of farm pond
- Formulated Project Management Information System software on Preparation of Detailed Project Report for Watershed Management (PMIS-DPR).
- Formulated software of DSS for Contour Trenching, Soil Loss Tolerance Limit (SLTL) Calculator and Rainfall Energy Calculator.

Human Resource Development

The Institute conducts capacity building courses of varying durations regularly for policy makers, NGOs, field functionaries and farmers in the field of soil and water conservation and watershed management. Since 1956, it has been organizing regular training courses of 22 weeks twice a year, in soil and water conservation and watershed management for officers and graduate assistants from various state agencies and other countries. Till August 2017, a total of 2,991 gazetted officers and 9,224 assistants have been trained, including 41 foreign participants, in 116 batches of long duration (4 to 5½ months) regular training courses. The Institute also conducts specialized tailor made short term training and sensitization courses for officers/officials sponsored by various agencies in India and abroad. Till March 2017, 244 short courses for officers (4,599 participants) and 669 short courses for assistants (18,145 participants) have been conducted.

Participatory Integrated Watershed Management

The concept of watershed planning, development and management, which was evolved and demonstrated by the Institute in 1970's, has emerged as a new paradigm for efficient management of land, water and other natural resources following bottom up participatory approaches. The success of watershed management concept in flood and drought moderation, ground water augmentation, increased biomass production, employment generation and improvement in socio-economic conditions of the local people was amply demonstrated through four model operational watershed projects implemented by CSWCRTI during 1970's at Sukhomajri and Nada (Haryana), Fakot (Tehri-Garhwal hills of Uttarakhand) and G.R. Halli (Chittradurga, Karnataka).

The strength and potential of participatory watershed management was amply demonstrated by Late Shri

Parshu Ram Mishra, Head, CSWCRTI Research Centre, Chandigarh by his pioneering work in Sukhomajri to transform denuded hills to forest wealth for which he was awarded Padam Shri in 2000 for his services in the field of ecology and environment. With the experience gained from these watersheds, the ICAR entrusted CSWCRTI, Dehradun and CRIDA, Hyderabad during 1980-86 with the development of 47 model watersheds in 16 states in collaboration with SAUs and State Departments through active participation of local community.

Non-Research Achievements

- **Strategy for Doubling Farmers' Income in Uttarakhand:** document finalized with GBPUAT
- **ISO 9001:2008 Certificate** followed by **ISO 9001:2015 Certificate**

Tea on Terrace Risers with annual crop cultivation on benches of terraces

Participatory integrated watershed development programmes like NWDPRA, IWDP and NAEP were undertaken during 1988-91 and previously launched rural development programmes such as RVPs & FPRs, WDPSCA, EAS, DPAP and DDP were converted to participatory integrated watershed management approach from 1990's onwards covering several thousand watersheds.

Till March 2007, 56.54 m ha has been treated in the country with an expenditure of Rs 19,470.57 crores under various watershed development programmes of the Ministries and other agencies. IISWC is playing an important role in PMKSY vis-à-vis watershed management through technology transfer, capacity building and preparation of District Irrigation Plan.

National Watershed Development Project for Rainfed Areas

During 2008 to 2014, under National Watershed Development Project for Rainfed Areas (NWDPRA) of Ministry of Agriculture, Government of India, CSWCRTI developed nine model watersheds located in nine states representing different agro-ecological regions of the country following participatory approach. Under environmental benefits, runoff from the watersheds reduced on an average by 40% and reduction in soil loss was 17%. Average rate of silt deposition was 13.6 t/ha/yr.

The vegetation cover increased by 4-9%. As a result of conservation, 0.43-24.2 ha-m of rain water harvesting potential was created and average rise in groundwater table was 0.18-4.0 m during summer and 12.8-18.3 m post monsoon. Crop productivity increased by 28-83% of various crops. Average increase in cropping intensity was 11% and reduction in fallow area was 13%. The WUE increased by 15-26% and 22-32% in kharif and rabi crops, respectively. Annual income earned by SHGs ranged from Rs. 11500 to Rs. 50400.

AWARDS

- **Best Institute Award 2005:** The Institute was bestowed with the most prestigious 'Sardar Patel Outstanding Institution Award – 2005' for best performance in Agricultural Research and Education in large ICAR institute category.
- **Best Annual Report Award 2009:** The Institute won the ICAR Trophy for 'Best Annual Report – 2009-10' in the large ICAR Institute category.
- **Best Institute Award 2016:** The Institute was again bestowed with the most prestigious 'Sardar Patel Outstanding Institution Award – 2016' for best performance in Agricultural Research and Education in large ICAR institute category.
- **Best Institute Award for Swachhata 2017:** The Institute was adjudged as the Best Institute for Swachhata Award – 2017 of ICAR.

THRUST AREAS FOR THREE ANNUAL PLANS (2017-2020)

To carry out research and training in the recently developed fields using state-of-art technology, besides ongoing programmes, the following new initiatives will be taken up by the Institute during three Annual Plans:

- Use of advanced techniques (AI, process modeling, RS, GIS) and development of DSS and expert system for watershed planning, water resources development and management, and land use planning and management for productivity enhancement (Water-Soil-Plant-Energy-Carbon Nexus).
- Augmenting groundwater recharge from surface storage structures and need based sizing through full scale hydrological monitoring with due regard to surface water quality.

- Assess rainwater storage potential (water yield map) in different terrain conditions and improve rain water use efficiency/water productivity through prolonged storage and multiple water use, especially in the light of climate change impacts.
- Development of erosion productivity relationship under different agro-climatic zones to help modify cropping systems in relation to intensity of degradation and vulnerability.
- To finalise the Map of Vulnerability of Agriculture and Allied Sector to Climate Change in Himalayan region.
- To develop new Intensity-Duration and Frequency (IDF) curve and project the effect of Climate Change on rainfall intensity for different climatic regions of India.
- To revise the Potential Erosion Map of the country based on high resolution new and updated data base in GIS environment.
- To develop online design software for all the soil conservation structures being constructed in the watersheds.
- To prepare policy papers in the domain areas for up-scaling NRM based technologies and strengthen Science and Policy.
- To initiate establishing Bench Mark watersheds for studying hydrologic performances of different land use system in the watershed perspective.
- To establish the importance of watersheds in the context of PMKSY and improving the status of water management in watersheds for improving upon the equity of water issues.
- National Mission on Sustaining Himalayan Eco-system (NMSHE) – Task force on Himalayan agriculture for lower and middle Himalayan region. (DST funded)
- Environmental tracer based study on erosion induced loss of soil organic carbon and its impact on agronomic productivity and environmental quality.
- Efficient groundwater management for enhancing adaptive capacity to climate change in sugarcane based farming systems in Muzaffarnagar, Uttar Pradesh (NMSA funded)
- Field evaluation of refinement of ravine reclamation technology in a model ravine area development project at Lohli-Bagli village in district Bundi (Rajasthan). (RKVY and Government of Rajasthan funded)

Silpaulin lined water storage tank of spring water harvesting system for hilly areas

Bamboo and anjan grass for enhancing productivity of ravines

- Refining methodologies for data validation, planning, monitoring and evaluation of watersheds. (World Bank and Government of Karnataka funded)
- Establishment of model nursery for fast multiplication of new cultivars of guava, litchi, aonla, pomegranate and mango. (HMNEH funded)
- Upscaling research on assessment of productivity, hydrological behavior, resource conservation and intangible benefits of selected commercial bamboo species in Uttarakhand. (INBAR funded)
- Promotion and expansion of Lemon grass (*Cymbopogon flexuosus*) cultivation as an alternative crop for livelihood security in SC and ST communities in Dehradun district. (DST funded)
- Farmer participatory technology application for sustainable resource management and livelihood security in north-western Himalayas (Farmer First Project)
- Study of atmospheric and soil carbondioxide fluxes in temperate mountainous ecosystem of Western Ghats with reference to climate change impact assessment. (NRSC-ISRO funded)
- Quantitative and qualitative assessment and management strategy for the sustainable development of groundwater resources in Haridwar District. (CGWB collaborative project)
- Development and rejuvenation of natural springs through soil and water conservation measures. (WIHG collaborative project)
- Land use effect on soil carbon stock and soil quality in Mahi ravine ecosystem of semi arid tropics. (NBSSLUP collaborative project)
- Updating Advanced Skill Development Centre on Soil and Water Conservation and Watershed Management with introduction of e-learning modules and mobile apps for popularizing and up-scaling NRM technologies

P K Mishra
Director, Indian Institute of Soil and Water Conservation
Dehradun 248 195 (Uttarakhand)
email: directorsoilcons@gmail.com

CAZRI patents encourage innovation

Recently, ICAR-CAZRI has been granted two patents out of fourteen applications filed. These technologies can be directly used by farmers, confectionery and cottage industries; along with skill development programmes run by the government and NGOs for the rural farmers, youth and farm women for improving their livelihood and income.

Jaisalmeri preserve and candy from fruit of Tumba (*Citrullus colocynthis*) (1381/DEL/2008)

This new patented technology ready for commercialization is related to detoxification and de-

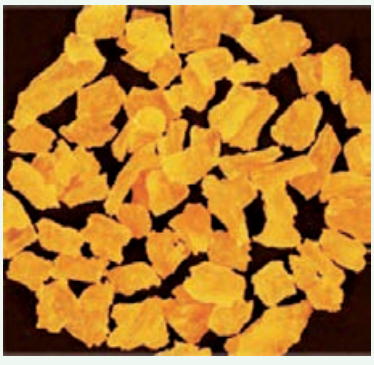
bittering the fruit pulp of Tumba and converting it into edible digestive sweet products known as "Preserves and Candy" that can be served as desert. Tumba (*Citrullus colocynthis*) grows naturally in western Rajasthan, on barren and uncultivated wastelands (about 7.9 lakh ha) during monsoon in the districts of the Jaisalmer, Barmer, Bikaner, Jodhpur, Churu, Ganganagar, Hanumangarh and Jalore on the sandy plains and dunes. Presently, its fruits are used mainly for feeding farm animals and seeds are used for extraction of non-edible oil for soap industry. However, no edible product from this plant is made due to presence of bitter and cytotoxic component 'cucurbitacin'. According to an estimate, one hectare can yield about 200-250 quintals of fruits that have 74% pulp which is used for the preparation of preserve and candy (potential sale price of this products is about ₹50 to 70 per kg).

Candy

Preserves

Aloe candy from *Aloe* species (262/DEL/2008)

Aloe is known to enhance immunity, improve liver function, prevent asthma and act as anti-inflammatory, anti-ulcer, anti-diabetic and anti-hypertension agent. Constraints with respect to its shelf life (despite use of preservatives), heat and pH instability, oxygen sensitivity and other factors that contribute to the deterioration of bioactive components limits its use for edible purpose. All the above drawbacks have been removed through a patented technology and a novel, ready to eat delicacy from the leaf of Aloe vera plant called 'Aloe candy' has been developed. The product has high fibre and low water content with appealing flavor, color and texture. About 25-30 tonnes of leaves can be harvested from one hectare plantation. Each kg of Aloe vera leaves yields about 100g of candy which cost about ₹30 to 50.



Dr Mrs Rajwant K Kalia
Central Arid Zone Research Instituite,
Jodpur 342 003 Rajasthan
email: rajwant.kalia@icar.gov.in

VL whitegrub beetle trap designed and patented

The VL Whitegrub beetle trap, which is designed and developed by ICAR-VPKAS, Almora has been granted a patent. The light trap is designed specifically based on the behaviour of whitegrub/ scarab beetles, so as to trap them excluding the other insects, which also get attracted to the light. Scarab beetles hover around the light source in circular fashion and thus, three hitting fins are arranged to have maximum success in hit and capture. The uniqueness of the trap lies on the space given between the light source and the hitting fins and the gap between the funnel stem and the collection pot. The space between the light source and hitting fins allow the weak fliers attracted towards light to pass on and not getting hit and trapped. The gap between the stem of the funnel and collection pot allows some other lighter insects to escape. The trap is found to capture 68% of scarab beetles, 32% others (mostly of *Isoptera* and *Lepidoptera*) and a negligible amount of beneficial insects to a tune of <0.8%, which shows it as a whitegrub specific trap. The trap is made of 24 gauge tin sheets and the hitting fins itself act as a light reflector at night.

A trap normally captures around 10,200 beetles per season (June to October) in the first year of installation at a site and around 5,000 beetles in the second year at the same place which reduces to 800 in the 5th to 6th year. The VL whitegrub beetle trap is well popularized in Uttarakhand through trainings and demonstrations conducted by VPKAS and state department of Agriculture.

emal: icarvpkaspmecell2@gmail.com

Identification of a high yielding finger millet variety VL *Mandua* 379

VL *Mandua* 379 (VL 379) is a high yielding finger millet genotype. It has been derived from a cross between GEC 440 (early maturing core collection germplasm line) and VL *Ragi* 149 (blast resistant finger millet variety). It recorded an average grain yield of 31.31 q/ha, which was 18.28% higher than the best check VL *Mandua* 352 (26.47 q/ha). It has been found resistant to neck and finger blast disease and recorded a lesser mean score of neck blast (2.2%) and finger blast (3.2%) as compared to check VL *Mandua* 352 (neck blast 5.0%, finger blast 4.0%) in coordinated trials. In mid hills, height of this variety is 92-100 cm and it matures in 103-111 days. It has semi-compact ear heads with top incurved fingers.

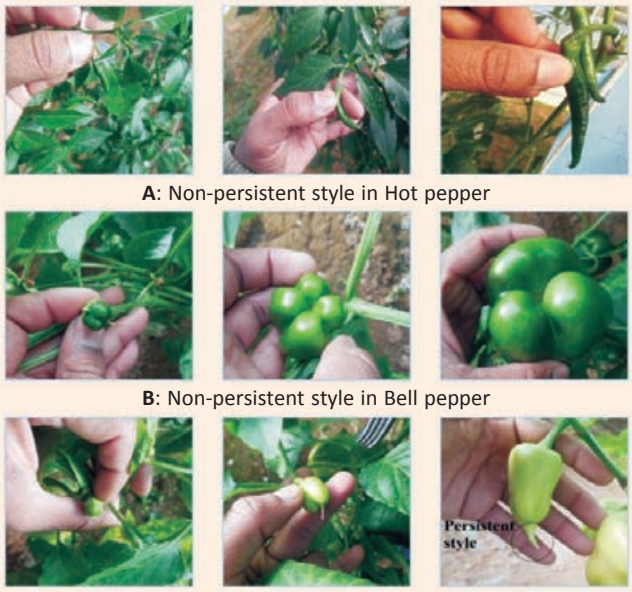
email: icarvpkaspmecell2@gmail.com

Pepper persistent style not appreciated

Normally, in pepper flowers, pollen grains deposit on stigmatic end, and after fertilization the fruit setting happens, the ovary grows in size as a fruit and simultaneously the style starts drying; in due course, the dried style falls out which is known as non-persistent style (A & B).

While evaluating the breeding material of bell pepper persistent style was found in VLCP-2016-2 and BLCPN-4, the persisted style does not fall and continues to grow as a fleshy "beak" like structure which looks not only unattractive but provides an entry site for pathogens upon breakage during transportation and post-harvest handling.

email: icarvpkaspmecell2@gmail.com



A: Non-persistent style in Hot pepper

B: Non-persistent style in Bell pepper

C: Persistent style in Bell pepper

Influence of long-term fertilization on carbon mineralization in the mid-Himalayas

Effect of long-term (21-years) study on mineral and organic amendments on carbon mineralization, glomalin related soil protein and soil biological properties under irrigated soybean-wheat cropping system in the mid-Himalayas showed higher cumulative C-mineralization under surface soil compared to subsurface layer (Fig. I.a and I.b). Other results showed that the soil under NPK + FYM significantly increased carbon mineralization (318 and 278 mg CO_2-C 100 g^{-1} soil for 0-15 and 15-30 cm soil depth, respectively) compared to NPK plots. Higher C-mineralization under NPK + FYM might be attributed to build-up of more root biomass and crop residue, which improved soil health and ultimately enhanced soil biological activity. The easily extractable glomalin related soil protein, total glomalin related soil protein, soil microbial indices (*q*MIC, *q*CO_2 and MP) were significantly enhanced under NPK + FYM plots compared to rest of the treatments. The activities of seven enzymes viz. dehydrogenase, ^{2}-glucosidase, invertase, acid phosphatase, alkaline phosphatase, arylsulphatase and urease were also significantly higher under the NPK + FYM compared to the rest of the treatments. The above parameters under NPK and FYM were non-significant, but these were signiûcantly better than N and control. Soil microbial properties had strong positive correlation with SOC, MBC and activities of soil enzymes. These results clearly showed that NPK + FYM provided the best management practice for healthy soil.

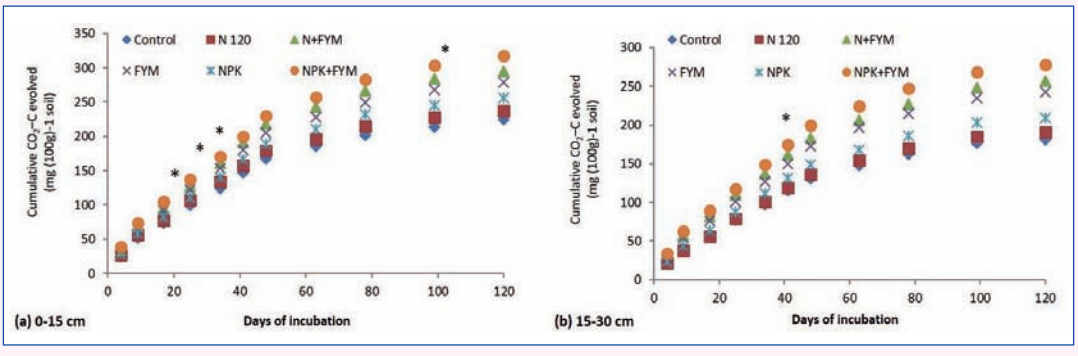


Fig. 1. Influence of long term application of mineral fertilizer and organic manure on cumulative CO_2-C evolution in 0-15 (a) and 15-30 cm (b) under irrigated soybean-wheat cropping system. Symbol '*' denotes non-significant difference between the treatments.

Dr J K Bisht
Director, VPKAS, Almore 263 601
email: icarvpkaspmecell2@gmail.com

Boon for cattle of Rajasthan

Prosopis juliflora was introduced for the first time in arid Rajasthan by the Maharaja of Jodhpur in late 18th century and later on aerial seeding was done in Western Rajasthan to increase the forest cover. Initially it was considered a boon for the desert since its wood was used for fuel and other purposes. However, in due course of time, it spread profusely, encroaching upon all types of lands and human habitations and became a nuisance. Its spread can be checked if its propagating materials i.e. seed/pods are exploited for beneficial uses. The preparation of concentrate animal feed from the pods could be an excellent example of its uses.

Preparation of P. *juliflora* based livestock feed

ICAR-CAZRI, Jodhpur demonstrated processing technology of *P. juliflora* based livestock feed preparation at household level to farmers of village Harsolav. The simplicity of technology, easy availability of raw material i.e. *P. juliflora* pods and its cost effectiveness was explained to the farmers. Once convinced Shri Vijay Singh, a farmer agreed to process *P. juliflora* pod based cattle feed in his household. At the first instance, his family members collected ripe pods of *P. juliflora* from village commons, wastelands and extra territorial sources. During peak pod bearing season (mid March to May end), members of household on an average collected 20-25 kg pods per day. The collected pods were sun dried for a week. After proper drying in the sun they were ground in a traditional hand driven grinder, locally known as 'ghatti' available with him.

With pod pulp, seeds were also grounded in the process to make fine powder. This fine powder of *P. juliflora* whole pods (20-25%) was mixed with tumba (*Citrullus colocynthis*), seed cake (15-20%), guar (*Cyamopsis tetragonoloba*), korma (14-19%), til (*Sesamum indicum*), seed cake (10-15%), wheat bran (20%), maize grain (9%), common salt (1%) and mineral mixture (1%), with a spade/ hands and then stored in gunny bags. This balanced cattle feed had 20% crude protein and 73% total digestible nutrients (TDN). The cost for processing this *P. juliflora* pod based cattle feed was ₹17/kg, which was ₹2.75/kg less than the conventional cattle feed available in the market. It could save ₹137.50 for each 50kg bag as compared to the conventional feed. Tremendous acceptance of this technology by stakeholders was due to the fact that this process technology requires minimum labour and energy inputs, and raw ingredients are readily available at livestock owners' doorstep. Shri Vijay Singh reported encouraging results of feeding *P. juliflora* pod based self-processed cattle feed by way of increase in milk yield from 8.1 to 8.6 litres. Moreover, this reduced the cost of concentrate providing a total benefit of ₹7,039/cattle/year. He further told that one of his cows which failed to conceive after repeated attempts had conceived after feeding of this cattle feed. Adoption of this technology by Shri Vijay Singh, and other farmers has opened the doors for its further extension in the arid region.

B K Mathur and **M Patidar**
Division of Livestock Production and Range Management
ICAR-Central Arid Zone Research Institute, Jodhpur
email: bk.mathur@icar.gov.in

Meghalaya's underutilized potential leguminous root crop – 'Soh-phlang'

Flemingia procumbens Roxb. [syn. *Moghania vestita* (Baker) Kuntze] locally called as 'Soh-phlang' belongs to the family Fabaceae. It is an underutilized minor tuber crop domesticated in Indian subcontinent and restricted to its cultivation in Khasi and Jaintia Hills of Meghalaya, Northeast India. It is known to improve soil quality being a leguminous crop. It is a trailing or straggling herbs, stems hirsute, weak or viny, up to 80 cm long, leaves 3-foliolate, petioles 1-3 cm long and hairy.In Soh-phlang edible tuberous roots are consumed by the Khasi and Jaintia tribals after peeling off the outer yellowish skin. Soh-phlang is propagated by tubers mostly in March. It starts flowering from August and tubers mature by November when harvest is started.

Keeping in view the importance of this underutilized tuber crop, a crop specific exploration was undertaken as per National exploration plan 2017-2018. A total 27 accessions of soh-phlang were collected as tubers with two accessions of *Perilla ocimoides* (Perilla- locally known as 'Neileih' in Khasi Hills) during mid of November 2017. The collected tuber varied shape (from round, fusiform, napiform and cylindrical), size (from 3-12 x 2-10 cm), colour of peel (from cream-creamish yellow), peeled tuber thickness (very thin-thick) and tuber texture (juicy-dry), and taste and flavour (nutty flavour with mild sweet- bitter). Farmers were growing this tuber under organic farming practice, without use of pesticides. The total crop duration is 7-8 months; it is grown as rain fed crop mostly in the *jhum* field in raised bed along with other vegetatively propagated crops like taro, ginger potato and turmeric and oilseed crop such as perilla in mixed cropping. In market ready to eat tubers (already peeled) were sold along with *chutney* prepared from roasted perilla seeds along with salt and chilli powder. The tubers were reported for anthelmintic properties mainly for de-worming in young children.

Soh-phlang is grown as a cash crop and sold at ₹100-300 per kg in the market. Farmers are growing the crop after a gap of minimum five years in rotation. After harvest of tubers they are graded to larger size and smaller size tubers and sold in village market; large tubers are sold at higher rates in the Shillong market. The freshly harvested tubers of small size are kept for self consumption and also for storage purpose for next season growing. For long-term storage (4-5 months) they are normally stored inside the pit near the field and dugout until next season. The collected material is being maintained at ICAR-NBPGR, Regional Station, Shillong for further evaluation.

1. Grading of freshly harvested tubers; **2.** Soh-phlang tubers; **3, 4.** Inter-cropping with ginger and taro; **5.** Peeling of outer skin for sale; **6.** Soh-phlang tubers with perilla sold in village market

S Nivedhitha[1*], Subarna Hajong[2], Hammylliende Talang[3], S P Ahlawat[4] and A K Mishra[5]

[1]ICAR-National Bureau of Plant Genetic Resources, New Delhi

[2]ICAR-NBPGR, Regional Station, Umiam, Shillong, Meghalaya

[3]ICAR Research Complex for NEH Region, Umiam, Shillong, Meghalaya, India

email: s.nivedhitha@icar.gov.in

EDITORIAL BOARD

Chairman
Dr T Mohapatra
Secretary, DARE and DG, ICAR

Members
Dr K Alagusundaram, DDG
(Agric. Engg. and Natural Resource Management)

Dr J K Jena, DDG
(Fisheries Science and Animal Science)

Dr N S Rathore, DDG
(Agric Edu)

Dr J S Sandhu, DDG
(Crop Science)

Dr A K Singh, DDG
(Agric. Ext)

Dr A K Singh, DDG
(Horticultural Science)

Member-Secretary
Dr Satendra Kumar Singh, Project Director (DKMA)

Published by Dr Satendra Kumar Singh, Project Director, Directorate of Knowledge Management in Agriculture, Indian Council of Agricultural Research, New Delhi 110 012. *Phone:* 011-25842787; *Fax:* 011-25843285; *e-mail:* director.dkma@icar.gov.in. Lasertypeset by M/s Print-O-World, Shadipur, New Delhi 110 008, and printed in India at M/s Royal Offset Printers, A-89/1, Naraina Industrial Area, Phase I, New Delhi 110 028.

Editing : **Seema Burman** ***Design & Production :*** **Dr V K Bharti and Punit Bhasin**

WAY FORWARD

ADVANCES in technology are a key to the future of agriculture as farmers strive to feed the world with limited natural resources. Agricultural development is largely driven by innovations in the entire value chain of different commodities. The type of innovation that ultimately makes the difference is the extent and intensity on farmers make their choices. Until recently, little attention was given to the farmers-led innovations, including technological, management, and institutional. It is now realized that there are numerous innovations, which yielded higher returns and made farming more economical and sustainable. A number of farm implements were also designed to enhance farm efficiency. It is an irony that the farmers-led innovations could not be popularized due to lack of awareness of other farmers. Also, the intellectual propriety rights on the innovation made by the farmers have often been ignored. It is therefore necessary to develop a platform for farmer-scientist interface to recognize the importance of farmer-led innovations and identify ways to commercialize those. This will require developing an inventory of farmer-led innovations, and validating and refining them by blending those with modern science so that these can be commercialized and out-scaled for sustainable agricultural growth and development.

All farmer-led innovations are not technical, but they have socio-economic and institutional dimensions because farmers operate under constrained and uncertain environment and their livelihood depends on how smart choices they make. Farmers take initiatives at their own capabilities to overcome their problems. Challenged by the ever-changing environmental, policy and market situations, farmers' innovations are a product of their informal experimentation and knowledge handed to them by their forefathers. Financial constraints force them to adopt low cost technologies. Their ability to innovate goes beyond production and improves networking, communication, institution building, information management, marketing, planning, accessing resources etc. in view of improving their agricultural and natural resource management activities.

Diversity requires situation-specific practices. Farmers live and work under a wide range of ecological, climatic, economic and socio-cultural conditions, and the range of farming systems is similarly diverse, not just across regions or countries, but also within districts and even localities. Each farming system has its own dynamics, strengths, challenges and opportunities. Comparatively, research scientists are few and there is no way they can generate the variety of innovations and adaptations required. Therefore, it is desirable to develop location specific technologies. Local adaptation and locally specific development of options need to be key elements in any agricultural research and development strategy. Scientists can spend more time on refining/enhancing farmers' led efforts to

Dr T Mohapatra, Secretary (DARE) and Director General (ICAR)

wider adoption of recommendations to suit local realities. Rapidly changing conditions require local capacities to adapt quickly**.** Innovations are not permanent neither are the conditions for farmers. This applies not only to those who practise agriculture under very diverse, complex and risk-prone conditions, but also to those affected by emergence of new pests and diseases, effects of climate change, and for to who see new opportunities opening up. The key to sustainability in farming lies in farmers' capacity to adapt. Farmers have to adapt more quickly in the present context than in the past. Recognizing farmers' innovation is a step towards encouraging this process and helping farmers find ways to adapt more quickly to ever changing bio-physical and socio-economic environment.

The potential of farmers could not be realized fully because of several challenges: *i)* lack of accommodative attitude of researchers, *ii)* lack of adequate opportunity for farmers to decide on research priorities, *iii)* lack of financial support, *iv)* lack of peers support, and *v)* illiteracy. In addition, researchers' perspectives also create problems. Some researchers are not familiar with the concept of farmer innovation, some find it difficult to use the data scientifically, and others have limited knowledge of the concept. The key ingredients for livelihood improvement are not external inputs but rather labour, knowledge and local management capacities that enable people to manipulate skillfully the local resources for their own benefits. Most rural development efforts have failed to mobilize and enhance these internal inputs.

The recent slogan given by ICAR – "Science with Farmer First" is very appropriate. It is necessary that farmer-led innovations are given due importance and are recognized for out-scaling or for further validation and large scale adoption for improving the livelihood of resource poor farmers.

(T Mohapatra)
e-mail: dg.icar@nic.in