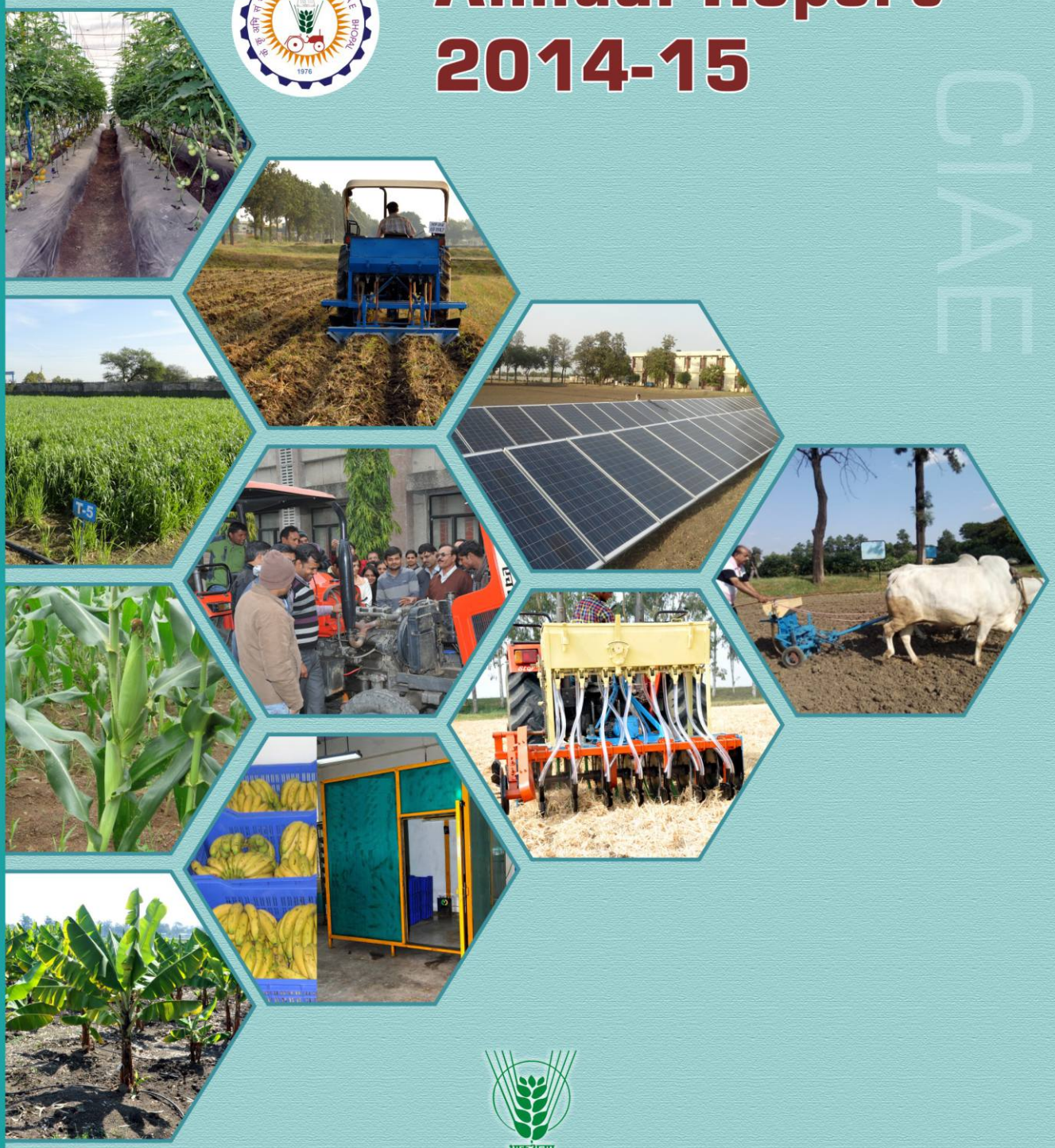
Annual Report 2014-15

CIAE



भाकृअनुप
ICAR

ICAR-Central Institute of Agricultural Engineering

(Indian Council of Agricultural Research)

Nabi Bagh, Berasia Road, Bhopal – 462 038

ANNUAL REPORT
2014-15

ICAR-Central Institute of Agricultural Engineering
Nabi Bagh, Berasia Road, Bhopal - 462 038

CIAE Annual Report
No. CIAE/2014-15/33

ICAR - Central Institute of Agricultural Engineering
Nabi Bagh, Berasia Road, Bhopal - 462 038(MP) India.
Tel. No. : +91-755-2737191, 2521000, 2521001
Fax : +91-755-2734016
E-mail : director@ciae.res.in
Website : www.ciae.nic.in

Published by
Director, CIAE Bhopal

Chief Editor
Agrawal K N

Editors
Badegaonkar Uday R
Gaikwad Bhaskar B
Murugkar Dipika Agrahar
Singh K P
Rao K V R
Singh P L
Singh S P

Photography
Bagde S K
Singh Kalyan

Word Processing
Shankar K

Printed at
Neo Printers
17-B, Industrial Area Govindpura, Bhopal
Phone : +91-755- 6900660

June 2015

Correct citation: Anonymous, Annual Report 2014-15, ICAR-Central Institute of Agricultural Engineering, Bhopal

KISAN CALL CENTRE - 1800-180-1551 (single nation-wide toll free number, accessible through landline as well as mobile numbers of all telecom networks from 6:00 AM to 10:00 PM on all days a week and all 365 days in a year.

PREFACE

The demand for better equipment and technology for promotion of agri-business and commercial agriculture has been continuously rising. The R&D in the field of agricultural engineering, therefore, requires orientation to support not only technological demand of general purpose farm machinery and processing equipment but also for specialized-equipment. The institute is engaged in developing appropriate technologies for enhancing production and productivity while conserving natural resources, reducing drudgery and creating employment opportunities in agriculture and allied sectors. Our research efforts are focused on providing need based solutions for major section of farmers while developing complete package of technology for a particular crop/commodity. During the period 2014-15, the Institute has taken up development of 32 equipment and technologies suitable for production and post-production agriculture.

The Nation has great expectations from this Institute not only in empowering the farmers with the latest technologies but also in attracting educated youth towards entrepreneurship activities in the areas of agricultural engineering. A Post Graduate (PG) Cell has been created at CIAE, Bhopal as Outreach Centre of PG School IARI, New Delhi for carrying out the academic activities in agricultural engineering. Frontline demonstrations at farmers' field and training activities involving users, manufacturers, rural women have enabled variety of stakeholders to improve their performance and their living standard. Commercialization through licensing and business planning activities have helped in faster dissemination of the technology to the end users.

I am indebted to Dr. S. Ayyappan, Secretary, DARE and Director General, ICAR for the encouragement and motivation received from time to time. I am grateful to Dr. K Alagusundaram, Dy. Director General (Engineering) for his invaluable guidance and liberal support for the CIAE programmes. I profusely thank Dr. Kanchan K Singh, Assistant Director General (Farm Engg.) for his kind support to carry out activities presented in this Annual Report. The contribution of Heads of Divisions , Project Coordinators of AICRPs, Scientists, staff of PME Cell and other staff members in the preparation of this report is thankfully acknowledged. Special thanks are due to the editorial team for their efforts in timely preparation of the Annual Report.

Bhopal
June, 2015

KK Singh
Director

CONTENTS

SUMMARY

Salient achievements with regards to development of technologies and processes, transfer of technology and human resource development have been as follows:

Development of new prototypes/gadgets

- A map based variable rate fertilizer application system for applying optimal basal dose of fertilizer.
- An animal drawn 3-row garlic planter with cup type metering mechanism having draft requirement (450 N), field capacity (0.08 ha/h) and operational cost of Rs725/ha.
- A prototype of sugarcane single bud sett cutting machine, operated by 0.75 kW (1 hp) electric motor. Cost of the prototype is Rs 12,000 and capacity is 1500 single bud setts/h of varying length.
- A high capacity chemical treatment plant (suitable for about 20,000 sugarcane budchips and 2000 double set buds) to address incidence of red rot and smut diseases in sugarcane, which could be easily transported to the sugarcane field, making it very convenient for field use.
- A manually guided power weeder operated by 1.34 kW (1.8 hp) petrol engine. The field capacity of the weeder is 0.24 ha/day with 89.7% weeding efficiency and less than 1% plant damage. It gives about 66% saving in cost in comparison to manual weeding using hand hoe.
- An animal drawn garlic digger having a curved digging blade. Average draught requirement of the developed unit has been found to be 683.5 N with 0.1 ha/h field capacity and 86% digging efficiency.
- An instrumented experimental set-up for measurement of torque requirement for cutting grain sorghum stalks to conduct laboratory studies leading to development of sorghum harvester.
- A solar powered cold storage system which facilitates short duration on-farm storage of horticultural crops to maintain their freshness. The solar PV cell based plant (25 kWp capacity) with battery backup powers the 2.5 TR capacity vapour compression refrigeration system. The energy output of the plant ranged from 80-110 kWh/day during November to March, which is sufficient to operate the cold storage unit.
- A hydro pre-cooler (100 kg/batch capacity), which helps in reducing the temperature of fruits/vegetables, before loading them in the cold storage chamber.
- A scrubber for removal of impurities such as CO_2 and H_2S from the biogas. The chemical scrubbing (water with 0.5 M NaOH solution) has been found to be more effective in increasing methane content of biogas from 64.3% to 92.3% as compared to water scrubbing (85%).
- A microprocessor based control system for grate rotation to control oxidation zone temperature during gasification process. Operation of gasifier at lower temperature avoids clinker formation.
- A hot water treatment chamber having capacity

of 20 kg/batch and a ripening chamber of 1 ton/batch capacity for controlled and uniform ripening of banana. The system has been found effective to produce good quality ripened banana with a shelf-life of five days whereas it is three days for the bananas ripened at trader's level.

- Moringa leaf stripper operated by 1.5 kW (2 hp) single phase electric motor. The prototype showed capacity of 300 kg/h with 98% stripping efficiency and negligible damage to the leaves.
- A prototype for preparation of probiotic soy-cheese (10 kg/batch), which consists of SS coagulation tank (50 l) fitted with electric heater, temperature controller, an outlet valve and a filtration unit.

Evaluation and refinement of equipment/ gadgets

- Evaluation of three different seed metering plates viz., vertical rotor, inclined plate and pneumatic metering plate for sowing of kodo, little millet, jute and carrot.
- Calibration of yield monitoring system fitted on combine (CLASS-Crop Tiger 30) for harvesting of wheat, soybean and paddy. The calibration factor was found to be 6.59 for wheat, 5.62 for soybean and 4.60 for paddy.
- Evaluation of a package of animal drawn implements under no tillage, minimum tillage and conventional tillage practices in soybean-wheat and soybean-gram crop rotations. No-tillage practice demonstrated 25% saving in input cost and 10% saving in energy in comparison to conventional tillage.
- Metallurgical improvement in oil palm harvesting knives (medium carbon steel, quenched and tempered) has shown significant improvement in wear resistance over the commercially available blades (Improved - 1.59 and 1.66 g/100 plants, Control- 3.95 g/100 plants).
- Audiometry test of 90 subjects (60 tractor divers and 30 office workers) to assess the hearing impairment of tractor drivers. The mean hearing threshold levels for both ears were found to be higher than 25 dB(A) at 3, 4, 6 & 8 kHz frequencies for tractor drivers with highest values of average estimated excess risk of hearing impairment of 7.0% as against 0.2% for office workers.
- Assessment of farm power availability on Indian farms using secondary data. The study indicated that the average farm power availability in India has reached to about 2.02 kW/ha (2.71 hp/ha) in 2013-14 as against 0.30 kW/ha (0.40 hp/ha) in 1960-61.
- Evaluation of performance of drip irrigation system in rice and wheat under system of crop intensification (SCI). Highest yield (7.06 and 3.47 t/ha) was observed with drip emitters spaced at 20 cm for crop spacing of 25× 25 cm and 30×30 cm for wheat and paddy, respectively.
- Spatial modelling of emitter discharge of drip irrigated field, which revealed that the spherical model fitted well over Linear, Gaussian and Exponential models to describe the spatial variability of emitter discharge. The variability of emitter discharge observed over two years period showed increase in coefficient of variation from 0.17 to 0.36 in consecutive year.
- Evaluation of surface drip in the field conditions to establish fertigation frequency for okra (Var. Syngenta Hy152), and tomato (Var.

S-22 IIHR). The highest yield in tomato (59.6 t/ha) and okra (33.9 t/ha) was found with 1.25 times of recommended dose; 120kg/ha and 100 kg/ha of N fertigation, respectively.

- Study of performance of Mango (Amrapali) and Guava (Lucknow-49) under three irrigation levels (100%, 80%, 60% of recommended level), and two fertigation levels (100%, 75% of recommended doses). Highest yield of 2.71 and 16.45 kg/plant, respectively for mango and guava was observed for 100% irrigation and 100% fertigation combination, thereby validating recommended dose in fertigation method.
- Comparative evaluation of real time soil moisture basis sprinkler irrigation and conventional flood irrigation method. Yield of wheat (Variety: HI1544) under sprinkler irrigation system operated under real time soil moisture basis increased by 14.86% over conventional irrigation method.
- Estimation of wind load acting on structural components of double arch type naturally ventilated greenhouse using finite element analysis. The design wind pressure was estimated to be 772 N/m^2.
- Comparison of plug type nursery and bare root nursery. The performance of both the crops, viz., tomato and capsicum are significantly higher for plug type nursery under polyhouse cultivation.
- Energy audit of a one tonne per hour capacity Dal Mill at Udaipura (Raisen district). The motor with lower utilization factor was considered for replacement with lower size of motor to save electrical energy. The wood used for generating hot air was suggested to be replaced with briquettes produced from crop residues and solar thermal energy.

Value added products and process development

- Briquettes from jute sticks using die and press type briquetting machine (500 kg/h capacity), which could be utilized as fuel for domestic purpose, brick kiln and boilers.
- Composite flour eggless cakes, replaces egg with banana, saturated fat with oil and refined flour with composite flour of wheat (33%), malted finger-millet (41%), sprouted soy (8.5%) and sprouted amaranth (17.5%). The produced cakes have 8.3-12 g protein, 19-22 g fat and 4.7-8.4 mg iron in 100 g of cake and its overall acceptability was 8 on the 9-point hedonic scale.
- Multi-grain laddoos as a tasty and nutritive snack for children. Made from a combination of cereals, millets, legumes, fruits, dairy whitener and oilseeds with jaggery as binding agent. Each 100g of Multi-grain laddoos contained 25 g protein, 30 g fat, 11 mg iron, 123 mg phenolics, 63% RSA anti-oxidants and 7 mg QE flavonoids as against 10 g protein, 30 g fat and 3 mg iron, 65 mg phenolics, 30 % RSA anti-oxidants and 5 mg QE of flavonoids in wheat flour control laddoo.
- Baked multigrain tortilla chips made from a mix of corn, wheat, rice and sorghum (plain-P and nixtamalized-N-soaked, cooked in an alkaline solution and milled), soybean and green-gram (sprouted and unsprouted), skimmed milk powder. The overall acceptability was observed to be 8.6 on 9-point hedonic scale. The product has higher protein and calcium and lower fat compared to plain corn tortillas.

- Soy fortified extruded snacks using rice flour (20-25%), corn flour (20-25%), wheat flour (10-15%), defatted soy flour (DFSF) (5-10%), fruit (3-5%) and vegetable powder (3-5%), soy protein isolate (3-5%) and dairy whiteners (5-10%). The protein content of soy fortified snack products varied from 15-21%. Storage study indicated that packaging in PET/PET met/LDPE could maintain product quality for six months.
- Disinfestation of green-gram and chickpea using continuous pilot-scale microwave-cum-hot air heating system. No adult emergence of *C. maculatus* was observed in grain samples after exposing to 2900 W, 2450 MHz micro-wave radiation and hot air at 60^{o}C for 6 min and storing at 9.5% moisture content (wb).
- A pre-treatment protocol (treatment with KMS (0.2%) and combination of KMS (0.1%) + AA (0.1%)) for banana. It helps in reduction of oxidation process of banana core to preserve colour, sensory characteristics (5-point hedonic scale), odour, protein, potassium, magnesium, sodium, calcium till 6 days of storage in polyethylene bags of 100 microns thickness.

Software development

- A web portal for agricultural engineering technologies on Institute website (www.ciae.nic.in), which serves the user friendly retrieval of information about commercialized and ready to be commercialized agricultural machines.
- Software is now available for semi-supervised image analysis of rice panicle to objectively measure some of its traits. A dynamic web database of authentic plant part images of rice, chickpea, okra and mustard is available at http://cropcorpus.ciae.res.in.

Technology transfer activities

- Licensing of self-propelled multipurpose hydraulic system for orchard operations to M/s TAFE (Tractor and Farm Equipment), Chennai, one of the leading multinational company to manufacture and market the technology, at a cost of Rs. 10.00 lakhs.
- Licensing of CIAE-Millet mill for the dehulling of important small millets like kodo, kutki to three firms at a cost of Rs. 1.00 lakh each.
- Licencing of soy-butter technology to a food industry of Central India, M/s Bio Nutrients (India) Pvt. Ltd., Bhopal, at a cost of Rs. 1.00 lakh.
- Manufacturing and supply of 4562 units of different prototypes worth Rs. 61.73 lakhs to various stakeholders.
- Manufacturing and supply of eighteen animal drawn inclined plate planters to Central Institute of Cotton Research, Nagpur for onward supply to six African countries.
- One International training programme for African-Asian Nations (9 foreigners), two Winter Schools (38 participants), two Model Training Courses sponsored by DOAC (33 participants), eight training programmes on entrepreneurship development on custom hiring and post-harvest technologies (229 participants) sponsored by Govt. of MP.
- Twelve training programmes on production of soy milk and paneer (119 participants) and four training programmes on preparation of soy based other products (64 participants).

- Three training programmes of one month duration benefiting 164 students from agricultural engineering colleges.
- Overall 1300 subject matter specialists, govt. officers, extension workers, rural women, rural youths, students, farmers, anganwadi workers etc. were imparted training through different programmes organized at the Institute and its extension centre at Coimbatore, TN.
- Organization of Krishi Parivartan Mela at CIAE on May 15, 2014 as part of the Krishi Parivartan Yatra conducted by NAIP to publicize the success of its 30 most successful projects. BPD-CIAE team was felicitated during Agri Innovation Conclave of NAIP held at NASC, New Delhi for excellent conduct of Krishi Parivartan Mela at CIAE.
- Display and demonstration of Institute technologies in 31 International, National and Regional level exhibitions/farmers' fair and trade fairs at different places all across the country.
- Distribution and demonstration of 631 units of improved tools and equipment to the women beneficiaries for long term use in two adopted villages Dhamarra and Kachhi-berkheda. The drudgery reduction in different farm operations performed by women ranged from 22 to 47%.
- Establishment of a farm machinery bank at Gaildubba, District Sheopur (MP) and three millet processing centres in Erode and Coimbatore (TN) and Chhindwara (MP) under Tribal Sub Plan (TSP) activities of Institute for tribal area development.
- Award of two copy rights to the institute by Dy. Registrar of Copy Right, New Delhi
- Filing of two patent applications.

Other achievements

- **Publications:** Institute scientist(s) published 65 research papers in national and international journals. Apart from those 7 books, 9 book chapters, 38 popular articles, 18 technical bulletins and 44 papers in symposium/ conference/ workshop were published.
- **Awards & Recognition:** Five scientists of the institute received national awards; one scientist was selected as fellow of Institution of Engineers. Four scientists received best paper award for poster presentation during various national and international seminars.
- **Meetings & Workshops:** RAC, IMC, NAAS silver jubilee workshop, Krishi Parivaratan Yatra, Rashtriya Sanghoshti, Swachch Bharat Abhiyan, SAC of KVK, Hindi week, World Food Day, International Women's Day, National Science Day, Farm Innovator's Day and Foundation Day.

INTRODUCTION

ICAR- Central Institute of Agricultural Engineering (CIAE), Bhopal is the premier Agricultural Engineering Institute in India devoted for expansion of agricultural mechanization and thereby enhancing agricultural productivity; reducing drudgery of agricultural workers; minimizing post-harvest losses, increasing processing of farm produce, on-farm energy and water management and creating employment and income generation opportunities in the rural sector.

The CIAE Bhopal was established on 15th February, 1976. The activities of the Institute have been further strengthened during subsequent periods through creation of new AICRPs, their centers and KVK. Various activities of the Institute are organized through five Divisions (Agricultural Mechanization, Agricultural Energy and Power, Irrigation & Drainage Engineering, Agro Produce Processing and Technology Transfer); four AICRP Centres (Farm Implements & Machinery, Utilization of Animal Energy, Energy in Agriculture & Agro Industries and Ergonomics & Safety in Agriculture); and a Krishi Vigyan Kendra and an outreach Industrial Extension Project at Coimbatore.

The mandates of CIAE are

- To undertake adaptive, applied and basic research leading to development / improvement of equipment, technology, process for production, post-harvest technology and processing and energy-use in agriculture and rural industries.
- To develop hardware and technology in co-operation with other ICAR Institutes in the area of crops, horticulture, aquaculture and animal husbandry for production and processing.
- To provide leadership and co-ordinate network of research with state agricultural universities for generating location-specific technology and value addition.
- To provide input to ICAR for policy intervention with respect to agricultural mechanization, energy management in agriculture, irrigation and drainage and post-harvest management.
- To provide consultancy and undertake sponsored research for agriculture machinery, industry and other organizations.
- To act as a repository of information on agricultural engineering.
- To act as a centre for training in research methodologies and technology and conduct graduate, post graduate and doctoral research programme.
- To collaborate with relevant national and international agencies in achieving the above objectives.

The Institute has a sanctioned strength of 423 personnel with 90 scientists belonging to the disciplines of agricultural engineering, agronomy, biochemistry, microbiology, food technology, mechanical engineering, electronics and instrumentation, computer application, statistics and economics.

The Institute has 93.85 ha farm area with six open wells, eight tube wells and four farm ponds; all well

connected through underground irrigation grid to irrigate 21 ha of cropped area and 15 ha of guava, mango, amla and ber orchards. A weather station is also there to automatically record and store meteorological data.

The infrastructure created at the Institute is ample to facilitate various research and development activities. The research workshop provides the facilities for fabrication of research prototypes and the prototype production centre for multiplication of prototypes for pilot introduction; CAD cell and AKMU help in computer applications in designing of research prototypes and database creation; instrumentation cell gives support in various research projects and Audio-Visual Unit supports research and extension. The institute has a modern library equipped with computerized cataloguing facility, more than 17000 books and bound journals and a large collection of CD ROMs on journals in agricultural engineering and related disciplines. The library subscribes to more than 125 Indian and foreign journals and provides e-subscription of some journals to the users.

The Institute also has well-furnished hostel and guest house facilities to accommodate 80 guests. The International Training Centre of the Institute has facilities for conducting International meetings and training programmes in excellent ambience.

The Industrial Extension Project of CIAE at Coimbatore addresses the mechanization issues of southern states of the country. It has adequate infrastructure for R&D and liaisioning with industries in the field of agricultural engineering. The Krishi Vigyan Kendra for Bhopal district is also located at CIAE and it is working for the rural population in order to disseminate the technology through vocational training of farmers, rural youths and women and front line demonstrations in the surrounding villages.

CIAE is linked with all the regions of the country through All India Coordinated Research Projects to address region specific technological issues. The network of AICRPs helps in identification of specific regional problems needing engineering intervention. These problems are then attended through expertise available at CIAE or other partner Institutes.

BUDGET (Rs. in Lakh)

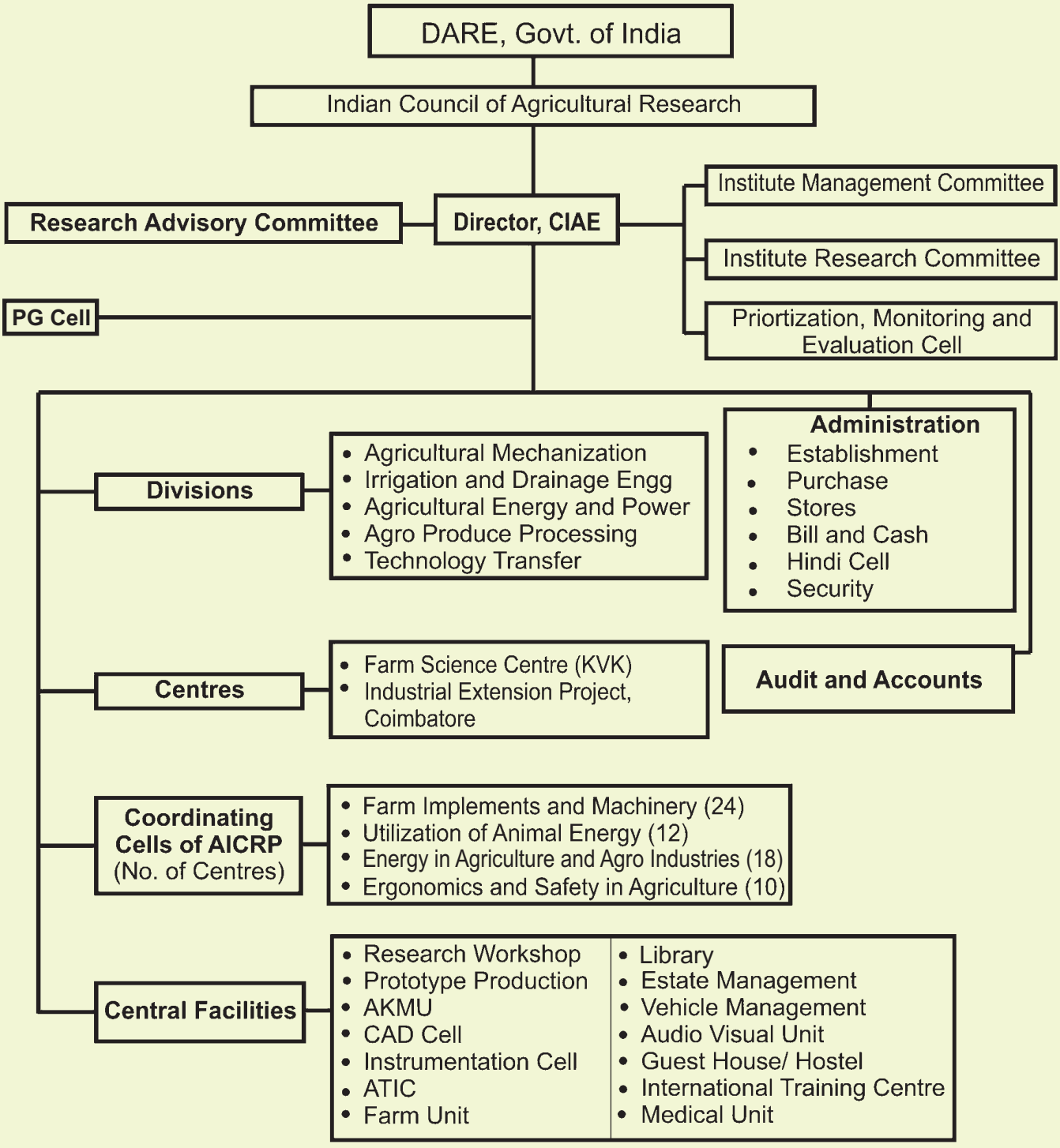
Head	Sanctioned	Expenditure
Plan	413.00	412.59
Non Plan	3748.00	3728.68

CIAE generated financial resources of Rs.172.8 lakh against target of Rs.170.0 lakh during 2014-15.

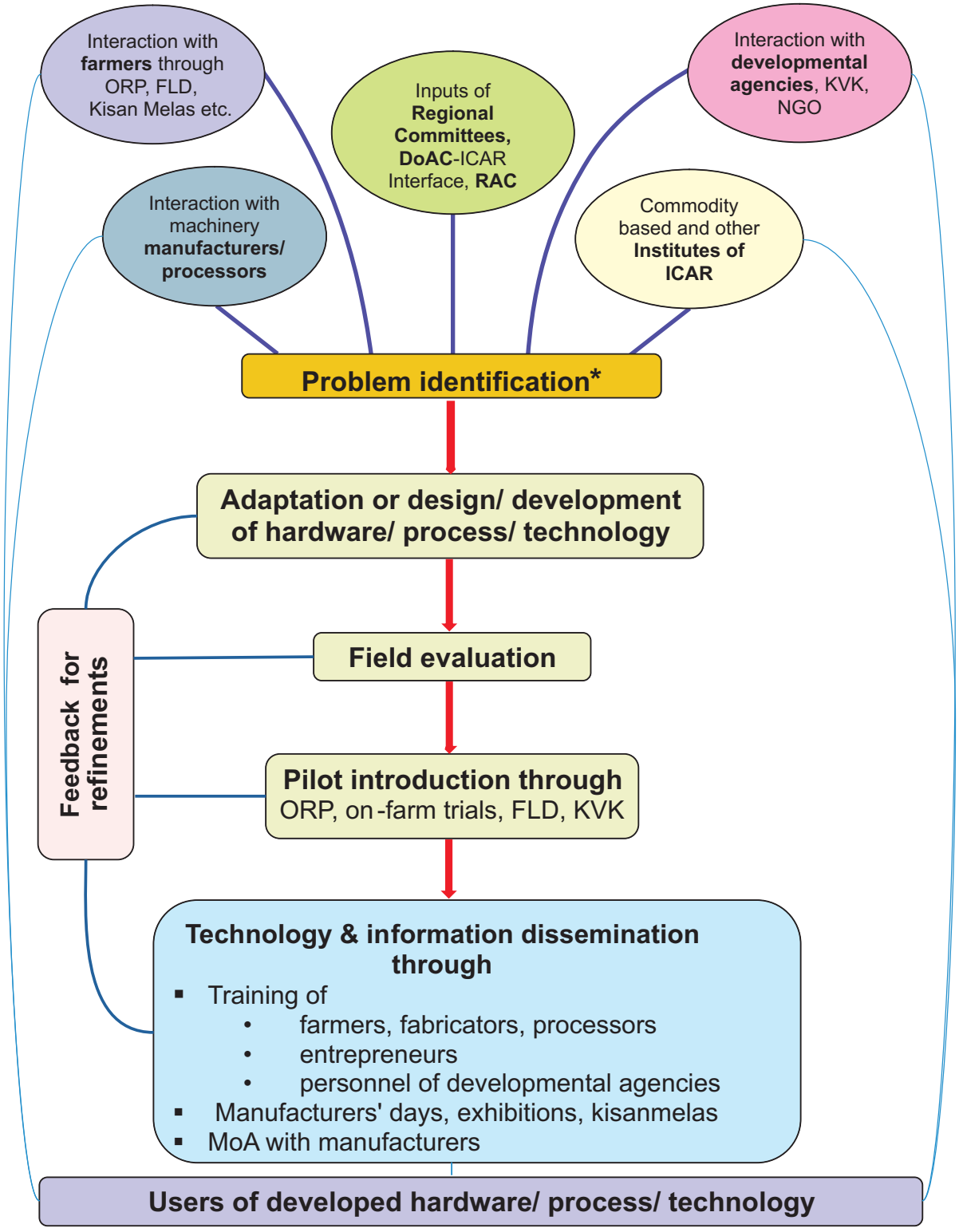
MANPOWER

Particulars	Sanctioned	Filled	Vacant
RMP	1	1	-
Scientific	90	61	29
Technical	171	135	36
Administrative	74	65	09
Supporting	87	62	25
Total	423	324	99

ORGANIZATIONAL STRUCTURE



Technology Development Process of CIAE

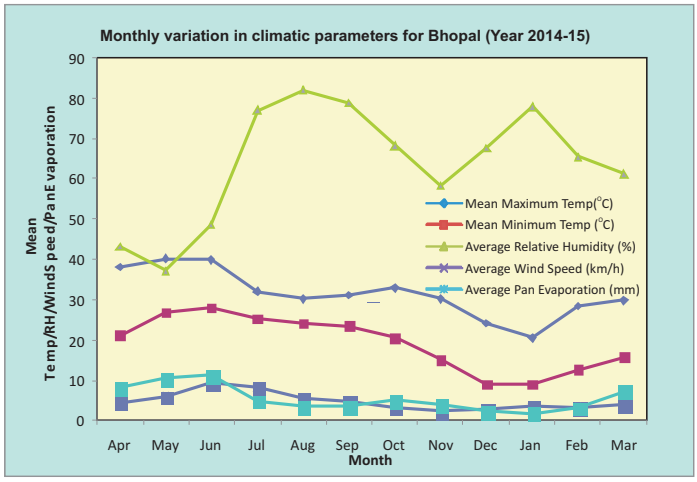


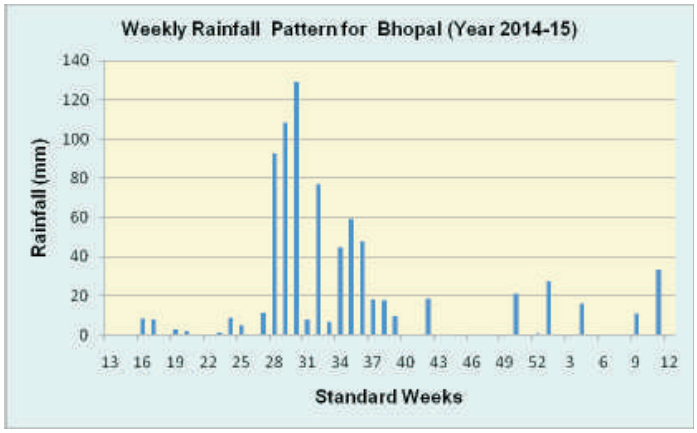
**For simplicity, involvement of farmers and other stakeholders, in other stages, has not been shown*

METEOROLOGICAL OBSERVATIONS

Agro meteorological station of the institute is located at 77°25' E longitude and 23°16' N latitude at an elevation of 498.7 m above mean sea level. Rainfall, minimum and maximum temperatures, relative humidity, pan evaporation, bright sunshine hours and wind velocity are recorded on regular basis. Salient meteorological observations for 2014-15 are:

- Monsoon started on June 12, 2014 and withdrew on October 19, 2014. The total monsoon season rainfall was 668.8.0 mm. The heaviest rainfall of the season (44.8.0 mm) was recorded on July 16 , 2014. Annual rainfall of 792.1 mm occurred in 58 rainy days during the year 2014.
- The maximum temperature of the year (45.5°C) was recorded on June 7, 2014 while minimum temperature (3.2°C) was recorded on January 18, 2015.
- The highest average wind velocity of 13.8 km/h was recorded on June 24,2014 while the lowest was 1.1 km/h on January 7, 2015.
- The highest pan evaporation of 17.8 mm/day was recorded on May 31, 2014 while the lowest was 1.6 mm/day on July 24, 2014 and August 7, 2014.
- The highest bright sunshine hours of 11.8 hour/day was recorded on June 1, 2014.





AGRICULTURAL MECHANIZATION

GPS based variable rate granular fertilizer applicator for basal dose application

The GPS based variable rate fertilizer applicator (Fig.1) applies optimal basal dose of fertilizer, according to nutrition requirement of the soil at various spots in a given field. The complete system consists of micro-controller, GPS, displacement position sensor, laptop, seed-cum-fertilizer drill, 12 V DC motor and 12V, 42 AH battery. The Graphical User Interface (GUI) and algorithm to change fertilizer application rate based on crop yield goal has been developed using MATLAB software, for major crops of central India. The developed program has four modules for; experimental soil nutrient entry, crop yield goal based nutrient recommendation, decision making about weight and fertilizer transfer.

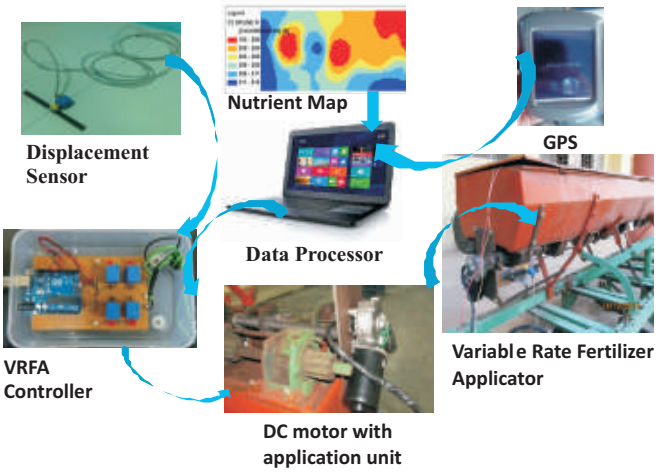


Fig. 1: GPS based variable rate granular fertilizer application system

Animal drawn 3-row garlic planter

Draft animal power (DAP) based mechanization for garlic sowing and digging has been introduced by developing animal drawn planter and digger matching to draftability of Malvi and local breed of bullocks. An animal drawn 3-row garlic planter (Fig.2) with cup type metering mechanism has been developed for precise placement of garlic cloves and maintaining the optimum plant population. Thinning operation, which is essentially required in traditional sowing because of very high seed rate, can be completely eliminated with the help of newly developed unit. It facilitates fertilizer application simultaneously with garlic sowing. During field testing, the draught requirement of planter was found to be 450 N. Field capacity was observed to be 0.08 ha/h. The seed damage was found in the range of 2-4% and operational cost was estimated to be Rs 725/ha.

Fig.2: Animal Drawn 3-row garlic planter

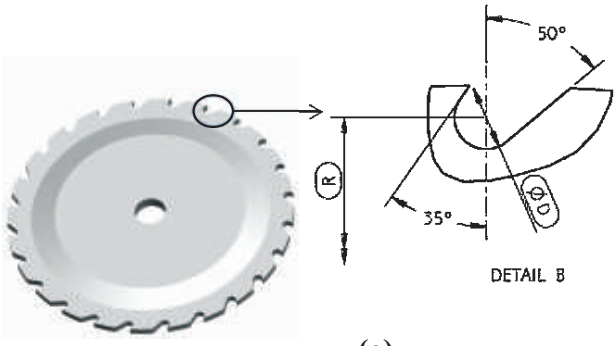
Animal drawn garlic digger

Existing CIAE groundnut digger was modified and made suitable for garlic digging. The animal drawn garlic digger (Fig. 3) with curved blade provides field capacity, digging efficiency and average draft of 0.1ha/h, 86% and 683.50 N, respectively. The newly developed animal drawn garlic digger saved 75% cost and 44.8% energy as compared to traditional method.

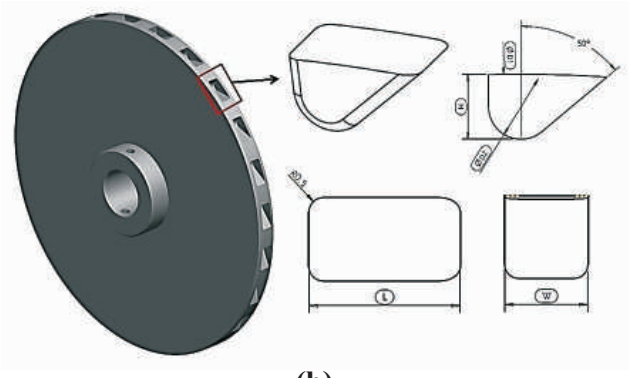
Fig. 3: Animal drawn garlic digger

Metering mechanism for small seeds

Sowing of small seeds like kodo, little millet, jute and carrot is done manually at the farmers' level due to non-availability of suitable seeders or planters. In order to take up development of seeder/planter for these seeds, seed metering mechanisms *viz*., vertical rotor, inclined plate and pneumatic metering plate were tested for laboratory sowing of kodo, little millet, jute and carrot using sticky belt experimental set-up. Different indices viz., multiple index, quality of feed index, miss index, precision index, coefficient of uniformity, seed damage percentage, seed rate and average seed to seed spacing were measured and calculated using MATLAB software and on the basis of these performance parameters, cell/orifice size suitable for each metering mechanism was optimized. The metering plate dimensions were optimized as R× D: 2.5×3mm and 3×3mm for inclined plate (Fig. 4a) and L × W:3×3 mm and 4×3mm for vertical rotor (Fig. 4b). For pneumatic planting, 0.8 mm diameter orifice size in pneumatic metering plate and suction pressure of 2 kPa was found suitable for selected seeds.



(a)



(b)

Fig. 4 Seed metering mechanisms (a) Inclined plate, (b) Vertical rotor

Single bud sett cutting machine for sugarcane

The sugarcane single bud sett cutting machine (Fig 5) has two circular blades made of high carbon steel, which rotates at a speed of 2800 rpm. A spacer is provided between the two blades, which facilitate variation in the size of single bud sett as per the requirement. Cutting of 1500 single bud can be achieved in an hour with the help of developed unit. The machine can be operated by 0.75 kW (1 hp) electric motor and its cost is Rs 12,000.

Fig. 5: Sugarcane single bud sett cutter

Mechanized system for sugarcane budsett/ bud chip treatment

A high capacity chemical treatment plant (suitable for about 20,000 sugarcane bud chips and 2000 double sett buds) has been developed (Fig. 6). The chemical treatment of sugarcane setts/buds before planting addresses the issue of red rot and smut disease management. Use of this equipment reduces the soaking time by almost 90% and allows more effective penetration of the chemical into the sugarcane setts / buds. Since the same chemical can be reused, it results in 80-85% saving in chemical, thus making the system environmental friendly too. The scaled up model is very convenient for on site use as it could be hitched to the tractor and transported to the sugarcane field. About 650 varieties of sugarcane have been pre-treated using the equipment and planted at ICAR- Sugarcane Breeding Institute, Coimbatore for further evaluation.

Fig. 6: Chemical treatment plant for sugarcane sett/bud treatment

Manually guided power weeder

Manually-guided power weeder (Fig. 7) for narrow spaced field crops consists of 1.34 kW (1.8 hp) petrol engine, drive shaft, handle with integral throttle trigger, gear head and weeding assembly. The weeding assembly contains set of two circular discs with four numbers of weeding tynes fixed on each disc, radially at equal distance along the disc circumference. The tynes are made of 5 mm thick mild steel flat. The field capacity of the weeder was observed to be 0.24 ha/day and weeding efficiency as 89.7%, while the plant damage is less than 1%. It gives about 66% saving in cost of weeding in comparison to manual weeding with hand hoe.

Fig. 7: Manually guided power weeder

Cutting mechanism for grain sorghum stalk

An experimental set-up has been developed (Fig. 8) for measurement of torque requirement for cutting grain sorghum stalks. It consists of plant holder, plant guide, cutting blade and torque transducer and the entire set-up has been mounted on the soil bin set-up so as to allow testing under simulated conditions.

Fig. 8: Setup for torque measurement

Three different types of blades; serrated, plain and circular saw, each of 220 mm diameters were tested in the range of 600-900 rpm for cutting grain sorghum stalks firmly planted in the soil bin as shown in figure 8. The varieties tested were Dagadi (Rabi variety) and MLSH-296 (Kharif variety). Preliminary trials demonstrated smooth cutting and lower cutting torque (2-15 Nm) for circular saw type blade.

Harvesting knife for oil palm

Metallurgical upgradation of palm harvesting blades was carried out to improve their service life. Based on material characterization results, medium carbon steel containing 0.54 C, 0.23 S, 0.69 Mn, 0.01 P and 0.008% S was selected for making oil palm harvesting knives. The heat-treatment of blades carried out at Indo-German Tool Room Indore comprised austenizing at 860 ^{0}C, tempering at different temperatures ranging from 250-550^{0}C and quenching in oil for obtaining different combination of mechanical and tribological properties. Field experiments showed that oil palm harvesting knives, quenched and tempered at 250 and 300 ^{0}C demonstrated the minimum wear rate of 1.59 and 1.67 g/100 trees, respectively which was significantly lower than that of control treatment (3.95 g/100 trees). This study has indicated that the oil palm harvesting knives should be tempered in the range of 250-300^{0}C after austenizing and quenching, for service life enhancement.

Evaluation of yield monitoring system for soybean -wheat cropping system

The yield monitoring system fitted on Crop Tiger 30 (CLASS) combine was calibrated for wheat, soybean and paddy harvesting for creating yield variability maps. The calibration factor was found to be 6.59 for wheat, 5.62 for soybean and 4.60 for paddy. Yield maps were created for 11 field plots of the institute farm for wheat harvesting during the year 2013 and 2014. Yield data of all the field plots were classified in five yield groups. Yield legend shows that about 63.9% area falls in 3910-4950

(a)

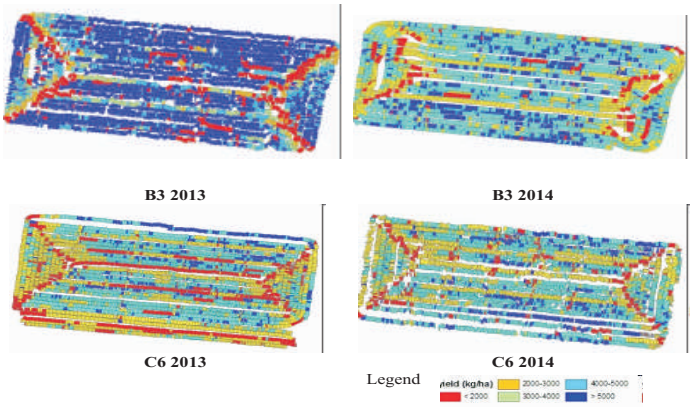


Fig. 9: (a) Combine harvester fitted with yield monitor (b) Yield maps of wheat crop in institute plots during 2013 and 2014

kg/ha yield group and 24% area is occupied by 2840-3910 kg/ha range. Similarly, the yield maps were created for soybean as well for 4 plots. Soybean yield was found to be low due to high rainfall and ranged between 311-842 kg/ha during the year 2013.

Zero-till drill with straw handling mechanism for sowing under heavy residue conditions

The major problem in no-tillage sowing is the high amount of residue of previous crop. Straw in the field often builds up in front of the tines of drill, and eventually blocks the tine and frame, causing long delays, uneven seeding rate and depth and a patchy stand of plants. Considering the above problems, a new prototype has been developed on the basis of soil bin studies. Soil-bin trials conducted during previous year showed straw cutting to be improving considerably with plain disc (98-99.5%) in comparison to serrated disc and notched disc. A prototype containing seven plain discs, powered through pto, was designed and fabricated (Fig. 10a & b). During field operation, the machine was found to be compatible with 35 hp tractor, as no overloading was observed. Based on the results of testing, further modifications and trial of the prototype are continuing.

Fig. 10a: Zero-till drill with straw handling mechanism

Fig. 10b: Testing under heavy residue conditions

Animal drawn implements for conservation agriculture under soybean-wheat and soybean-gram crop rotation

A package of animal drawn implements under no tillage, minimum tillage and conventional tillage practices has been put under evaluation for three years in soybean-wheat and soybean-gram crop rotations. In no tillage practice, seed drill with inverted-T type furrow opener was used in wheat harvested field. In minimum tillage, one pass of animal drawn *bakkhar* was carried out before sowing and in conventional practice one pass of bakkhar in summer followed by two passes before sowing. During first year, the soybean yield was found as 440, 480 and 530 kg/ha with no-till, minimum till and conventional till, respectively. Savings in input cost and energy were found as 25 and 10%, respectively under no-tillage practice as compared to conventional tillage.

Assessment of hearing impairment of tractor drivers

Audiometry of 90 subjects (60 tractor divers and 30 office workers) was performed using a portable audiometer. The mean age and driving experience of the tractor drivers were 39.9 (± 9.7) years and 16.2 (± 8.4) years respectively and that for office workers i.e. control, it was 40.1 (± 10.9) years and no tractor

driving experience. Audiometric measurements carried out at ten different frequencies of 0.125, 0.25, 0.5, 1, 1.5, 2, 3, 4, 6 and 8 kHz had mean hearing threshold levels for both ears, higher than 25 dB(A) at 3, 4, 6 & 8 kHz frequencies for tractor drivers. However, for office workers it did not exceed 25 dB(A) (Fig. 11a & b). There was a significant ($p < 0.001$) difference in auditory threshold values of office workers and tractor drivers at all the frequencies for both ears. Also, average hearing threshold levels were found to be increasing with increasing age group and driving experience of tractor drivers. Personal protective devices such as ear plugs and ear muffs are generally recommended to reduce the hearing loss while operating tractor in fields. The highest values of average estimated excess risk of hearing impairment were 0.2% and 7.0%, respectively for office workers and tractor drivers, with different model equations.

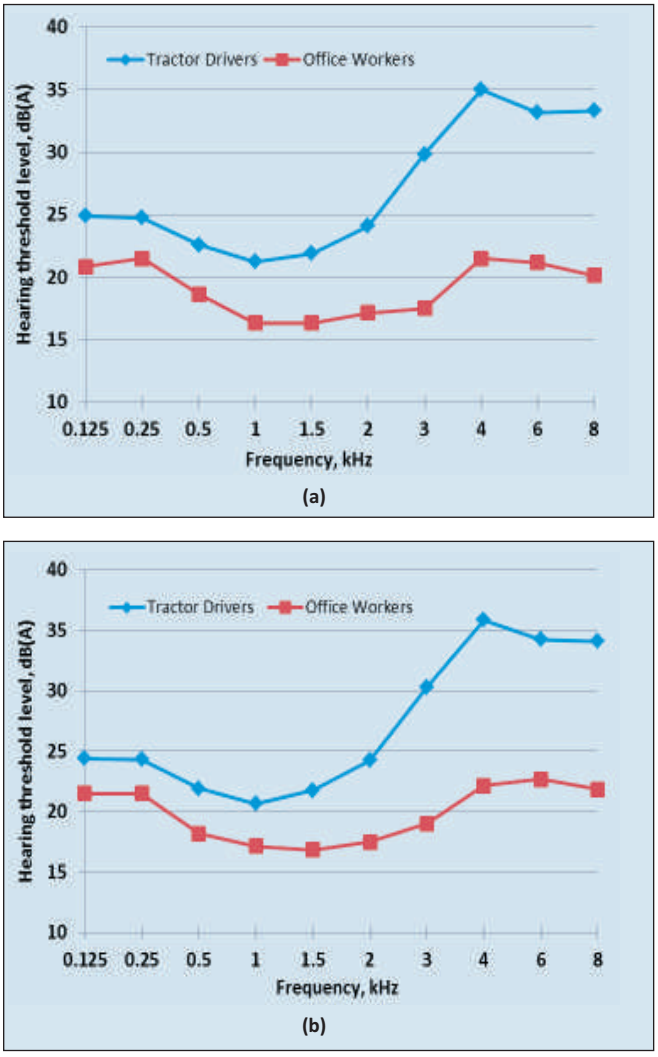


Fig. 11: Hearing threshold levels of (a) left ear of the subjects, (b) right ear of the subjects

Assessment of farm power availability on indian farms

Farm power availability on Indian farms was assessed using secondary data. The average farm power availability in India has increased from 0.30 kW/ha in 1960-61 to 2.02 kW/ha in 2013-14. Over the years the shift has been towards the use of mechanical and electrical sources of power, while in 1960-61 about 92.30% farm power was contributed by animate sources. In 2013-14 the contribution of animate sources of power reduced to about 11.80% and that of mechanical and electrical sources of power increased from 7.70% (1960-61) to 88.20% (2013-14).

Material and parts standardization of inclined plate planter

The structural components of bullock and tractor drawn inclined plate planter were modified for ease of manufacturing. Furrow openers were mounted on the square frame with standard U clamp. In metering system, the seed drive plate and its drive shaft bracket was made by casting instead of conventional machining and welding. The EN 47 grade case hardened gear set (12×12 teeth) were used. For frictionless rotation of seed plate, the Bakelite support plate was provided. The lifting fork, main drive shaft support and seed box shutter were modified and nylon transport wheel was adopted in bullock drawn planter for ease of manufacturing.

AGRICULTURAL ENERGY AND POWER

Solar PV based vapour compression refrigeration system

A cold storage facility for storage of fresh horticultural produce, powered by solar photovoltaic (25 kW_p capacity) with battery backup (240 V, 900AH capacity) has been developed and installed (Fig. 12 a & b). The power conditioning unit of the solar power plant converts DC power into three phase, 415-420 V, AC power. The puff insulated walk-in type cold storage chamber (LxBxH, m: 5x4.4x3) was constructed and fitted with a vapour compression refrigeration system (2.5 TR capacity) and a humidifier (Fig. 13 a & b). The racks were provided in the cold storage chamber to hold fruits/ vegetables. Cold storage room was fitted with temperature and relative humidity indicator-cum-controllers to set the room temperature (5-25°C) and relative humidity (65-95%) for storage of the horticultural produce. The energy output from the solar power plant ranged from 80-110 kWh/day during November to March, which was sufficient to operate the cold storage unit.

(a)

(b)

Fig. 12: Solar PV power plant (a) Panels (b) Power conditioning unit and battery bank

(a)

(b)

Fig. 13: Walk-in-type cold storage room (a) Outside view (b) Inside view

Pre-cooler for fruits and vegetables

The hydro pre-cooler (100 kg/batch) was developed for cooling fruits and vegetables (Fig. 14). It consists of an insulated water tank (LxBxH, m: 0.82x1.6x1.0), evaporative cooling tower with 0.37 kW motor and 0.45 m diameter axial fan, inclined trough for holding products submerged in the tank, belt conveyer and surface moisture drying unit. A pump (0.37 kW motor) was used to recirculate the cold water from evaporative cooling tower to the water tank. Surface moisture drying unit is fitted with an axial fan (0.45 m diameter) below the perforated tray (2 m^2) to blow the fresh air into the produce.

Fig. 14: Hydro pre-cooler for fruits and vegetables

Scrubbing of biogas for removal of impurities

A water scrubber (Fig. 15) was developed to remove impurities present in the biogas such as CO_2 and H_2S. The water scrubber consists of a scrubbing tower (HxD, m: 1.25x0.50), water/chemical solution collecting tank (HxD, m: 0.60x0.79), spraying nozzle and piston pump (2.2 kW and 720l/h capacity). An aqueous solution of NaOH at different molarities (0.1 to 0.5 M) was sprayed into the scrubbing tower. Biogas was supplied into the scrubber from the bottom using a compressor. For

Fig. 15: Biogas purification system

every cubic metre of biogas 14 ℓ of chemical solution was used. The chemical scrubbing was found more effective in increasing methane content of biogas from 64.3% to 92.3% (with 0.5 M NaOH solution) as compared to water scrubbing (85%). Total time required to scrub the 3m^3 biogas was 18 min.

Microprocessor controlled system for grate rotation

A microprocessor based system controls grate rotation to maintain temperature generated in oxidation zone during gasification process. The controller module has provision to set the oxidation temperature, pressure and time interval in which the relay operates. The rotation of grate at an interval of 2 and 4 min facilitated removal of ash accumulated over the grate. The temperature variation was observed in the range of 1140-1150°C in the oxidation zone and 748-753°C at 100 mm above oxidation zone. The study indicated that the microprocessor control system maintains the operation of gasifier lower than the set value for more than 72% time of operation. The operation of gasifier at lower temperature avoids clinker formation.

Briquetting of jute sticks

Jute stick contains higher lignin (18.2%) and lower ash (1.7%), making it suitable for briquetting. The jute sticks were ground below 2 mm particle size to produce the briquettes (Fig. 16) using die and press type briquetting machine (500 kg/h) with tapered die of 60 mm diameter. The true density and moisture content of the briquettes were 900-950 kg/m^3 and 6.2% (wb), respectively. The calorific value of the briquette was 18.6 MJ/kg.

Fig. 16: Briquette produced from jute stick

Energy auditing of a Dal mill

The energy auditing of a Dal mill (1 t/h), in Raisen district has been conducted. It has been observed that in the process of dal making electrical and thermal energy is used. Electrical energy is used for operating motors and thermal energy for drying operation. Dal mill has five electrical motors of 5.5-15 kW capacity. The electrical energy use was measured with help of clamp on power meter. Power factor for operation of different motors has been found in the range of 0.9-1.0. The motor of 11.25 kW capacity has been suggested to be replaced with 7.5 kW motor to improve utilization factor from 67 to 71%. The replacement of motor can save 1200 kWh/year, worth Rs 7,200/year with payback period of three years. Sixty four tonne of wood is being used annually by this Dal mill for drying purpose, which can be replaced with biomass briquettes. The replacement of wood with briquettes would save Rs. 73,000/- annually apart from reducing deforestation.

IRRIGATION AND DRAINAGE ENGINEERING

Evaluation of drip irrigation system in wheat crop under system of crop intensification (SCI)

A rainfed wheat variety *"Sujata"* was selected for evaluation of its performance under system of crop intensification using drip irrigation system (Fig. 17). Five treatments were considered in the study. T1: the conventional wheat cultivation practice (22.5 × 5 cm), T2: System of wheat intensification (25× 25 cm), T3: SCI with drippers spaced at 20 cm for 25 × 25 cm crop spacing, T4: SCI with drippers spaced at 30 cm for 25 × 25 cm crop spacing, T5: SCI with drippers spaced at 40 cm for 25 × 25 cm crop spacing. The crop performance was evaluated in terms of yield, water and energy productivity for these treatments. The study indicated that T3, gave highest yield (3.47 t/ha), water productivity (1.34 kg/m^3) and energy productivity (6.45 kg/kWh).

Fig. 17: Wheat crop under system of crop intensification

Evaluation of drip irrigation system in rice under system of crop intensification (SCI)

In order to establish the findings of the previous year, experiment was continued for the second year (Fig. 18). Experiment was planned with five treatments viz., T1: Conventional practice of paddy cultivation under ponding conditions, T2: System of rice intensification (SRI) with alternate wetting and drying, T3: SCI with drip emitters spaced at 20 cm, T4: SCI with emitters spaced at 30 cm and T5: SCI with drip emitters spaced at 40 cm. The crop transplanting practices of SRI were adopted in case of T3, T4 and T5 treatments. The maximum plant height (0.76 m) and root length (0.18m) were recorded under SCI with drip irrigation at 20 cm spacing (T3). Yield and yield attributes *viz:* productive tillers/m^2 (266), number of grains per panicle (162), average panicle length (0.28 m), average panicle weight (3.41 g), average grain yield (7.06 t/ha) and harvest index (61.93) were significantly higher in T3 as compared to conventional practices (T1). Superior performance of T3 treatment in terms of water productivity and water-energy productivity was also observed. Among the drip irrigated treatments there was no significant difference in grain yield among T3 and T4 treatments, indicating the drippers spaced at 30 cm could be recommended due to relatively lower cost.

Fig. 18: Rice crop under system of crop intensification

Performance of bare root and plug type nursery under open field and covered cultivation

The performance of tomato and capsicum crop (nursery raised by bare root method and protray)

was evaluated in open field and under poly house conditions (Fig.19). Seedlings of tomato (*Heemsohna*) and capsicum crop (*Swarna*) variety were raised on bare soil and in protray using soil less media. The seedlings were transplanted on the same day in open field and in poly houses. Three treatments viz. T1: Bare root seedlings, transplanted in open field; T2: Plug type nursery seedlings transplanted in open field; T3: Plug type nursery seedlings in polyhouse were studied. In all the treatments drip irrigation system was adopted along with same fertigation schedule. The performance of tomato and capsicum (Table 1) crops in different treatments indicated that the seedlings raised under plug type nursery performed better in open field as compared to seedlings raised with bare root nursery.

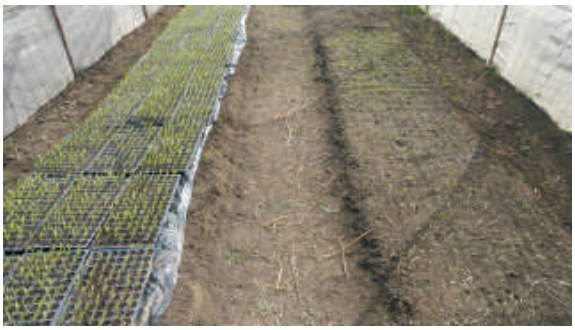


Fig. 19: Seedlings of bare root (R) and plug nursery (L)

Table 1: Performance of tomato and capsicum crop in different treatments

Treatment	Average no. of fruits per plant	Average weight of fruit per plant, kg	Average yield/plant, kg
Tomato			
T1	12	0.19	1.68
T2	15	0.20	1.92
T3	42	0.31	5.86
Capsicum			
T1	5	0.15	0.51
T2	5	0.18	0.76
T3	11	0.35	2.80

Adoption of drip fertigation system for mango and guava crops

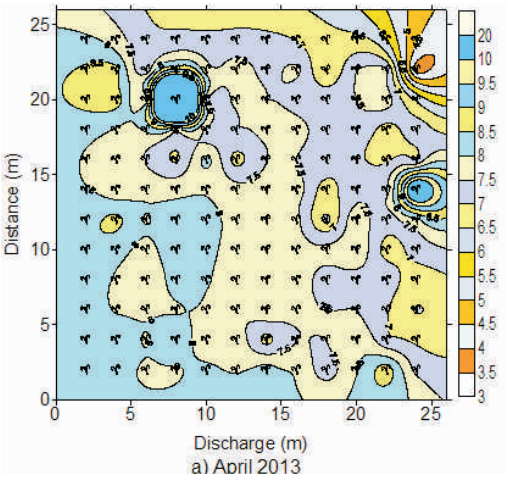
The performance of Mango (*Amrapali*) and Guava (*Lucknow-49*) under different treatments of irrigation and fertigation were studied (Fig 20).Treatments were three irrigation levels (100%, 80%, 60%), and two fertigation levels (100%, 75%) of recommended doses.The results indicated that the treatment of 100% irrigation and 100% fertigation gave the highest yield of 2.71 and 16.45 kg/plant, respectively for mango and guava whereas lowest was observed under treatment 60% irrigation and 75% fertigation i.e., 0.15 and 12.07 kg/plant respectively for these crops.

Fig. 20: Drip fertigation system for Mango

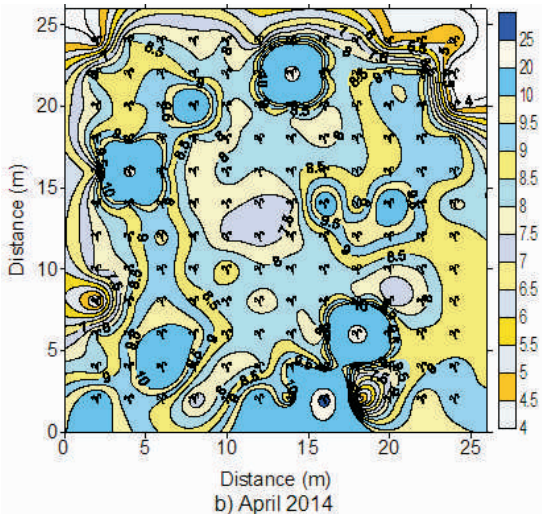
Spatial and temporal variability of emitter discharge

The emitter discharge contours were drawn for the field using the universal point kriging technique to assess the spatio-temporal distribution of plant wise rate of emitter discharge as observed during the last two years (Fig. 21 a & b). The discharge was uniformly distributed over the field as evident from the less number of contours. However, number of loops and contours were increased and indicated increased variability in emitter discharge rate in the succeeding year. The statistical and uniformity parameters in the first year have indicated uniform distribution having lesser variability than that of following year (Table 2). The coefficient of variation of emitter discharge among the observed periods was found to increase from 0.17 to 0.36.

Spatial modelling of emitter discharge of drip irrigated field was conducted by gridding using the point kriging at 0.1 × 0.1m grid for the interpolation of intermediate point values. The experimental semi-variograms and auto-correlograms of krigged values were analyzed using Linear, Spherical, Gaussian and Exponential models in two directions of 0° and 90° at the tolerance of 30° and 60° angles for each model. The values of ME (mean square error), RMSE (root mean square error), and RSS (residual sum of square) obtained from cross validation were considered and compared for all the fitted models. The developed semi-variogram models have indicated a strong spatial structure and low nugget values as an indicator of better model prediction. The analysis revealed that the Spherical model fitted well over Linear, Gaussian and Exponential models to describe the spatial variability of emitter discharge.



(a)



(b)

Fig. 21:Discharge contour maps measured in (a) First year (b) Second year

Table 2: Statistical parameters of discharge in last two years

Discharge Parameters	I Year	II Year
Mean±Standard Deviation	7.72±1.30	8.86±3.18
Standard Error	0.12	0.27
Kurtosis	56.97	21.76
Skewness	6.17	4.12
Uniformity Parameters		
Christiansen's Uniformity Coefficient (CUC)	0.93	0.84
Wilcox-Swailes Uniformity Coefficient (WSUC)	0.83	0.64
Statistical Coefficient of Uniformity (SCU)	0.87	0.72
Coefficient for Emitter Flow Variation (CEFV)	0.12	0.21

Performance of crops at different fertigation levels

Experiments were conducted to establish the fertigation frequency under surface drip in the field conditions for selected crops of okra (Var. *Syngenta Hy152*), and tomato (Var. *S-22 IIHR*). Each of the experiment consisted of four doses of fertilizers (0.50, 0.75, 1.0 and 1.25 times recommended dose (RD)), each at three fertigation frequencies. Same layout was followed in both the crops with three replications under the split plot design. The analysis revealed that the highest tomato yield (59.6 t/ha) was found in 1.25 times of recommended dose (120 kg/ha) of N fertigation, followed by the treatments of 1.0, 0.75 and 0.5 RDs at 49.95, 48.06 and 41.75 t/ha respectively, which were significantly different at 1 per cent level (CD**=9.79). While, the pod yield of okra was found highest (33.9 t/ha) for 1.25 times the recommended dose (100 kg/ha) of N fertigation, followed by the 1.0, 0.75 and 0.5 RD at 32.3, 30.8 and 30.6 t/ha, respectively.

Wind load assessment on greenhouse structure

Study was conducted on double arch type naturally ventilated greenhouse for estimating wind load. The steel frame was modeled by using the BEAM 188 element in the FEM code of ANSYS 15.0. The rafter was constrained on the ground by using translational and rotational stiffness. The truss and columns of the structure were studied with deflections and possible deformations (Fig. 22). The design wind pressure estimated to be 772 N/m^2.

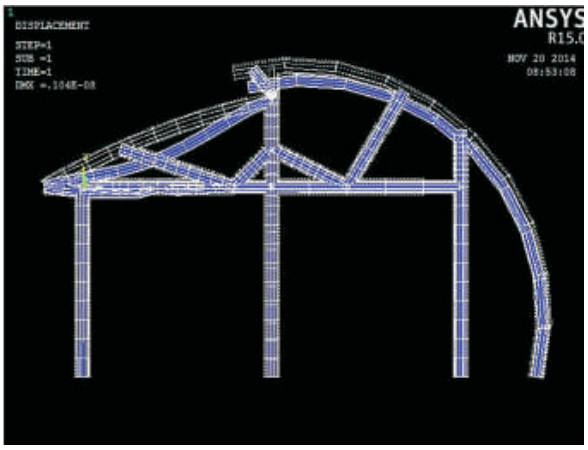


Fig. 22: Structural analysis using ANSYS

AGRO PRODUCE PROCESSING

Equipment for post-harvest treatment of banana

The set of equipment for post-harvest treatment of banana includes hot water treatment chamber and portable ripening chamber. The hot water treatment chamber having capacity of 20 kg/batch has been found suitable to retard fungal growth and increase shelf life of banana. Heat treatments were conducted at 40 and 45°C for 30 to 60 min and different physico-chemical and microbial load were measured during storage and ripening. Heat treatment at 45°C for 45 min was found to be optimum to retard total fungal count and increase shelf-life by five days compared to control.

A portable ripening chamber (L×B×H: 2.44×2.44×2.44 m) of one tonne per batch was developed for controlled and uniform ripening of banana (Fig. 23). The chamber contains an air-conditioner to maintain the temperature (15-17°C), humidifier to maintain R.H. (85-90%), ethylene generator and ethylene analyzer. Bananas were kept inside the ripening chamber overnight in crates (20 kg each) so as to reduce the pulp temperature to 17-18°C. The samples were then exposed to ethylene gas at a concentration of 100 ppm for one day. Thereafter the door was opened for about 20 min to remove ethylene gas as well as carbon-dioxide accumulated inside the chamber due to respiration. Bananas were left for further three days inside the chamber for ripening. During this period the door was opened at every 16 h interval for ventilation. Bananas took five days to ripen fully at 17°C and 90 R.H %. These bananas had five days shelf-life compared to three days of market ripened ones.

Fig. 23: Fruit ripening chamber

Moringa leaf stripper

A moringa leaf stripper comprising of stripping assembly, main frame assembly, sieve assembly and power source (1.5kW single phase motor) for large scale stripping was developed and evaluated. The stripping assembly consists of four wooden rollers of 1200 mm length fitted with nylon brushes of 0.5 mm bristle thickness and 25 mm height. The stripping rollers are provided with MS guard on the top. The vibrating sieve unit made of SS screen was kept at an inclination of 10 degree below the stripping assembly. A variable speed drive is provided to adjust speed of rollers to the requirement. The stripping operation can be performed by three persons simultaneously. The capacity of the machine is 300 kg/h with three persons, compared to 6 kg/h manual stripping by one person. The stripping efficiency was 98% and damage to the leaves was negligible.

Demonstration unit for probiotic soy cheese spread

A unit for preparation of probiotic soy-cheese with a capacity of 10 kg/batch consisting of SS coagulation tank (50 l) fitted with electric heater, temperature controller, an outlet valve and a filtration unit was designed and fabricated (Fig. 24). Experimental trials were conducted for soymilk coagulation and further for separation, the coagulated milk was transferred to a filtration unit where the whey was separated to obtain the soy cheese spread.

Fig. 24: Demonstration unit for preparation of probiotic soy cheese

Process technology for probiotic freeze-dried culture, probiotic soymilk powder and soy-cheese spread

Process technology for probiotic freeze-dried culture to prepare probiotic soymilk powder and soy-cheese spread (Fig. 25) was developed and viability of probiotics was evaluated. In freeze-drying culture, higher survival of lactic acid bacteria above 57% was found in products stored in a laminated pouch at 4°C compared to other probiotic bacteria. Different ingredients viz. cow's milk, sucrose and okara (0.5%) were used as substrates for growth of fermented probiotic bacteria to produce probiotic soy-cheese spread. The quality of the products was evaluated in terms of viable cell-counting, colour, rheological and sensory properties. Okara in lower concentrations was sufficient to stimulate growth, retain viability and stability of selected probiotic organisms even in spray-dried powders stored at 4°C, up to 2 months. Therefore, okara is an ideal substrate for growth and maintenance of the viability of probiotic cultures in soy-cheese spread.

(a) **(b)**

Fig. 25: Probiotic (a) soy cheese spread, (b) soymilk powder

Composite flour eggless cake

The aim of the study was to replace egg, saturated fat and refined flour to develop cake with good nutritional value and taste (Fig. 26). For this purpose egg was replaced by banana along with yoghurt (T1)/ chia seeds (T2)/ soy milk powder (T3); fat was replaced with refined oil; refined flour was replaced with a composite flour of wheat (33%), malted finger-millet (41%), sprouted soy (8.5%) and sprouted amaranth (17.5%). Test cake contained

8.3-12 g protein, 19-22 g fat and 4.7-8.4 mg iron in 100 g of cake. Banana with yoghurt and soymilk powder can be effectively used as egg replacers and composite flour can effectively replace refined flour for making cake.

Fig. 26: Composite flour eggless cake

Nutri-Laddoo

Multi-grain *laddoo* was prepared using a combination of cereals, millets, legumes, fruits, dairy whitener and oilseeds with jaggery as binding agent. Particle size, nutritional, functional and sensory profile of *laddoos* was studied as quality parameters. Whole wheat flour, malted finger-millet flour, green-gram flour, roasted peanut, dairy whitener, papaya powder and jaggery were the main ingredients used. *Laddoos* contained 25 g protein, 30 g fat, 11 mg iron, 123 mg phenolics, 63% RSA anti-oxidants and 7 mg QE flavonoids in 100 g *laddoo* as against 10 g protein, 30 g fat and 3 mg iron, 65 mg phenolics, 30 % RSA anti-oxidants and 5 mg QE of flavonoids in wheat flour control *laddoo*. The overall acceptability of the test *laddoo* on the 9-point hedonic scale was 8 against 6 for control. The shelf life of the *laddoo* was 15 days and 30 days under normal packaging and 30 and 45 days when packed under vacuum in LDPE and LDPE lined Aluminum packs, respectively.

Multi-grain tortilla chips (Nachos)

Baked multigrain tortilla chips were made from a combination of corn, wheat, rice and sorghum (plain-P and nixtamalized-N-soaked, cooked in an alkaline solution and milled), soybean and green-gram (sprouted and unsprouted), skimmed milk powder and compared to corn (P and N) tortillas to study effect of nixtamalization and sprouting on tortilla chips. Particle size and physical properties of flours; nutritional, functional and textural properties of dough and chips were analysed and compared. The particle size of test flour (24 µm) were found to be significantly ($p \leq 0.05$) lower than control flour (29 µm-31 µm) flours. Nixtamalized flour showed significantly ($p \leq 0.05$) higher Water Absorption Index (3.3 and 3.5g/unit g) and lower Oil Absorption Capacity (0.71 g/unit g) compared to plain (1.1) and sprouted (0.8 g/unit g) flour. Firmness of test doughs was significantly ($p \leq 0.05$) lesser than control corn doughs. The fracturability of chips made from control flours was significantly higher than test flour chips (4.1-5.3N). Overall acceptability on 9-point hedonic scale was highest for nixtamalized and sprouted chips (8.6) followed by sprouted-test chips (7.8) and nixtamalized control (7.4). The nixtamalized and multigrain based tortillas had significantly higher calcium content (466 mg/100g) compared to corn chips. Nixtamalized and sprouted multi-grain tortillas are a healthy and nutritive option to plain corn tortillas in terms of all parameters assessed and also make a tasty snack.

Nutrient and anti-nutrient profile of processed soy foods

Nutritional and anti-nutrient analysis of Full fat soy flour (FFSF), Medium fat soy flour (MFSF) Defatted soy flour (DFSF), Soy-biscuits, nuts (roasted and fried) and soy sattu was determined and the results are given in Table 3.

Table 3: Nutrient and anti-nutrient profile of processed soy foods

Sl No.	Product	Protein g/100g	Fat g/100g	Ca g/100g	P mg /100g	Fe mg/100g	TI mg/g sample	OS g/100g	Phytic acid mg /100g	Saponin mg /100g
1	Raw	41.4	16.6	0.12	581	28.3	8.53	4.4	66.1	11.5
2	FFSF (blanched)	43.6	16.8	0.13	639	5.5	0.99	1.7	48.6	11.5
3	FFSF (sprouted)	42.6	17.9	0.27	568	5.4	1.78	0.9	11.7	1.7
4	MFSF	37.4	13.8	0.13	555	8.1	1.65	3.4	57.8	11.6
5	Soy Milk*	4.8	1.6	0.02	4	0.1	0.02	0.04	3.6	0.1
6	Tofu	16.7	7.3	0.07	39	1.7	0.30	0.2	25.8	0.9
7	Nuts (roasted)	44.9	15.3	0.10	572	9.2	0.86	4.0	84.5	2.1
8	Nuts (fried)	45.8	26.5	0.11	604	11.8	0.52	3.4	43.9	1.4
9	Soy Sattu	24.50	20.4	0.35	357.8	18.27	0.26	2.1	49.9	4.3
10	Soy Biscuits	14.31	21.3	0.26	240.3	7.78	0.35	1.4	0.0	4.4

** the reported values are on volume basis, OS- Oligosaccharide*

Soy fortified extruded snacks

Soy fortified extruded snacks were prepared using rice flour (20-25%), corn flour (20-25%), wheat flour (10-15%), defatted soy flour (DFSF) (5-10%), fruit powder (3-5%), vegetable powder (3-5%), soy protein isolate (3-5%) and dairy whiteners (5-10%). The protein, fat, carbohydrate and energy content of extruded snacks were found to be 18-21%, 2-3%, 60-65% and 345-360 kcal, respectively. Storage study indicated that packaging in PET/PET met/LDPE could maintain product quality for six months.

Using a commercial noodle-making machine noodles were prepared from DFSF (20%), refined wheat flour (50%) and wheat flour (30%). The protein content of soy fortified noodles varied from 15-17%.

Disinfestation of pulses using microwave treatment

Disinfestation trials of chickpea and green gram infested with adult *C. maculatus* were carried out in a continuous pilot-scale microwave heating unit (2900W, 2450 MHz) at IICPT, Thanjavur. The chickpea and green gram conditioned to different moisture contents (7.5-9.5% wb) were laid on the belt to about 1cm bed thickness corresponding to 4 and 4.5 kg, respectively. Pulses were subjected to microwave-cum-hot air heating with a belt speed 5, 7 and 9 mm/s with corresponding exposure time (min) of 6, 4.15 and 3.20, respectively. Exposure of 2900 W microwave and air flow at 60^{O}C for 6 min with grain moisture content of 9.5% (wb) was found optimum for green gram and chickpea.

The microwave-treated green gram and chickpea were stored in LDPE (40µm), PP (40µm) and Aluminum lined laminated (30 µm) pouches for 6 m (18-32 °C, 44-90% RH). Water-vapour transmission rate of LDPE, PP and Aluminum lined packages measured at 38^{O}C and 94% (RH) were 185.02, 77.09 and 7.71 g/m^{2} per day, respectively. The gas-transmission rate of LDPE, PP and laminated packages measured at 38^{O}C and 94% (RH) were

1665.65, 694.31 and 6.91 ml/m^2 per day, respectively. No adult emergence of *C. maculatus* was observed in treated samples stored in all packaging materials.

Pre-treatment of banana central core

Central core of banana has the property of quick oxidation because of polyphenol oxidase. Various pre-treatments like citric acid (CA), ascorbic acid (AA) and potassium meta-bisulphite (KMS) with varying concentrations (0.05, 0.1 and 0.2%) and combinations were tried for standardizing pre-treatment method. Polyethylene bags (100 microns) were used for packaging and samples were stored under both ambient and refrigerated conditions. It was found that with KMS at 0.2% and combination of KMS (0.1%) + AA (0.1%), there were no changes in colour, sensory characteristics (5-point hedonic scale) and odour or depletion in protein, potassium, magnesium, sodium, calcium for treated samples after 6 days of storage.

Material and parts standardization of motorized fruit grader

The power transmission system of diverging belt type fruit grader was modified with repositioning of pulley and electric motor to accommodate it within the machine frame to make machine more compact. The size of belt safety guard was reduced. Number of pulleys has been reduced to 12 from 16. Nylon pulleys were used in place of MS casted pulleys. The reinforced rubber belts and fruit movement trays have been replaced with food grade poly urethane material. The input and output trays have been modified for ease of packaging and disassembly. Fig. 27 shows some modified parts/components of the machine.

(a) (b) (c)

Fig. 27: Motorized fruit grader (a) Nylon pulley, (b) Fruit movement tray, (c) Reinforced rubber belt

Material and parts standardization of pedal operated potato slicer

The problem of frequent chain derailment during operation was eliminated with adoption of commercially available sprocket of 26 and 90 teeth with matching chain. The PVC water spray pipes, top cover fixed with main frame through standard hinges, press fit lock type potato feeder gate and laser cut potato drum cover were incorporated in modified machine. A central handle was provided instead of two individual handles.

Machine vision for distinguishing among crop varieties

Field observations were recorded for DUS characteristics of rice and mustard. New characters helpful in distinguishing the varieties were: Rice-leaf venation pattern, length of ligule, and rachilla shape; Mustard - leaf blade shape and leaf venation pattern. Images of plant parts were captured using camera, scanner, microscope and hyperspectral imaging system. More than 15,000 plant part images were uploaded on the web-based database <http://cropcorpus.ciae.res.in> being maintained at CIAE Bhopal.

Software was developed for semi-supervised analysis of rice panicle (Fig. 28). A user graphically selects points on the panicle axis and the software calculates two angles between stem and line joining apex and median points of axis to stem tip; radius of panicle axis curvature; ratio of minor to major axis of oval circumscribing the panicle and length of the axis; panicle spread factor; angle of the flag leaf attached to the panicle. These features of the panicle are variety specific and take longer to determine using conventional techniques.

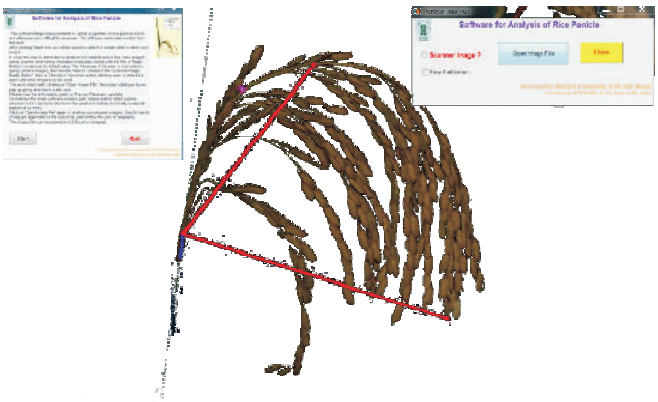


Fig. 28 : Screen shot of rice panicle image analysis software

TECHNOLOGY TRANSFER

Commercialization of CIAE technologies

Commercialization and promotion of equipment and technologies for production and post-production agriculture is among the priorities of the Institute. During 2014-15, following three CIAE technologies were commercialized successfully:

i. Self-propelled multipurpose hydraulic system for orchard operations

The "Self-propelled multipurpose hydraulic system for orchard operations", developed by CIAE has been licensed to M/s TAFE (tractor and farm equipment), Chennai, one of the leading multinational company to manufacture and market the technology. The machine has good demand among farmers and other stakeholders involved in production of orchard crops. The license agreement was signed on June 5, 2014 at Krishi Bhawan, New Delhi in gracious presence of Dr. S. Ayyappan, Hon'ble DG, ICAR and Secretary, DARE, by Dr. Pitam Chandra, Director-CIAE and Mr. Kesavan, COO-PS & CR, TAFE. Dr. D. Rama Rao, DDG (Engg) & National Director-NAIP, Dr KK Singh, ADG (FE) and CIAE Scientists who developed this machine Dr. VK Bhargav and Er AK Roul were also present on this occasion. It is expected that M/s TAFE will be manufacturing and marketing this CIAE developed machine in the country soon, at an affordable cost for farmers & orchard owners. For non-exclusive rights, the one time license fee charged was Rs. 10 lakh.

ii. Millet mill

Dehulling (removal of husk) of millets is a difficult task owing to its small size and shape. The CIAE-Millet mill for the dehulling of important small millets like kodo and kutki has been licensed to three firms at a cost of Rs. 1.00 lakh each. M/s AVM Engineering Industries, Salem, a leading manufacturer of quality rice milling machinery, agreed to take license and manufacture the machine. The license agreement was signed on April 27, 2014 at Industrial Extension Project of CIAE at Coimbatore. The license agreement was exchanged between Dr. Pitam Chandra, Director-CIAE and Sh. KG Rajasekar, Proprietor-AVM Engineering Industries. Dr. Vijayan Nair, Director, Sugarcane Breeding Institute (ICAR), Coimbatore and

Dr. C Divakar Durairaj, Dean, College of Agricultural Engineering, TNAU, Coimbatore, Er Sivaprakasam, Superintending Engineer (Agricultural Engineering), Govt. of Tamil Nadu were also present. In addition, more than 150 participants including, scientists, extension functionaries from KVK, representatives from 5 NGOs, 12 manufacturers, processors, traders and farmers attended the programme.

iii. Process technology of soy butter

CIAE developed the technology for making Soy-butter which is rich in fat and protein. This has been licenced to a food industry of Central India, M/s Bio Nutrients (India) Pvt. Ltd., Bhopal. The license agreement for soy butter technology was signed between Dr. Pitam Chandra, Director, CIAE and Sh. Sumit K Agrawal, Director-Bionutrients (India) Pvt. Ltd, Bhopal at CIAE in presence of Scientists and Senior Officers of CIAE, on June 12, 2014, at an agreed license fee of Rs. 1 lakh for non-exclusive manufacturing rights. The commercuial launching of soy butter took place at the Inaugural function of the 12th Agricultural Science Congress on February 3, 2015 at ICAR-NDRI, Karnal.

Development of technology information portal

A web portal containing information about commercialized and ready to be commercialized agricultural engineering technologies has been hosted on Institute website (www.ciae.nic.in),which serves the user friendly retrieval of information about commercialized and ready to be commercialized agricultural engineering technologies. Any user can directly access the useful information about various agricultural engineering technologies online. It functions as single window information portal on product/technology suppliers, and advisory on feasibility of few agri-businesses. The information can be helpful in planning and developing entrepreneurship based on agricultural engineering technologies.

The database contains details of more than 1500 manufacturers and technologies from all across the

DATABASE - HOME PAGE

country for all the states and their districts. Information about the manufacturers and their technologies on district level can be accessed by anybody anywhere on a Single Window.

Adoption of package of animal drawn implements for cotton and soybean in malwa plateau of Madhya Pradesh

A package of animal drawn implements for seedbed preparation, inter-culture/ weeding and spraying was demonstrated at village–Bhuriyapura in district Dewas. The package consisted of CIAE- improved *bakkhar*, *patela* harrow, 3-row seed-cum-fertilizer drill (for soybean), 3-row inclined plate planter (for cotton) and 3-tine sweep cultivator. Use of improved *bakhar* resulted in saving of 3-4.5 man-h/ha in overall labour requirement. In soybean sowing average field capacity, field efficiency and labour requirement using the seed-cum-fertilizer drill were 0.2 ha/h, 83.5% and 4.45 man-h/ha, respectively. Weeding in cotton using improved *bakhar* with 500 mm wide blade showed enhanced field capacity of 0.013 to 0.019 ha/h and labour saving of 2.1 to 2.9 man-h/ha over traditional *bakkhar* (450 mm). Weeding operation in soybean with sweep cultivator (15.8 man-h/ha) showed 67% saving in labour, in comparison to local blade hoe (*Dora,* 150 mm).

Transfer of technology of gender-friendly equipment

Two villages, Dhamarra and Kachhiberkheda of Bhopal district were adopted to assess the status of women's involvement in agricultural activities and their awareness level about various drudgery reducing gender-friendly improved technologies and to identify the improved tools and equipment required in the villages.

Total 631 units of improved tools and equipment, namely double screen grain cleaner (2), hand ridger (18), grubber weeder (18), seed treatment drum (4), twin wheel hoe (156), Naveen dibbler (9), ground nut decorticator (9), tubular maize sheller (189), improved sickle (225) and ground nut stripper (1) were demonstrated and distributed to women beneficiaries for future use.

TRIBAL SUB PLAN (TSP) ACTIVITIES

Establishment of farm machinery bank

A farm machinery bank has been established under TSP at Gaildubba, District Chhindwara (MP) for which need based tools and implements were supplied by the Institute through M.P. Vigyan Sabha. The tools and implements supplied for utilization in the form of farm machinery bank includes Manual Ridger (5), Manual Dibbler (5), Rotary Dibbler (5), Multi fuel cook stove (10), Portable charring kiln (2), Motorized briquetting machine (1), Double screen grain cleaner (5), Sack holder (5), Pedal-cum-power seed cleaner(1), Twin wheel hoe weeder (10), Tubular maize Sheller (20), Naveen Sickle (20) and Multi-Millet thresher (2). The Farm Machinery Bank is functioning in PPP mode through Self Help Group of Farmers.

Establishment of millet processing centres

Three millet processing centres have been established at Aasanur, Thimban (Erode district) and Coimbatore in Tamilnadu and Seradhana, Patalkot (Chhindwara district) in Madhya Pradesh. Each centre was provided with millet thresher, destoner-cum-grader-cum-aspirator, pulveriser, millet mill, grain polisher, flour sifter, weighing machine and packaging machines for developing millet processing facility in PPP mode.

Prototype production and supply

The prototype production centre of the institute supplied 4562 portotypes worth Rs, 61.72 lakh to farmers, research institutes, agricultural universities, krishi vigyan kendras, State/Central development agencies, NGOs, manufacturers, etc.

Sl. No.	Name of Equipment	Numbers	Amount, Rs
1.	Manual Maize Sheller	2716	163920
2.	Manual Naveen Sickle	1167	70020
3.	Manual Hand ridger for women	10	7000
4.	Manual Naveen dibbler	16	11200
5.	Manual Rotary dibbler	14	32200
6.	Manual Groundnut Decorticator	25	60000
7.	Manual Sack Holder	22	26400
8.	Manual Double Screen Grain Cleaner	30	135000
9.	Manual Paneer Pressing Device	01	4000
10.	Manual Twin wheel hoe	282	225600
11.	Manual Cycle wheel hoe	05	5500
12.	Manual PAU Seed Drill	01	1600
13.	Manual Peg type dry land weeder	14	11200
14.	Manual Grubber weeder	23	9200
15.	Manual Cono weeder	02	3800
16.	Animal drawn 3-row seed drill	02	14000
17.	Animal drawn 3-row seed cum fertilizer drill	84	756000
18.	Animal drawn 3-row inclined plate planter	19	285000
19.	Animal drawn groundnut digger	01	7200
20.	Animal drawn Improved Bakhar	02	8000
21.	Animal Tread Mill	01	400000
22.	Power Tiller Seed cum Fertilizer Drill	02	36000
23.	Power Tiller drawn Sweep Cultivator	01	8000
24.	Power Tiller Till Plant Machine	01	15000
25.	Portable weighing balance for Animal	01	140000
26.	Pedal cum power operated seed cleaner with motor	18	360000
27.	Pedal cum power operated seed cleaner without motor	01	15000
28.	Pedal operated potato slicer	05	60000
29.	Pedal operated potato peeler	03	51000
30.	Portable charring kiln	04	32000
31.	Portable updraft Gasifier	01	27500
32.	Paneer Plant	01	180000
33.	Tractor operated precision plot drill -6 row	03	270000
34.	Tractor Drawn Mole Plough	03	54000
35.	Motorized Semi Axial Flow Thresher 7.5 hp	01	100000

Sl. No.	Name of Equipment	Numbers	Amount, Rs
36.	Motorized Multi crop plot Thresher	03	84000
37.	Motorized Single Ear Head Thresher	04	104000
38.	Motorized Dal Mill with 2.0 hp Motor	09	270000
39.	Multipurpose Grain Mill 1 hp motor	05	95000
40.	Multi fuel Cook stove	03	3000
41.	Motorized Soybean Flaking Machine	02	40000
42.	Motorized Soybean Dehuller	05	90000
43.	Motorized Jute Decorticator	10	1320000
44.	Motorized Millet Mill	03	114000
45.	Motorized Millet Thresher	02	90000
46.	Motorized Briquetting Machine with Motor	01	34000
47.	Hand Operated Potato Peeler	18	144000
48.	Hand Operated Potato Slicer	01	9500
49.	Hand Operated Briquetting Machine	05	4375
50.	Solar Cabinet Dryer	01	20000
51.	Concave for Groundnut Decorticator	05	750
52.	Vegetable Dryer	02	140000
53.	Fruit Grader	01	25000
	Total Rs.	**4562**	**61,72,965**

Prototype supply to African Countries

Eighteen Animal Drawn Inclined plate planters were fabricated and supplied to Central Institute of Cotton Research, Nagpur for onward supply to six African countries. The package of supplied material is given in the figure.

Participation in Exhibitions/Farmers' fairs

Sl. No.	Exhibition	Dates	Venue
	International		
1	India-International Trade Fair (IITF)	14-27 Nov, 2014	Pragati Maidan,
2	Agri Expo	26-28 Feb, 2015	New Delhi
	National		
3	Haldhar- Agri Expo., organized by Govt. of MP	26-28 Sep, 2014	Bhopal
4	Agro-Vision 2014	4-7 Dec, 2014	Nagpur
5	12th Agricultural Science Congress India Expo	3-6 Feb, 2015	NDRI Karnal
6	Agro Bihar 2015 Krishi Yantrikikaran Mela	11-14 Feb, 2015	Patna
7	Regional Agriculture Fair	19-21 Feb, 2015	CPRS Patna
8	Pusa Krishi Vigyan Mela	10-12 March, 2015	IARI, New Delhi
9	All India Farmers fair & Agro Industrial Exhibition" Krishi Kumbh,	13-16 March, 2015	GBPUAT Pantnagar
10	Fodder Day Cum Kisan Mela		IGFRI Jhansi
	Regional		
11	Krishi Vigyan Mela, organized by ATMA	25-28 May, 2014	Rajgarh
12	Kisan Goshthi organized by E-Chaupal. ITC	6-7 June, 2014	Sagar

Sl. No.	Exhibition	Dates	Venue
13	Kisan Goshthi organized by E-Chaupal. ITC	13-15 June, 2014	Sehore
14	Krishi Avam Udyaniki Mela, organized by Govt. of MP	25-27 June, 2014	Rajgarh
15	Technologies for Sustainable Rural Development, organized by AMPRI & MPCOST	4-5 July, 2014	Bhopal
16	Krishi Mahotsava Kisan Mela	16-18 Oct, 2014	Burhanpur
17	Bundel khand Vigyan Mela	17-18 Oct, 2014	Khurai
18	Science Fiesta, organized by Regional Science Centre, Govt of India	10-11 Nov, 2014	Bhopal
19	Jan Suchana Abhiyan (PIB, Ministry of Information & Broadcasting)	10-12 Dec, 2014	Katni
20	Jan Suchana Abhiyan (PIB, Ministry of Information & Broadcasting)	15-17 Dec, 2014	Raisen
21	Rose exhibition	10-11 Jan, 2015	Bhopal
22	4th Bhopal Vigyan Mela	20-23 Feb, 2015	Bhopal
23	Vidisha Kisan Mela	24-26 Feb, 2015	Vidisha
24	MP Sate level Jaivik krishi sangoshti evam jaivik haat	2-4 March, 2015	Bhopal
25	CODISSIA-AgriIntex	18-21 July, 2014	Coimbatore
26	Agri & Horti Tech 2014	11-14 Sept, 2014	Coimbatore
27	Horticultural Intex 2014	7-9 Nov, 2014	Coimbatore
28	Agri-Flori Tech 2014	19-21 Dec, 2014	Coimbatore
29	Mega agricultural machinery Fair III 2015	24-26 Jan, 2015	
30	Promotion of oil palm cultivation in India through NMOOP	5-6 Feb, 2015	IIOPR, Pedavegi
31	Mega Kisan Mela	20 March, 2015	Coimbatore

MEDIA ACTIVITIES

Radio Talks

Presenter	Date	Title
PL Singh	13 May, 2014	*Urja Shroto Se Sinchai*
SD Kulkarni	4 June, 2014	Khadya Prasanskaran ke Laabh
S Balasubramanian	27 Aug 2014	CIAE Millet Mill
SD Kulkarni	15 Oct, 2014	Opportunities for young entrepreneurs / farmers through soybean processing at rural level
SS Deshpande	8 Jan, 2015	Soybean utpaad swarojgar hetu
SD Kulkarni	18 Feb, 2015	Income generation opportunities through agro produce processing and value addition in rural areas

TV Programmes

Presenter	Date	Title
SD Kulkarni	22 March, 2014	Fruit and vegetable processing for loss minimization and employment and income generation
LK Sinha	25 April, 2014	Agro processing
S Balasubramanian	29 April, 2014	CIAE Millet Mill
SD Kulkarni	30 May, 2014	Soybean processing for entrepreneurship
SD Kulkarni	9 July, 2014	Soybean processing
S Balasubramanian	13 July 2015	CIAE Millet Mill
SD Kulkarni	9 Oct, 2014	Soybean processing based entrepreneurship opportunities
SD Kulkarni	22 Jan, 2015	Soybean Processing Opportunities for Nutrition improvement and income generation
Nachiket Kotwaliwale	22 Jan, 2015	Agro-Product Processing Opportunities for value addition and income generation
K V Ramana Rao	24 Jan, 2015	Protected cultivation technologies

Farmers' Field Day

Farmers' Field Day on *Repair, maintenance and safety of tractor and farm machinery* was organized on 16 Jan, 2015 in NICRA adopted village Kachhiberkheda. Total 78 farmers participated in this field day.

KVK Activities

KVK, CIAE organized following trainings for 417 participants:

- Crop production engineering and post- harvest technology
- Crop production machinery
- Farm mechanization
- Kharif sowing and weeding machinery for soybean, paddy and maize crops
- Mechanized soybean and maize crop cultivation technologies
- Operation, repair, maintenance of tractor system
- Role of improved agricultural implements in crop production and organic farming
- Use of weeding tools and equipment in the Kharif crop

Farmer's Field School

- Four farmers' field school were organized in Phanda Kala, Khajuri Sadak and Phanda village in collaboration with State Agricultural Department, on the following topics:
- Insect, pest and disease management in soybean, nutrient management in paddy
- IPM in soybean and paddy crop
- Plant protection in soybean crop, nutrient management in paddy crop
- Excess water management in Kharif crop

Frontline Demonstration

- Frontline demonstration of following equipment/crops were conducted in the farmers field:
- Twin wheel hoe
- Maize sheller
- Water soluble fertilizer
- Marigold
- Onion (Variety : *AFDR*)
- Okra (Variety : *VRO-22*)

Advisory/ Diagnostic Services

KVK scientists provided 44 advisory services/ diagnostic services to the farmers through Kisan Mobile and Farmers' portal.

TRAINING AND CAPACITY BUILDING

Post Graduate (PG) Cell

A PG Cell has been created at CIAE, Bhopal as Outreach Centre of PG School IARI, New Delhi for carrying out the academic activities in Agricultural Engineering (Farm Power & Machinery, Soil and Water Conservation Engineering and Agricultural Processing and Structures). The Director of the Institute is the professor for the PG programme at the Institute and liasoning with PG School, IARI, New Delhi. The first batch of six PG students of Agricultural Engineering (All Ph.D.: 5 in Agricultural Processing and Structures and 1 in Farm Power and Machinery disciplines) have joined the programme at CIAE.

International training programme for African-Asian countries

A two-week International Training programme titled *Equipment and Technologies for Processing and Value-Addition to Agricultural Product at Small Scale/Rural Level* was organized for the Nationals of African and Asian countries during February 10-24 , 2015. It was sponsored by the African-Asian Rural Development Organization (AARDO) and funded by the Ministry of Rural Development, Govt. of India under international collaborative programme. Nine African–Asian nationals belonging to eight African-Asian countries namely Egypt, Ghana, Iraq, Jordon, Nigeria, Sri Lanka, Taiwan & Yemen participated in the training programme.

Winter School on *micro irrigation systems and fertigation*

Winter school on *Recent Advances in Micro Irrigation Systems and Fertigation under Covered and Open Cultivation for Sustainable and Enhanced Crop Production and Productivity in Vertisols* was organized during September 9-29, 2014. Fifteen participants representing six states viz., Andhra Pradesh, Jharkhand, Karnataka, Madhya Pradesh, Maharastra, Orissa participated in the winter school.

Winter School on *application of sensors, in precision/conservation agriculture*

Winter School on Application of Sensors, Nano-sensors, Wireless Sensor Network and Instrumentation in Precision/Conservation Agriculture was organized during December 3-23, 2014 for 23 participants from 11 States representing

Jammu and Kashmir, Punjab, Tamil Nadu, Karnataka, Andhra Pradesh, Maharashtra, Jharkhand, Gujrat, Uttar Pradesh, Chattisgarh and Madhya Pradesh.

Entrepreneurship training programmes on custom hiring business of agricultural machinery

CIAE has taken initiative with Govt. of Madhya Pradesh (MP) to set up custom hiring centers in the state so that the availability of agricultural machinery is ensured to farmers at affordable costs and at the time it is required. Therefore, according to understanding between CIAE and the Directorate of Agricultural Engineering, Govt. of MP, the Directorate would identify and sponsor the interested candidates who wish to set up their Custom Hiring Centres in the state. The Govt of MP would also support in the sanction of bank loan and subsidy. The CIAE has taken up the responsiblity for training and capacity building of these youths for setting up custom hiring enterprises. CIAE planned the training programme focusing on identification of region specific machines, their operation and maintenance, economic viability and decision support system to facilitate these budding entrepreneurs run their enterprise successfully. Total 169 youths from various districts across the state were trained in six batches during this year, as detailed in the table below.

National/ Regional level trainings organized

Sl. No.	Title of Training	Date	No. of Participants	Participants profile
1	Weeding and interculture tools & equipment	28 May to 3 June, 2014	6	NEH Tribal Farmers
2	Agri-business Management and Entrepreneurship Development based on Agricultural Engg. & Technology (Model Training Programme sponsored by DoAC, Govt. of India)	15-22 Dec, 2014	17	State Govt. Officials
3	Women-friendly Technologies for Agricultural Production and Processing Operations (Model Training Programme sponsored by DoAC, Govt. of India)	27 Oct to 3 Nov, 2014	16	State Govt. Officials
4	Post-harvest technologies for on-farm processing of agricultural commodities	16-21 March, 2015 & 23-28 March, 2015	60	Farmers/ rural youth

Sl. No.	Title of Training	Date	No. of Participants	Participants profile
5	Entrepreneurship Development for Custom Hiring of agricultural machinery as an enterprise (sponsored by Govt of MP)	1-7 Aug, 2014 1-7 Sep, 2014 7-13 Oct, 2014 2-8 Dec, 2014 2-8 Jan, 2015 2_8 Feb, 2015	169	Rural Youths
6	Improved Horticulture Cultivation technologies	25-26 Aug, 2014 15-19 Sep, 2014	48	Farmers
7	Protected Cultivation technologies	19-20 Sep, 2014 18-19 Nov, 2014	47	Farmers
8	MIS and Protected Cultivation technologies	10-11 Nov, 2014 25-26 Nov, 14 27-28 Nov, 14 16-17 Dec, 14 18-19 Dec, 14 22-23 Dec, 14	165	Farmers
9	Soybean processing for diversified food use	26-30 May, 2014 24-28 June, 2014 4 8 Aug, 2014	55	Subject matter specialists of different KVKs
10	Improved tools/ equipment and agro-processing technologies for drudgery reduction and income generation of farm women (sponsored by Tejaswini Rural Women Empowerment Programme)	6-13 Jan, 2015	158	Rural women
11	Production of soy milk and soy paneer	12 training	119	Upcoming entrepreneurs
12	Production of full fat soyflour		9	Upcoming entrepreneurs
13	Field Training of undergraduate students of Agricultural Engineering Colleges	1 to 2 month duration	164	Students
14	Women's training on preparation o f nutritious and tasty soy foods at domestic level (One each of 5-days duration in Khejada, Parvaliya Sadak, Pipaliya and Chopra village.)	1-5 July, 2014 8-12 Sept, 2014 8-12 Dec, 2014 24-28 Feb, 2015	26 17 22 34	Rural women

Trainings organized by CIAE Regional Centre - IEP Coimbatore

Sl. No.	Title of Training	Duration	No. of Participants	Participants profile
1	Hands on training on CIAE Millet Mill	19 March, 2014	30	KVK staff and farmers
2	Hands on training on banana centre core dicing and slicing equipment	9 Oct, 2014		Entrepreneurs
3	Hands on training of Curry leaf stripper and dryer	7 Nov, 2014		Entrepreneurs
4	Awareness training for tribal farmers on millet processing	17 March, 2015	50	Tribal farmers
5	Field Day on New Technology for treatment of sugarcane setts/buds against diseases	21 March, 2015	35	Farmers, cane officers

HUMAN RESOURCE DEVELOPMENT

Name and Designation	Course Title	Duration	Place
LK Sinha Principal Scientist	Science Administration and Research Management	15-26 Sep, 2014	ASCI, Hyderabad
SD Kulkarni Principal Scientist	Training Programme for "Technical Committee Members"	18-19 Sep, 2014	National Institute of Training for Standardization, NOIDA
Muruganandam G T-6	Solid works	10 Oct 2014	Coimbatore
T Senthil kumar Senior Scientist	8th Refresher course on Agricultural Research Management for newly recruited senior scientists and Principal scientists	10-22 Nov 2014	NAARM, Hyderabad
Ravindra Naik Senior Scientist	Use of textural analysers	11-12 Nov 2014	GKVK, UAS, Bangalore
MK Tripathi Senior Scientist	Advances Microbial Techniques	25 Nov to 1 Dec 2014	Centre of Excellence in Biotechnology, Dept of Science &Technology, MPCST, Bhopal, M.P
N Kotwaliwale Head, APPD	Management Development Programme on Leadership Development (a pre-RMP programme)	1-12 Dec 2014	NAARM, Hyderabad
Manish Kumar Scientist	Climate Change and Conservation Agriculture	28 Jan to 4 Feb 2015	ICAR-IISS, Bhopal

Foreign deputation

Dr. KK Singh, Director attended the 5th meeting of Agriculture Food Task Force (ATF) on Sustainable Consumption on Production, organized at FAO Headquarter, Rome, Italy during September 10-12, 2014.

Dr CR Mehta, Project Coordinator, AICRP on FIM attended the first Annual Meeting of the Asian and Pacific Network for Testing of Agricultural Machinery (ANTAM), organized at Beijing, China during September 16-19, 2014.

Dr. AC Saxena and Dr. S Ganesan, Principal Scientists visited United Republic of Tanzania during January, 12-16, 2015 for studying the feasibility of a Tractor Assembly unit and manufacturing of agricultural machinery in Tanzania. The visit was arranged by Development Partnership Administration, Ministry of External Affairs, Government of India.

SUCCESS STORIES

Gerbera cultivation in polyhouse enhanced farmer's income

Shri Md. Asfaq, 33 Years old, 10th pass from Shahpur Madha village in Raisen district owns 2 acres of agriculture land and was able to make about Rs 50,000/- per annum with traditional crop rotation of Soybean-Wheat and Gram. In the year 2012, he attended a training programme on protected cultivation technologies at Central Institute of Agricultural Engineering (CIAE), Bhopal. In the year 2013, he installed a naturally ventilated polyhouse sizing 2000 m. He cultivated gerbera plants of six different color varieties on raised beds in the polyhouse. Initially he faced difficulties in managing the crop during summer season due to high temperatures, but with the suggestions from the scientists of Precision Farming Development Centre (PFDC), CIAE, Bhopal he managed the production of gerbera very well and started getting around 1000 flowers per day. In a year, about 3.5 lakhs flowers were harvested and sold by him at an average whole sale price of Rs. 3 per flower. With this multi-enterprising approach, he has been able to achieve profit of more than four lakh. He maintains regular contact with the CIAE scientists and staff for plant protection measures as well as irrigation and fertigation issues. He is disseminating the technology to the other farmers and has become a role model for them.

Soy based food products enterprise

Mr. Eknath Dhamdhere, an entrepreneur trained at CIAE, Bhopal has been successfully running a soy-based food product enterprise - **Sangram Soy Food Products** at Pune, Maharashtra. Initially he started production with products like tofu, flour, biscuits, selling at a domestic level to local consumers in colonies, fitness clubs, gymnasiums, etc. Later he added few more products like *soy-shrikhand* and *soy-sattu*. His wife Smt Nanda Dhamdhere also joined hands in the business and they expanded operations by including soy-*shrikhand*, soy-*sattu*, etc. They now supply 75 kg of soy-*sattu* and 500-600 kg soy laddu/ month; 30-40 kg soy-*shrikhand* and 200 kg soy-biscuits per week. *Soy*-nuts, soy-*sev* and soy-*chakli* are also on their product list. They are also planning to introduce soy-butter milk in near future. They also participate and exhibit their soy products in exhibitions organized in different areas of Maharashtra.

Entrepreneurship in custom hiring of agricultural machines

Having undergone training at CIAE Bhopal, Shri Kamlesh Sahu of Begumpura village of Raisen District started custom hiring centre for agricultural machines in his village in the year 2014. He started his custom hiring centre with a tractor, plough, rotavator, thresher and a straw reaper with the financial assistance from the bank. During first year itself he did a business of approximately Rs. 8.0 lakhs, and earned profit of about Rs 3.0 lakhs.

ALL INDIA COORDINATED RESEARCH PROJECTS (AICRPs)

All India Coordinated Research Project on Farm Implements and Machinery

Pomegranate spraying system based on ultrasonic sensors

A tractor mounted ultrasonic sensor based pomegranate spraying system has been developed by AICRP on FIM (IIT, Kharagpur centre). The

sensor, controller and non-return valve were attached to the commercially available air assisted spraying system and evaluated at research farm of MPKV, Rahuri. A ground wheel with proximity sensor was attached to the spraying unit to sense the forward speed. The spraying system was tested with and without sensor with turbo and hollow cone nozzles. The effective field capacity and number of plants covered were 0.88 ha/h and 1370 plants/h, respectively. The saving of spray solution was 25-30% with turbo nozzles and 45-50% with hollow cone nozzles.

Tractor drawn turmeric rhizome planter

A tractor rear mounted turmeric rhizome planter consisted of three ridger bottoms and planting mechanism for planting on one side of the ridge in

single pass (TNAU, Coimbatore Centre). The planting mechanism included hopper, cup feed type seed metering mechanism, metering shaft, shoe type furrow opener and spike tooth type ground wheel with chain sprocket drive. The row spacing of the planter can be adjusted. The effective field capacity of the unit is 0.15 ha/h and its cost is approximately Rs. 45,000/-.

Tractor operated garlic harvester

A tractor operated garlic harvester-cum-windrower has been developed by AICRP on FIM (MPUAT, Udaipur). The machine consists of a blade with triangular point knives mounted for lesser draft. The machine has chain type separating mechanism made of MS bars of 12 mm at spacing of 38 mm along with horizontal vibrating forks of 250 mm length at spacing of 200 mm for separation of soil from garlic bulbs. The windrower unit is made of MS bars at spacing of 25 mm and mounted at 90 degree to conveyor direction in two unequal halves. The equipment was driven by tractor pto. The field capacity of the harvester was 0.26 ha/h at forward speed of 2.4 km/h against manual harvesting capacity of 0.03 ha/h.

Tractor operated cassava harvester

The tractor operated cassava harvester consists of main frame, shanks, digging blade, hitching frame and depth adjustment wheels (TNAU, Coimbatore). It is designed for both two rows and single row operation. The shank has been designed as a bent leg plough with an angle of 150° to dig cassava tubers. The blade angle of 5° has been provided for easy penetration into the soil and wheels to adjust the depth of operation. The field capacity was found to be 0.08 ha/h for single row and 0.17 ha/h for double rows. Tuber recovery was 97.5% and damage was less than 1%. The cost of operation of cassava harvester is Rs. 2,380/ha and it saves 40% cost as compared to manual harvesting.

Tractor drawn turmeric digger

A 33.6 kW tractor drawn turmeric digger with working width of 1.45 m has been developed (ANGRAU, Hyderabad). The rake angle of digger blade was kept 55° with dead weight of 150 kg for deeper penetration. The developed turmeric digger was working well for digging the turmeric rhizome lying 200-250 mm depth. The field capacity of the implement was found to be 0.36 ha/h at forward speed of 2.5 km/h with operational cost of Rs. 4830/ha. The cost of the implement is Rs. 25,000.

Tractor operated fertilizer dibbler for ratoon sugarcane

A tractor operated fertilizer dibbler for ratoon sugarcane has been developed by AICRP on FIM (TNAU Coimbatore) for placement of fertilizer without soil disturbance in crop residue conditions. The implement consisted of revolving spade, fertilizer metering device, fertilizer placement funnel, soil covering and pressing device. The cost of the unit was Rs. 45,000/- and field capacity was found to be 0.2 ha/h with cost of operation of Rs.1550/ha.

All India Coordinated Research Project on Utilization of Animal Energy

Animal drawn helical blade puddler

A helical blade puddler has been developed for operation with bullocks having body weight of 300-350 kg (AAU, Jorhat Centre). The weight of the puddler is 26 kg and costs Rs 4,500. The draft requirement of the puddler is 450 N. Field capacity of puddler was found to be 0.04 ha/h with cost of operation Rs 600/ha.

Saddle for domesticated yak for pack load transport

The CAE&PHT, Gangtok Centre developed a saddle (weight: 3.2 kg, tensile strength: 24.8 N/mm^2, unit price: Rs 1000) for yak. The saddle was made of composite material (resins, hardener, reinforcement element, silica, glass wool, jute net) to ensure strength and durability. The maximum pack load of 120 kg can be carried by yak over a distance of 5.5 km on steep slope of 60 degree in two hours. The developed saddle was able to take 30% more load over traditional saddle.

Development of animal drawn multi-crop seed drill

An animal drawn seed drill was developed by AICRP on UAE (MPUAT, Udaipur Centre). Feed box consists of plastic discs having grooves/cups on the periphery. Two pneumatic wheels were provided for transportation on either side of the main frame through axles. One of these wheels drives metering mechanism. A clutch is provided to engage or disengage the power transmission to seed metering device. The draft requirement was 220 N which is well within the draught capacity of bullocks. The effective field capacity and field efficiency were 0.24 ha/h and 82.8%, respectively.

Evaluation of bullock drawn ridge type drum seeder

AICRP on UAE (OUAT, Bhubaneswar Centre) evaluated bullock drawn drum seeder with a small pair of bullock having body weight 500 kg per pair. The output was found to be 0.18 ha/h with field efficiency of 68.25%. The cost of the drum seeder was found to be Rs 13,500/- with operational cost of sowing pre-germinated paddy was Rs 118/ha. The bullocks could sustain the draft for 3 hours as the fatigue score was found to be 17.5. The average heart rate, respiration rate and body temperature were observed to be 90 bpm, 54.5 bpm and 37.80°C, respectively.

All India Coordinated Research Project on Ergonomics and Safety in Agriculture

Two wheel tractor trailer with safety attachment

A two wheel tipping trailer (5t) with safety features has a hydraulic braking system, a rear over turning protection mechanism, a side (lateral) overturning alarm indicator, rear lights and other safety feature (TNAU, Coimbatore Centre). Cost of the trailer is about Rs 2.50 lakh.

Power operated arecanut dehusker

A power operated (0.75 kW electric motor) arecanut dehusker with dehusking capacity of 20 kg/h was developed by Dr. BSKVV, Dapoli. It costs Rs. 25,000/- with operational cost is Rs 3.70/ kg as compared to Rs 5.10/ kg by manual dehusking.

Gender friendly three-row rice transplanter

A three-row rice transplanter suitable for women workers was developed by AICRP on ESA (OUAT, Bhubaneswar). The anthropometric data and strength parameters of women workers were considered for designing this transplanter. The mean working heart

rate of women workers was observed to be 126 beats/min, showing that the equipment can be comfortably operated throughout the day with normal rest pauses. The average field capacity was 0.017 ha/h. Weight of the unit is 18 kg and it costs Rs. 8,500/-.

Improved bamboo ladder

A light weight ladder made from locally available bamboos weighing 12.5 kg was developed by AICRP on ESA (CSKHPKV Palampur Centre**).** It's height is 2.4 m and costs Rs 1,050. This bamboo ladder can help the women workers to carry out the plucking of fruits comfortably. One worker can harvest about 100 kg of apples/h. It can also be used for plucking other fruits like apricot, walnut, pomegranate etc.

Personal protective equipment for use in cashewnut processing operations

Nine different types of hand protection devices were evaluated by AICRP on ESA (Dr. BSKKV, Dapoli Centre) for their suitability during de-shelling and scooping operation of cashewnut. The result showed that the pure latex (non-slip grip) glove resulted in higher capacity of deshelling (12.66 kg/h) with no sweating effect and no decrease in sensation to hands as compared to de-shelling without gloves (3.2 kg/h). In scooping operation, the mean output of a worker was 8.37 kg/h as against 2.15 kg/h without gloves. The gloves provided protection from cashewnut shell liquid and minimized chances of injury. Cost of these gloves is Rs 25.

Personal protective equipment for women workers in fish processing units

A study was carried under AICRP on ESA (Dr. BSKKV, Dapoli Centre), to identify suitable hand protection equipment for use in fish dressing activity. The study included finger coats, medical gloves, surgical gloves, cotton gloves and combination of medical and cotton gloves. The average capacity of dressing of fish without gloves was observed to be 36.6 kg/h as against 42.4 kg/h while using the combination of medical examination gloves inside and cotton gloves outside. It was observed that combination of medical examination gloves (inside) and cotton gloves (outside) provided good grip and protection from cold.

Single axis sun tracker

A photo sensor micro-controller based single axis sun tracker was developed by AICRP on EAAI (SPRERI, VV Nagar Centre). Microcontroller receives the signals available from the photo sensors to control the operation of DC motor that aligns the PV panel for maximizing absorption of the solar energy. The performance of the tracker was evaluated by fixing one kW_p PV panels on the mounting frame. Compared to the fixed mode, the PV panels generated 16 to 18% more energy in tracking mode. The fluctuations in the output voltage and the current were also found lower in the tracking mode. The estimated cost of the tracker is Rs 30,000.

Solar steam generation system

A solar steam generation system having thermal efficiency of 15.4% was developed by AICRP on PAU, Ludhiana centre. Three solar collectors each having aperture area of 1.90 m^2 was used. Each solar collector had 15 heat pipe type evacuated tubes of outer diameter 59 mm and length 172 mm. A heat exchanger connected to the solar collectors was installed in storage tank. The heated thermic fluid (Hytherm 600) from solar collectors is circulated through the heat exchanger. The approximate cost of the steam generation system was worked out to be Rs 80,000/-.

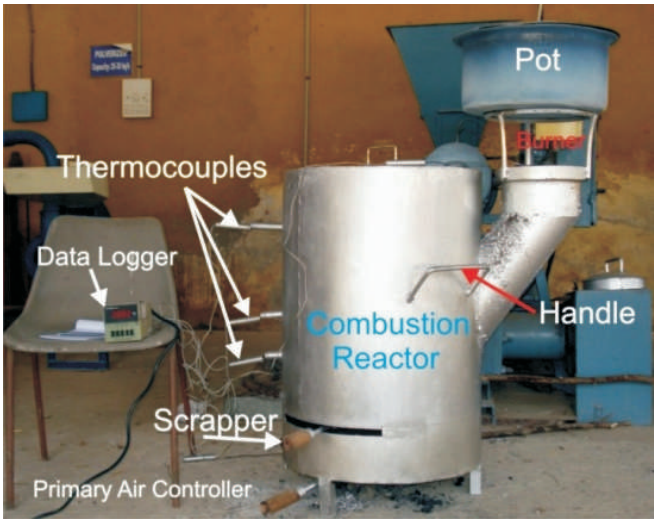
Humic acid extraction plant for slurry management

The AICRP on EAAI (MPUAT, Udaipur Centre) conducted experiments to extract humic acid (HA) from the biogas spent slurry (BSS) using different methods and analyzed the quantity & quality of HA. On the basis of laboratory experiments a prototype of Lab scale humic acid extraction plant (LSHAEP) having refluxing unit volume of about 13.0 ℓ was

developed and its performance was evaluated. The average yield percentage of HA from LSHAEP was found to be 13.22 % of total solids [TS] of BSS and E4/E6 ratio was 3.98. Fulvic acid (FA) which comes out after extraction along with HA may also be utilized for crop production. Extraction of HA and FA may be helpful in slurry management.

Biomass gasifier cook stove

The AICRP on EAAI (MPUAT, Udaipur Centre) designed a community sized biomass gasifier cook stove. The cook stove was made of MS cylinder of 540 mm outer and 400 mm inner diameter and height of 960 mm. Refractory cement and cerawool were used as insulation material to reduce heat losses and risk of burn injury. The developed cook stove consumes 3.0 kg of sized fuel wood (100×30mm) per hour. Thermal efficiency of cook stove is estimated to be 36.38 % with power rating of about 5.0 kW.



Pilot plant for glycerol refinement

Crude glycerol, a by-product of transesterification process contains 9.4% soap, 4.3% ash, 4.2% free fatty acid, 21.5% methanol and has pH of 10.8. A pilot plant for glycerol refinement was developed by AICRP on EAAI (TNAU, Coimbatore Centre). The pilot plant consists of a neutralization chamber of capacity 25 ℓ with a removable lid and an agitator set up. Neutralized glycerol was passed by gravity flow into a double jacketed methanol and moisture distillation reactor of 35 ℓ capacity with an agitator set up and heat supplied through a steam generator. A water cooled glass condenser was used to condense methanol and moisture. Vacuum distillation was conducted in the same chamber and the distillate collected in a chamber of 6 ℓ capacity. Vacuum distilled glycerol was drained into a decolourization chamber of capacity 2 ℓ. The yield of refined glycerol from 100g of crude glycerol by this process was 39%.

AWARDS AND RECOGNITIONS

Awards

Dr. KP Singh, Senior Scientist received NASI-ICAR award on July 29th from Hon'ble Union Agriculture Minister, Shri RM Singh. He received this award for design and development of farm tools and machines for reducing the drudgery of hill and tribal women. The award carries Rs. 1.00 lakh including citation and certificate.

Dr. S Mangaraj, Senior Scientist was awarded with ICAR Jawaharlal Nehru Award for PG Outstanding Doctoral Thesis Research in Agricultural and Allied Sciences. Dr Mangaraj completed his Ph.D. on the topic Modified Atmospheric Packaging of Apple, Guava and Litchi.

Dr. PC Bargale, Head, Technology Transfer Division was awarded Fellowship of the Indian Society of Agricultural Engineers (ISAE) for his professional achievements in the field of Agricultural Process Engineering. The fellowship has been conferred at the 49th Convention of the ISAE held at PAU, Ludhiana during February 23-25, 2015.

Dr. S Mangaraj, Senior Scientist was awarded Commendation Medal of the Indian Society of Agricultural Engineers (ISAE) for his professional achievements in the field of Agricultural Process Engineering. He received the medal in the 49th Convention of the ISAE held at PAU, Ludhiana during February 23-25, 2015.

Er Ajit Kumar Nayak, Scientist was awarded Young Scientist Award 2015 of MP Council of Science and Technology (MPCST) for his research article on Evaluation of wind load on the double arch type greenhouse and study its stability. He received the award in the 30th MP Young Scientist Congress held at MPCST Bhopal during February 24 to March 1, 2015. The award carries Rs 25,000/-, a trophy and a certificate.

Dr. S. Balasubramanian, Principal Scientist was awarded Fellow in Institution of Engineers (India)

Awards for best paper

The paper entitled "*Nutritionally and functionally*

rich food products with sprouted legumes and malted millets and fruits/vegetables" authored by Dr. Dipika Agrahar Murugkar, National Fellow won first prize in oral presentation at 5th International Conference on Advances in Food Technology and Health Science at JNU, New Delhi during October 15-16, 2014.

Dr. Nachiket Kotwaliwale, Head APPD received best paper award for the paper presented in International Conference on Emerging Research in Computing, Information, Communication and Applications (ERCICA-14) at Bangalore.

The paper entitled *Processing of pulses: Equipments and Technology*, published in Indian Food Industry, authored by Dr. S Mangaraj was awarded IFI Best Feature article (2013) by Associations of Food Scientist and Technologist, India. Dr. Mangaraj received this award during XXIII, ICFOST held at NIFTEM, Kundli during December 13-14, 2014.

Er. S Mandal, Scientist received the Best poster presentation award on paper titled "*Design and fabrication of low-cost portable biomass fired dryer and evaluation of its performance during drying of large cardamom"* during the 12th Agricultural Science Congress, NDRI, Karnal (Feb. 3-6, 2015).

Recognition

The Team of BPD Unit of the Institute was felicitated for excellent conduct of Krishi Parivartan Mela and Krishi Parivartan Yatra at CIAE. Mr. Onno Ruhl, Country Head, World Bank felicitated Dr. PC Bargale, PI, BPD-CIAE and Mr. Jitendra Chhabra, Business Manager at the Agri Innovation Conclave, NASC, New Delhi on May 19, 2015.

Two members of BPD-CIAE were also felicitated. Shri Ritesh Palival, an entrepreneur as well as a selected Yatri of Krishi Parivartan Yatra, trained and groomed at the unit was felicitated for successfully setting up an enterprise of Custom Hiring of Agricultural Machinery in Rajgarh, Madhya Pradesh. Another member, Er. Abhay Verma was honoured for developing and success-fully marketing millet based instant nutritional drink in Delhi-NCR. His business plan was adjudged among top 5 in the Agri Biz Idol Camp organized on this occasion.

Director in Committees

- Member, United Nations Environment Programme-Food & Agriculture Organizations (UNEP-FAO) Agri-Food Task Force on Sustainable Consumption and Production (ATF on SCP).
- Chairman, Agricultural Tractors and Power Tillers Sectional Committee (FAD-11), Food & Agriculture Division, BIS, New Delhi.
- Member, Executive Council and Sectional Committee-Agricultural Engineering of the National Academy of Agricultural Sciences (NAAS), New Delhi.
- Member, Board of Management, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, MP.
- Member, Agricultural and Processed Food Products Export Development Authority (APEDA), New Delhi.
- Member, Research Advisory Committee, Indian Institute of Crop Processing Technology (Ministry of Food Processing Industries), Thanjavur, Tamilnadu.
- Member, Board of Governors, Institute of Nano Science and Technology (Department of Science & Technology), Mohali.
- Member, Research Advisory Committee, Sardar Patel Renewable Energy Research Institute (SPRERI), Vallabh Vidyanagar, Gujarat.

LINKAGES AND COLLABORATIONS

Organization	Collaboration Issues
Central Agricultural University, Imphal	Biomass based decentralized power generation plant (50 kW)
NASF, ICAR, New Delhi	Research project on 'Use of machine vision for distinguishing among crop varieties'
SOPA, Indore	Soy-oil industry interaction
Women and Child Development Department	Soybean based foods - incorporation in public funded nutrition programmes
BIS, New Delhi	Development of draft standards for soy foods
NABARD, Chennai	Rural Innovation Fund- Research project - Design and development of improved millet mill (Rs. 12.73 L)
DST, New Delhi	Research project on "Development of mechanization system for effective sett/bud treatment for sugarcane" (Collaboration with Sugarcane Breeding Institute, Coimbatore, TN)
DST, New Delhi	Research project on "Development of handheld instrument for on field fibre content measurement in sugarcane" (Collaboration with Sugarcane Breeding Institute, Coimbatore, TN)
MoFPI, New Delhi	Research project on "Developing post harvest mechanization package for banana central core.(In collaboration with National Research Centre for Banana, Tiruchirapalli, TN)
Department of Agriculture and Co-operation, Ministry of Agriculture, New Delhi	Strengthening of Agriculture Machinery Testing Centre Multiplication evaluation of tools and machinery for harvesting in Oil palm in collaboration with DOPR, Pedavegi, AP
All India Agricultural Machinery Manufacturers Association (AIAMMA) MP Small Scale Agricultural Machinery Manufacturers Association	• Entrepreneurship Development Programme • Training to Entrepreneurs • Technology development

Organization	Collaboration Issues
Directorate of Agricultural Engineering, Govt of Madhya Pradesh MP Govt. State Department of Agriculture and farmers' welfare. Nationalized banks (SBI, CBI, BoI etc.) Dept of Agriculture & Cooperation, Ministry of Agri., Delhi MSME Development Institute, Indore NGOs (Hand in Hand India, KGVK Agro, Ranchi) ICRISAT, TNAU, IICPT, CFMTTI, Budni M/s TAFE, M/s Mahindra & Mahindra, M/s Bio Nutrient Pvt Ltd., M/s SRF Ltd., M/s Greenfield, M/s CLAAS Tractors, M/s JVS Foods Pvt. Ltd, M/s Valampuri Industries, Coimbatore, M/S AVM Engineering Industries, Salem, TN, M/s Perfura Technologies India (Pvt.) Ltd., Coimbatore. MP Co-op Dairy Federation for feed plant & Central Avian Research Institute, Izatnagar, Bareliy	♦ Entrepreneurship Development Programme ♦ Training to Entrepreneurs ♦ Technology development ♦ Technology Licensing ♦ Commercialization of technologies ♦ Liasioning for bank loans to the trained entrepreneurs

National Fund for Basic, Strategic and Frontier Application Research in Agriculture (NFBSFARA) Project

Project	Leader	Partners
Use of machine vision for distinguishing among crop varieties	CIAE Bhopal	IARI, New Delhi; NBPGR, New Delhi; C-DAC, Kolkata
Development of solar-hybrid refrigeration technology for on farm (in production catchments) safe transient storage of horticultural produce	SPRERI Vallabh Vidyanagar	CIAE, Bhopal and AAU

CONSULTANCY AND INTELLECTUAL PROPERTY

License agreement signed

Name of firm	Name of technologies
M/s Bio Nutrients (India) Pvt. Limited, M.P. Nagar, Bhopal	CIAE Soy-Butter
M/s TAFE Ltd, No. 861 Annasalai, Chennai – 600 002	Self-Propelled Hydraulic Multipurpose System for Orchard Operations
M/S AVM Engineering Industries, TN, Pin - 636004	CIAE Millet Mill
M/s TAFE, Chennai	1. Inclined Plate Planter 2. Roto Till Drill
M/s Valampuri Industries, Coimbatore	CIAE Millet Mill
M/s Perfura Technologies India (Pvt.) Ltd., Coimbatore	CIAE Millet Mill
M/s Global Greenfield Equipment India Private Limited, Coimbatore	Arecanut Sheath Shredder
M/s Nexgen Drying Systems Private Limited, Pune	Curry leaf stripper, multiplier onion peeler and aloevera gel extraction equipment

Patents Filed

Date of filling	Application Number allotted by the issuing Authority	Title	Innovator(s)
22.07.14	2356/MUM/2014	Commercial scale step wise expanding pitch fruit grader	Dr. ShukadevMangaraj Dr. R.K. Pajnoo
22.07.14	2357/MUM/2014	Multi millet thresher-cum-dehuller	Dr. K. P. Singh Er. R. R. Potdar

Copyrights Granted

Title	Worker(s)
Software for inventory management of perishable products (useful for food, feed and other perishables)	PP Ambalkar PC Bargale Karan Singh
Decision support system and business models for custom hiring of farm machinery	Anurag K Dubey RS Singh Karan Singh

Consultancy/ Contract projects undertaken by CIAE Bhopal

Consultancy /contract project(s) were taken with two private firms on food grain storage and soy industry plant hygiene with total consultancy fee of Rs. 4,87,369/- .

Commercial testing of farm machinery

Test reports of the following equipment, which were received for testing, have been provided to their manufacturers.

Name of Equipment	Manufacturer
Tractor Operated Seed Cum Fertilizer Drill (11 Tyne)	M/s Gurunanak Agriculture Implements Pvt. Limited, Jhansi (UP)
Knapsack Power Sprayer (2 Stroke)	M/s Padgilwar Agro Industries, Nagpur (Maharashtra)
Knapsack Power Sprayer (4 Stroke)	M/s Padgilwar Agro Industries, Nagpur (Maharashtra)
To Reversible Plough (Field King)	M/s Beri Udyog Pvt. Limited, Karnal (Haryana)
To Reversible Plough (Hydraulic)	M/s Sona Agro Equipment, Sehore (MP)
Tractor Op. Cultivator Field King (9 Tyne) Rigid Tyne	M/s Beri Udyog Pvt. Limited, Karnal (Haryana)
Tractor Op. Cultivator Field King Spring Loaded (9 Tyne)	M/s Beri Udyog Pvt. Limited, Karnal (Haryana)
Tractor Operated Cultivator (9 Tynes)	M/s Metalweld Engineering Pvt. Limited, Indore (MP)
Hand Operated Knapsack Sprayer	M/s Agro Life Science Corporation, New Delhi
Tractor Operated Cultivator (Duckfoot)	M/s Darbar Agro Equipment Pvt. Limited, Sehore (MP)
Tractor Operated Cultivator (7 Tynes)	M/s Shyam Industries, Satner, Betul (MP)
Tractor Operated Seed Drill (9 tyne)	M/s Metalweld Engineering Pvt. Limited, Indore (MP)
Tractor Operated Seed Cum Fertilizer Drill (9 Tyne)	M/s Metalweld Engineering Pvt. Limited, Indore (MP)
Tractor Operated Seed Drill (9 Tyne)	M/s Darbar Agro Equipment Pvt. Limited, Sehore (MP)
Tractor Operated Seed Drill (11 tyne)	M/s Metalweld Engineering Pvt. Limited, Indore (MP)
Tractor Operated Seed Drill (9 Tyne)	M/s Paras Engineering Works, Harda (MP)
Maize Thresher	M/s Ganga Industries, Ab Road, Dewas (MP)
Spring Loaded Cultivator (9 Tyne)	M/s Metalweld Engineering Pvt. Limited, Indore (MP)
Power Operated Knap Sack Sprayer	M/s Agro Life Science Corporation, New Delhi
Tractor Operated Seed Drill (9 Tyne)	M/s Swastika Engineering Pvt. Limited, Katni (MP)
Tractor Operated Seed Cum Fertilizer Drill (9 Tyne)	M/s Swastika Engineering Pvt. Limited, Katni (MP)
Tractor Operated Seed Drill (9 Tyne)	M/s Viswakarma Laghu Udyog, Sanwer, Ujjain (MP)
Tractor Operated Seed Cum Fertilizer Drill (9 Tyne)	M/s Laxmi Industries, Ratlam (MP)
Tractor Operated Seed Drill (9 Tyne)	M/s Ashwin Fabrication Udyog Pvt. Limited, Dewas (MP)
Tractor Operated Seed Drill	M/s Shani Engineering Works, Khurai, Sagar (MP)
Multi Crop Thresher	M/s Shani Engineering Works, Khurai, Sagar (MP)
Tractor Operated Boom Sprayer (Jet Stream:300 Litre)	M/s Premier Crop Protection Equipment Pvt. Limited, Faridabad
Tractor Operated Boom Sprayer (Jet Stream: 550 Litre)	M/s Premier Crop Protection Equipment Pvt. Limited, Faridabad

PUBLICATIONS

- Research Paper in national and international journals : 65
- No. of Books : 7
- Book chapters :9
- Popular articles : 38
- Technical bulletins : 18
- Paper presented : 44

Research Papers

1. Abraham A, SK Giri, MK Tripathi, R Singh, WE Devi and V Shukla. 2014. Optimization of fermentation conditions for the development of probiotic soymilk using *Lactobacillus paracasei 013* Strain. International Journal of Research in Engineering & Advanced Technology, 2(3): 1-8.
2. Agrahar-Murugkar D, P Gulati, N Kotwaliwale and C Gupta. 2014. Evaluation of nutritional, textural and particle size characteristics of dough and biscuits made from composite flours containing sprouted and malted ingredients. JFST, DOI: 10.1007/s13197-014-1597-y.
3. Agrahar-Murugkar D, P Gulati, N Kotwaliwale, C Gupta, SK Chakraborty and Aiman. 2015. Optimization of nutritionally rich instant porridge with sprouted legumes, malted millets and papaya and its comparison with conventional porridge in terms of textural, rheological and particle size properties. International Journal of Food and Nutritional Sciences (IJFANS), 4(1):49-58.
4. Agrahar-Murugkar D. 2015.Effect of different process parameters on the quality of soymilk and tofu from sprouted soybean. Journal of Food Science and Technology, 52(5): 2886-2893.
5. Ambrose DCP and SJK Annamalai. 2013. Development and performance evaluation of continuous type root vegetable washer. Madras Agric. J., 100(7-9): 774-776.
6. Ambrose DCP and R Naik. 2014. Studies on the mechanical drying of curry leaf. International Journal of Processing & Post Harvest Technology, 8 (1): 8-11.
7. Balasubramanian S, D Apramita, KK Singh, JD Bosco and MM Ashish. 2014. Application of glass transition in food processing. Critical Reviews in Food Science and Nutrition, DOI:10.1080/10408398.2012.734343.
8. Balasubramanian S, MG Jincy, M Ramanathan, P Chandra and SD Deshpande. 2015. Studies on millet idli batter and its quality evaluation.International Food Research Journal, 22 (1): 139 –142.
9. Balasubramanian S, MG Jincy, M Ramanathan, P Chandra and SD Deshpande. 2015. Studies on millet *idli* batter and its quality evaluation. International Food Research Journal, 22(1): 128-131.
10. Balasubramanian S, M Swapnil, Meshram and Vikash Shukla. 2015. Studies on physical properties of soybean seed and splits as influenced by moisture content. The Allahabad Farmer. LXX (2).
11. Balasubramanian S and R Viswanathan. 2014. Studies on compaction behavior of composite flours during uniaxial compression process of pasta making. Advances in Applied Research, 6(1):15-21.

12. Byale NA, VD Patil and BM Nandede. 2014. Influence of fertilizers on chlorophyll and anthocyanin pigments in Bt cotton. *Bioinfolet,* 11 (3A): 735 – 737.

13. Byale NA, VD Patiland, BM Nandede. 2014. Effect of fertilizers on the yield of bt cotton under rain-fed condition. *Bioinfolet,* 11 *(3A)*: 738 – 739.

14. Chakraborty SK, DS Singh and BK Kumbhar. 2014. Influence of extrusion conditions on the colour of millet-legume extrudates using digital imagery. Irish Journal of Agricultural and Food Research, 53(1): 65–74.

15. Chandel NS, VK Tewari, M Kumar and KR Jha. 2015. Development of a self-propelled jute seed drill cum rural cum transport. Agricultural Mechanization in Asia, Africa, and Latin America, 46(1): 7-13.

16. Dhakad MS, KVR Rao, KP Mistra and SK Verma. 2014. Economic feasibility of mole drains for soybean crop. Green Farming, 5(6): 1146-1149.

17. Dhakad SS, KVR Rao, V Agrawal and SK Verma. 2014. Effect of different mole drain spacings on the growth characters and yield of soybean in Raisen district of MP. Research in Environment and Life Sciences. 7(1): 23-25.

18. Dubey AK, MM Selvan and M Shyam. 2015. Biomass conversion for energy carriers: An analytical review on future issues for rural application in India. Agricultural Mechanization in Asia, Africa and Latin America, 46(1):43-47.

19. Gangil S. 2014. Distinct splitting of polymeric cellulosic signals in cashew shell: a TG-diagnosis. Cellulose, 21(4):2913-2924.

20. Gangil S. 2015. Benefits of weakening of thermo-gravimetric signals of hemicellulose and lignin for producing briquettes from soybean crop residue. Energy, 81: 729-737.

21. Gangil S. 2015. Superiority of intrinsic biopolymeric constituents in briquettes of lignocellulosic crop residues over wood: A TG-diagnosis. Renewable Energy, 76:478-483.

22. Guru PK, PS Tiwari and RK Naik. 2014. Physical properties of seeds and its effect on seed drill performance. International Journal of Agricultural Engineering, 7(1): 152-155.

23. Kaledhonkar MJ, SK Gupta, CK Saxena, DP Sharma and A Kumar. 2013. Emerging issues due to adoption of submersible pump technology in marginal quality areas of Haryana. Journal of Agricultural Engineering, 50(4): 58-64.

24. Kalyani G, S Balasubramanian and P Chandra. 2015. Plant based butters. Journal of Food Science and Technology, DOI: 10.1007/s13197-014-1572-7.

25. Khardiwar M, AK Dubey, D Mahalle and S Kumar. 2014. Performance of open core gasifier with briquettes of different crop residues. International Journal of Engineering Science & Research Technology, 3(5): 833-840.

26. Khardiwar M, AK Dubey, D Mahalle and S Kumar. 2014. Study on physical and chemical properties of crop residue briquettes for gasification. American Journal of Energy Engineering, 2(2): 51-58.

27. Khare AK, AK Biswas, S Balasubramanian, MK Chatli and J Sahoo. 2014. Optimization of meat level and processing conditions for development of chicken meat noodles using response surface methodology. Journal of Food

Science and Technology, 10.1007/s13197-014-1431-6.

28. Kollah B, G Dubey, P Parasai, JK Saha, S Gangil and, SR Mohanty. 2015. Interactive effect of biochar size and organic amendments on methane consumption in a tropical vertisol.Soil Use and Management, DOI: 10.1111/sum.12168.
29. Kulkarni SD. 2014. Defatted soyflour in bakery products - Potential vehicle for nutrition improvement and entrepreneurship. Processed Food Industry. 17(8):21-24 & 26.
30. Malviya N, MK Yadav, MK Tripathi, BK Sarangi and D Yadav. 2014. Environmental concerns for transgenic Plants: An overview. Octa. J. Biosci, 2(2): 86-90.
31. Mandal S, A Kunmar, RK Singh and SV Ngachan. 2014. Road Map for farm mechanization in Assam state. Indian J. of Hill Farming, 27 (1):51-61.
32. Mandal S, BC Verma, GI Ramkrushna, RK Singh and DJ Rajkhowa. 2015. Characterization of biochar obtained from weeds and its effect on soil properties of North Eastern Region. J of Environmental Biology, 36(2): 499-505.
33. Mangaraj S, TK Goswami and PV Mahajan. 2014. Development and validation of a comprehensive model for MAP of fruits based on enzyme kinetics theory and Arrhenious relation. Journal of Food Science and Technology, DOI: 10.1007/s13197-014-1364-0.
34. Mangaraj S, TK Goswami and DK Panda. 2014. Modeling of gas transmission properties of polymeric films used for MA Packaging of fruits. Journal of Food Science and Technology, DOI: 10.1007/s13197-014-1682-2.
35. Mehta CR, NS Chandel, T Senthilkumar and KK Singh. 2014. Trends of Agricultural mechanization in India, Policy Brief and Issue no.2. 2014. Published by United Nations, Centre for Sustainable Agricultural Mechanization.
36. Mehta CR, NS Chandel and T Senthilkumar. 2014. Status, challenges and strategies of farm mechanization in India. Agricultural Mechanization in Asia, Africa and Latin America, 45(4): 43-50.
37. Muthamilselvan M, R Naik, SJK Annamalai and V Kumar. 2014. Wet banana pseudostem chipper for compost industry. ICAR News. 20(1): 8, 10.
38. Nandede BM, H Raheman and GVP Kumar. 2014. Standardization of potting mix and pot volume for the production of vegetable seedlings in paper pot. *Journal of Plant Nutrition*, 37:1214-1226.
39. Nandede BM, H Rahemanand and HV Deore. 2014. Selection of suitable furrow opener and furrow closer for vegetable transplanter. Agricultural Mechanization in Asia, Africa and Latin America, 45 (2):40-47.
40. Nayak AK and KVR Rao. 2014. Estimation of wind load on a greenhouse and evaluation of its structural stability. International J. Agric. Engg.7 (2): 461-466.
41. Nayak AK. 2014. Evaluation of variation of instantaneous velocity and Reynolds stress due to spherical obstruction in a fluid flow. International J. Agric. Engg., 7(2): 432-435.
42. Nevase SS, CN Gangde, S Gangil and AK Dubey. 2014. Investigation on performance and emission from genset after supplementing liquefied petroleum gas with producer gas.

International Journal of Agricultural Statistics Science, 10(1): 259-264.

43. Nevase SS, CN Gangde, S Gangil and AK Dubey. 2014. Comparative study of producer gas and LPG based Power Plant. The Ecoscan. 8 (1&2): 115-119.
44. Saxena CK, SK Gupta, PC Purohit and SR Bhakar. 2015. Salt water dynamics under point source of drip irrigation. Indian Journal of Agricultural Research, 19(2): 101-113.
45. Selvan M, SJK Annamalai, K Katrivel and S Thambidurai. 2014. Human factors intervention and design improvement of manual single row cono weeder for gender neutrality in lowland rice. Agricultural Mechanization in Asia, Africa and Latin America, 45(4): 51-57.
46. Selvan M M, SJK Annamalai, N Thavaprakash and D Anathakrishnan. 2014. Design and development of three row improved pull type rice transplanter for small farms. The Indian Journal of Agricultural Sciences, 84(11):1422-1427.
47. Selvan MM, SJK Annamalai, K Kathirvel and S Thambidurai. 2014. Human factors intervention and design improvement of manual single row conoweeder for gender neutrality in low land rice. Agricultural Mechanization in Asia, Africa and Latin America, 45(4): 51-57.
48. Selvan MM, AK Dubey and KC Pandey. 2014. Advantaged performance of tractor engine fuelled with dewaxed degummed jatropha oil on long run evaluation under loads. The Indian Journal of Agricultural Sciences, 84(1):131-36.
49. Singh D and DP Mondal. 2014. Effect of quenching-tempering process and shot peening intensity on wear behaviour of SAE-6150 steel. Indian Journal of Engineering & Materials Science, 22: 168-178.
50. Singh D, KP Saha and DP Mondal. 2014. Effect of heat-treatment under changeable applied load on wear response of agricultural grade medium carbon steel: A multiple range analysis. Agricultural Engineering, Vol. 39 (4): 1-10.
51. Singh R, S K Giri and and KVR Rao. 2014. Respiration rate model for mature green capsicum (*Capsicum annum* L.) under closed aerobic atmospheric conditions. Croatian Journal of Food Science and Technology, 6 (2):110-115.
52. Singh R S, Surendra Singh and S P Singh. 2015. Farm Power and Machinery Availability on Indian Farms. Agricultural Engineering Today, 39 (1): 45-56
53. Singh RC and CD Singh. 2014. Design and development of an animal drawn farmyard manure spreader. African Journal of Agricultural Research, 9 (44): 3245-3250.
54. Singh RC, S Lenka and CD Singh. 2014. Conservation tillage and manure effect on soil aggregation, yield and energy requirement for wheat (*Triticum aestivum*) in vertisol. Indian Journal of Agricultural Sciences, 84 (2): 267-71.
55. Singh RC, D Singh, CD Singh and V Gonjari. 2015. Yield response to bed sowing of soybean and wheat crop in zero tillage with crop residue. Green Farming, 6(1): 55-59.
56. Singh RS, K Singh and A Dubey. 2014. Custom Hiring Business Model and Decision Support System of Agricultural Machinery. Agricultural Engineering Today, 38 (4): 31-36.

57. Singh S, RS Singh and SP Singh. 2014. Farm Power Availability on Indian Farms. AET, 38 (4): 44-52.

58. Tiwari PS, MM Pandey, LP Gite and AK Shrivastava. 2014. An ergonomic intervention in operation of a rotary maize sheller. Indian Journal of Agricultural Sciences, 84(7): 791-5.

59. Tiwari PS, MM Pandey, LP Gite and AK Shrivastava. 2014. Development of a dynapod for occupational activities in agriculture. Journal of Agricultural Engineering, 51(4): 33-39.

60. Tripathi MK and G Mittal. 2014. Effect of soaking on composition of soymilk. Medicinal Plant-International Journal of Phytomedicines and Related Industries, 6(2):108-113.

61. Tripathi L, AK Choubey, AK Dubey, PL Singh and S Gangil. 2014. Significance of bio-mass in reduction of global warming. Anusandhan Journal, 3(5):1-5.

62. Tripathi L, AK Mishra, AK Dubey, CB Tripathi. 2015. Biomass an alternate of coal. Indian Journal of Applied Research, 5(1):61-63.

63. Tripathi L, AK Mishra, AK Dubey, CB Tripathi. 2015. Water Pollution through Energy Sector. International Journal of Technology Enhancements and Emerging Engineering Research, 3(3):92-96.

64. Tripathi MK and SK Giri. 2014. Probiotic functional foods: Survival of probiotics during processing and storage. Journal of Functional Foods, 9:225-241.

65. Veenadhari S, CD Singh and B Mishra. 2014. Machine learning approach for forecasting crop yield based on climatic parameters. Computer Communication and Informatics (ICCCI): 2:1-5.

Books

1. Ali Nawab and S Mangaraj. 2014. Principles and Practices of Agricultural Processing. Satish Serial Publication, New Delhi. Total Page: 542, ISBN No.: 978-93-81226-94-0.

2. Mangaraj S. and Nawab Ali. 2015. Concepts and Terminology in Agricultural Processing. Satish Serial Publishing House, New Delhi. Total page: 295, ISBN No.: 978-93-84053-07-9.

3. Mangaraj S, RT Patil and P Chandra. 2014. Agro Processing and value addition for Entrepreneurship Development. Satish Serial Publishing House, New Delhi. India. Total page: 408, ISBN No.: 978-93-81226-90-2.

4. Senthilkumar T, SJK Annamalai and Ravindra Naik. 2014. Agricultural mechanization schemes of Govt. of India (Tamil), Booklet published by Agricultural Machinery Manufacturers Tamil Nadu chapter.

5. Singh Surendra and RS Singh. 2014. Energy in Production Agriculture. Published by DKMA, ICAR, New Delhi. ISBN No.: 978-81-910-388-5-9.

6. Singh RC. 2014. Conservation Agriculture Technology: Energy and Environment. Jaya Publishing House, Dilshad Garden, Delhi, pp: 350, ISBN No.: 978-93-82471-68-4.

7. Tripathi MK. 2013. Soy Food Analysis: Analytical and Molecular Approach. Lap Lambert Academic Publishing, Germany. Total page: 328, ISBN No.: 978-3-65946088-3.

Book Chapters

1. Chakraborty S, RKS Tomar and SK Chakraborty. 2014. Drudgery reduction of farm women in groundnut shelling. In: Technologies for Sustainable Rural Development – Having Potential for Social

Economic Upliftment (Ed. JP Shukla). Allied Publishers Pvt. Ltd., New Delhi. pp: 13-18, ISBN No.: 978-81-8424-862-3.

2. Chourasia MK, TK Goswami and S Mangaraj. 2014. Processing of Potato for Value Additions and Supply Chain. In: Agro Processing and value addition for Entrepreneurship Development (Eds. Mangaraj S, Patil RT and Chandra P, 2014). Satish Serial Publication, New Delhi, pp: 271-288, ISBN: 978-93-81226-90-2.
3. Deshpande SD. 2014. Application of Modified Atmosphere Packaging for Extension of Shelf-Life of Food Commodities. In: Polymers for Packaging Applications (Eds. Sabu Thomas, Sajid Alavi, KP Sandeep, Nandakumar Kalarikkal, Jini Varghese and Yaragalla Srinivasarao). Book Chapter in Section 4, Chapter 15, pp: 381 – 394, Apple Academic Press Inc., USA.
4. Dawn CP Ambrose and CT Devadas. 2014. Corrugated Fibre Board Boxes from Non-wood Fibre. Scholars Press, Germany.
5. Naik Ravindra, Dawn CP Ambrose and V Krithika. 2014. Role of Silicone membrane for increasing shelf life of perishables- A case study. Elsevier publication. National Conference on packaging Technology to Hasten Emergency Food Relief. Page 87-95.
6. Nath A, S Mandal, RK Singh, BC Deka and SV Ngachan. 2015. Ascorbic acid, ß-carotene and Antioxidant Activity of Broccoli during Short-term Refrigerated Storage. In: Processing and Impact on Active Components in Food, Ed: Victor R Preedy, Academic Press, James town Road, London, UK. pp: 27-34.
7. Rao KVR, R Keshri, S Simaya and L Chourasia. 2014. Techno-Economic study of paddy crop performance under drip and conventional irrigation. In: Technologies for sustainable rural development-having potential of socio-economic upliftment edited by Shukla JP, Allied publishers. 212-218.
8. Singh KP. 2014. Evaluation of conservation agriculture machinery on carbon emission: A case study, Conservation Agriculture for Carbon Sequestration and Sustaining Soil Health. New India Publishing Agency, ISBN No.: 978-93-83305-32-2, 392-401.
9. Singh RC. 2014. Role of farm machinery in success of CA. In: Conservation Agriculture for Carbon Sequestration and Sustaining Soil Health (Eds. J Somasundaram, RS Chaudhari, A Subba Rao, KM Hati, NK Sinha and MV Coumar), New India Publishing Agency, New Delhi, pp: 371-390, ISBN No.: 978-93-83305-32-2.

Popular Articles

1. Agrawal Nidhi, SP Singh, and N Kotwaliwale. 2014. *Kisano ke liye upyogi anaj safai evam shrenikaran hetu spiral separator machine*- Krishi Pariwartan, 2(3).
2. Chakraborty S and SK Chakraborty. 2014. *Bhojan mein dalon ka mahatwa*. Krishak Jagat, 17(5-11 January, 2015): pp. 16.
3. Chakraborty S, MS Parihar and SK Chakraborty. 2015. *Santra prasanskaran*. Krishak Jagat, 69(21): pp. 12.
4. Chakraborty S and SK Chakraborty. 2014. Minimally processed fruits and vegetables. Indian Farmers' Digest, 47(9): pp. 30-31.
5. Chandel NS, CD Singh, KP Singh and H Tripathi. 2014. *Raised bed planter dwara fashalo ke buwain tatha uske labh*, Bhumi Nirman, 12.

6. Chandel NS, H Tripathi, PS Tiwari and AK Dubey. 2014. *Sabji utpadan men unnat krishi yantronka upyog and mahatwa*. Kisan Kheti, 1(4): 89-90.
7. Chandel NS, H Tripathi and PS Tiwari. 2014. *Upaj nigrani pranali: Ek suniyojit krishi prodyaogiki*. KHETI. 66 (1): 27-29.
8. Dawn CP Ambrose. 2014. Tamarind– The Sour fruit used in Indian cuisine. Food & Processing World. Sept. pp: 63.
9. Dawn CP Ambrose and L Alice Daunty. 2015. *Moringa oleifera* "Mother's best friend – an ideal health food". Food & Beverage World, 42(2): 33-34.
10. Mohapatra D, Saroj Kumar Giri and Sumedha Deshpande. 2014. Processing and storage of mushrooms for value addition. Udyog prearna. 9(4): 68-71.
11. Khadatkar A, RR Potdar, H Wakudkar, BS Narwariya and N Saini. 2014. *Bharatiya krishi me mahilao dwara nidaye evam gudai ke liye prayukt hath chalet upkaran aur yantra*. Kisaan kheti 1 (3): 61-62.
12. Khadatkar A, RR Potdar, H Wakudkar and BS Narwariya. 2014. Some drudgery reducing hand tools and equipment used by women worker in Indian agriculture. Agri Gold Swarna Sedyam, 42-45.
13. Khadatkar A, RR Potdar, H Wakudkar and BS Narwariya. 2014. Women Friendly Tools and Equipment Used in Rice Cultivation. Popular Kheti, Issue – 2(3): 75-78.
14. Khadatkar A, RR Potdar, H Wakudkar and BS Narwariya. 2014. *Krishi me mahilao dwara kataie me prayukt kuch hasth sanchalit upkaran*. Kissan Kheti 1(4): 84-87.
15. Khadatkar A, RR Potdar, H Wakudkar, BS Narwariya, and Neha Saini. 2014. *Krishi me mahilaon ka swasth ster*. Kissan Kheti 1(4): 94-96.
16. Khadatkar A, RR Potdar, H Wakudkar and BS Narwariya. 2014. *Bhartiya krishi mei dhan ki kheti ke liye mahila upyogi unnat upkaran*. Kissan Kheti 1(4): 88-90.
17. Khadatkar A, RR Potdar, H Wakudkar and BS Narwariya. 2014. *Talabo me Makhana ki kheti evam bhuraie: ek paramparaik pranali*. Kheti, May issue, 20-21.
18. Khadatkar A, LP Gite, VK Gupta and H Wakudkar. 2014. An ergonomics role in harvesting makhana from ponds with improved system. Bharatiya Krishi Anusandhan Patrika, 29(3): 136-140.
19. Khadatkar A, VK Gupta, H Wakudkar, BS Narwariya and S Sharma. 2014. *Paramparik pranali se talabo me Makhana ki kheti me shamil kathin parishram*. Bharatiya Krishi Anusandhan Patrika, 29(1): 25-30.
20. Kulkarni SD. 2014. New trends in food processing: opportunity for food industry. Udyog Prerna 9(4): 8-14 & 16 (Sept. - Nov. 2014 issue).
21. Kulkarni SD. 2015. Food product development for export – need and concept. Udyog Prerna 10 (1):5-6, 11-14.
22. Kulkarni SD. 2015. Food product development for export – need and concept. Udyog Prerna 10 (1):5-6, 11-14.
23. Kulkarni SD. 2015. Importance of soy food products for food and nutrition security.IN Souvenir cum Proceedings of All India Seminar on Food Security – issues and Challenges (Feb. 13-14, 2015) organized by Institution of Engineers, New Delhi. pp: 66-75.

24. Kulkarni SD and SK Giri. 2014. Canning Industry – Way Ahead. Udyog Prerana, 9(3): 8-10, 13-20.

25. Kulkarni SD and SK Giri. 2015. Spices-Natural contributor to Food flavour, taste, colour and health. Processed Food Industry, 18(4): 16-17, 20-24.

26. Lenka S, NK Lenka, RC Singh, J Raghubansi and A Subbarao. 2014. *Soybean-Gahun fasal pranali par sarankshan Krishi parikshan*. Kheti, July 2015, pp 51-52.

27. Magar AP, BM Nandede and Dushyant Singh. 2014. *Sabjiyo ke poudhalagat ka yantrikaran: Dash evam disha*. Tech. Bulletin No: CIAE/2014/174, PP: 4.

28. Senthilkumar T, R Kavitha, Ravindra Naik. 2014. Mechanized rice planting and sowing, Agri gold Swarnasedyam, XVII (8) 39-40.

29. Senthilkumar T. 2014. Chisel plough (Tamil). Spic pannaiseithi, vol.4 (5): 7.

30. Senthilkumar T. 2015. Farm implements suitable for cultivation (Tamil), spic pannaiseithi, 4(6): 18-21.

31. Singh CD, NS Chandel, PS Tiwari, H Tripathi and K Golhani. 2014. *Multi crop thresher ka chunav, prachalan, surakcha awam rakhrakhav*. Bhumi Nirman. 18(1): 12.

32. Singh KP. 2014. *Carbon utsarjan ke niyantran me sanranchhan krishi ka yogdan*. Krishi Abhiyantriki Darpan. No 22-23: 5-6.

33. Singh PL and PC Jena. *Saur water pump ki dakshta badhane ke liye sukshm niyantrak adharit sun tracker*, Krishi Abhiyantriki Darpan, Vol. 24, 2014, pp10.

34. Singh RC, S Sharma, Reena Nayaer, Mukesh Singh and Ashish Patel. 2014. *Saheje mitti aum paryavaran*. Krashak Jagat, 28 May, 2014 pp.5.

35. Sinha LK and SD Kulkarni. 2015. Soy-millet extruded snacks based enterprises– A contributor to livelihood and rural development. Productivity 55 (3): 231-243.

36. Deshpande SS and Debabandya Mohapatra. 2014. Millets-potential, need and facts. Udyog Prearna. 9(4): 63-67.

37. Tiwari PS, K Golhani and NS Chandel. 2014. *Krishi men global positioning system kabadhata upyog*. Kheti, 66 (4): 26-28.

38. Tripathi MK. 2014. Fast facts about lecithin. Scientific India Magazine, Vol.2, issues.4, Pp 41.

Technical Bulletins

1. Agrawal KN, LP Gite and RR Potdar. 2014. *Madhya Pradesh mein krishi hetu suraksha upayay*. Technical Bulletin No. CIAE/AMD/KNA/2014/177.

2. Biennial Report 2012-14, ICAR-CIAE, Bhopal Centre, AICRP on Renewable Sources of Energy. Technical report No. CIAE/AEP/2014/445.

3. Dubey AK, S Gangil, PL Singh, M Shyam, S Kamraj, Venkatachalam, Shrivastava, KC Pandey and CR Mehta. 2014. Value chain on biomass based decentralised power generation for agro-enterprises. Technical Report No. CIAE/TTD/2014/166.

4. Dubey AK, BM Nandede, NS Chandel and AK Roul. 2015. Biannual progress report 2013-14, ICAR-CIAE Bhopal Centre, AICRP on FIM. Technical Report No. CIAE/AMD-FIM/2015/452.

5. Kumar Manish, GS Chouhan, Dushyant Singh and AP Magar. 2015. Biennial Workshop report

2013-2015 for ICAR-CIAE Bhopal centre. Technical Report No. CIAE / AMD / UAE / 2015 / 453.

6. Mehta CR, NS Chandel, BM Nandede, RK Tiwai and YS Bhokardankar. 2015. Research highlights 2015, Project Co-ordination Cell, AICRP on FIM, ICAR-CIAE Bhopal, and Technical Bulletin No. CIAE/ FIM/2015/179.
7. Ramana Rao KV and CK Saxena. 2014. Advances in Micro Irrigation Systems and fertigation under covered and open cultivation. Technical Manual No. CIAE / IDED / 2014 / 441.1-330.
8. Singh CD, CK Saxena, NS Chandel, KP Singh, H Tripathi. 2014. Application of Sensors, Wireless Sensor Network and Instrumentations in Precision Agriculture, ICAR-Central Institute of Agricultural Engineering, Bhopal 462 038 (India).Technical Bulletin No.CIAE / IDED / 2014 / 447.pp: 268.
9. Saha KP, D Singh, Manish Kumar, M Din, D Choudary, and DK Dwivedi. 2015. Status and utilizations of draught animal power in Madhya Pradesh. Technical Bulletin No. CIAE/UAE/2015/181.
10. Singh KP, Anil Kumar Dubey, Anil Kumar Dohre, Priyanka Pathak, Sanjeev Kumar, AribaFatmi. 2014. Success story, Raised Bed Former-cum-Seeder, Technical Bulletin No CIAE/2014/ 173.
11. Singh KP, CR Mehta, Anil Kumar Dubey, Mukesh Kumar Singh, UC Dubey. 2014. Conservation Agriculture Machinery and its scope to reduce carbon Emission: A case Study, Technical Bulletin No CIAE/2014/171.
12. Singh KP, RC Singh, Anil K Dubey, CD Singh, Mayuri Gupta, Anil Kumar Dohre, Sanjeev Kumar Garg. 2014. Raised bed cultivation technology for climate resilient agriculture, Technical Bulletin No. CIAE/2014/172.
13. Singh KP, RC Singh, Anil K Dubey, CD Singh, Mayuri Gupta, AK Dohare and SK Garg. 2014. Raised bed cultivation technology for climate resilient agriculture. Ext. Bulletin No. CIAE/AMD/172.PP. 8.
14. Singh KP. 2014. Design of small grain thresher, application of sensors, wireless sensor network and instrumentation in precision agriculture, Technical Report No CIAE/IDED/2014/447: 200-209.
15. Singh RC, PC Jena and PL Singh. A leaflet on technology developed in Agricultural Energy and Power Division, leaflet No. TL / AEP / CIAE / 2014/93.
16. Singh RS, KN Agrawal and K P Singh 2014. *Rashtra ke badalate parivesh me krishi abhiyantriki anusandhan ewam vikas ke naye aayam*, Technical Bulletin No.CIAE/2014/ 174.
17. Singh RS. 2014. Cost Economics and Custom Hiring Business Model of Agricultural Machinery. Technical Bulletin No. CIAE/IDED/2014/447: 210-2015.
18. Tiwari PS, NS Chandel, KN Agrawal, Karan Singh, Himanshu Tripathi and Kamlesh Golhani. 2014. Sensors and Actuators for Precision Farming.Training Manual for NAIP (ICAR) Sponsored National Training organised at CIAE, Bhopal during March 3-12, 2014. Technical Report No.CIAE/AMD/2014/434.

IMPORTANT COMMITTEES

Research Advisory Committee (RAC)

1	**Dr. BS Pathak** Former Director Sardar Patel Renewable Energy Research Institute (SPRERI) Vallabh Vidhyanagar	:	Chairman
2	**Dr. Jaskaran Singh Mahal** Dean College of Agricultural Engineering & Technology Punjab Agricultural University, Ludhiana	:	Member
3	**Dr. DC Joshi** Dean Faculty of Food Processing and Bioenergy Anand Agricultural University, Anand	:	Member
4	**Dr. Murari Shyam** Director Sardar Patel Renewable Energy Research Institute (SPRERI) Vallabh Vidhyanagar	:	Member
5	**Dr. Rajendra Singh** Dean-UGS Indian Institute of Technology, Kharagpur	:	Member
6	**Dr. KK Singh** Director Central Institute of Agricultural Engineering, Bhopal	:	Member
7	**Dr. Kanchan K Singh** Assistant Director-General (Farm Engineering) Indian Council of Agricultural Research, New Delhi	:	Member
8	**Dr. PC Bargale** Head Technology Transfer Division Central Institute of Agricultural Engineering, Bhopal	:	Member Secretary

Institute Management Committee (IMC)

1	Director, CIAE	:	Chairman
2	Dr. Kanchan Kumar Singh Asstt. Director General (Farm Engg.), ICAR, New Delhi	:	Member
3	Dean, College of Agril. Engg., JNKVV, Jabalpur	:	Member
4	Dr. SK Kamra Head, Div. of Irrigation & Drainage Engg., CSSRI, Karnal	:	Member
5	Dr. CR Lohi Director, CFMTTI, Budni	:	Member
6	Dr. Niranjan Prasad Head, PPDD, IINRG, Ranchi	:	Member
7	Dr. Sunita Singh Principal Scientist, IARI, New Delhi	:	Member
8	Dr. CR Thyagraj Principal Scientist, CRIDA, Hyderabad	:	Member
9	Shri AK Maheshwari FAO, Dir. of Soybean Research, Indore	:	Member
10	Shri Ravi Kumar Chief Administrative Officer Central Institute of Agricultural Engineering, Bhopal	:	Member-Secretary

Institute Research Committee (IRC)

1	Director, CIAE	:	Chairman
2	All Scientists of the Institute/ Head of Divisions	:	Member
3	Dr. Sandip Gangil, Principal Scientist	:	Member- Secretary

Institute Technology Management Committee (ITMC)

1	Director, CIAE	:	Chairman
2	Dr. CR Mehta, Project Coordinator, FIM	:	Member
3	Dr. LP Gite, Project Coordinator, ESA	:	Member
4	Dr. PS Tiwari, Head, AMD	:	Member
5	Dr. Sanjay Shrivastava, Principal Scientist, IISS, Bhopal	:	Member
6	Dr. Tarun Kapur, Principal Scientist, APPD	:	Member
7	Dr. S Gangil, Principal Scientist, AEP	:	Member
8	Dr. LK Sinha, Principal Scientist, APPD	:	Member
9	Dr. PC Bargale, Head, TTD	:	Member Secretary

Prioritization, Monitoring and Evaluation Cell

1	Director, CIAE	:	Chairman
2	Dr Tarun Kapur, Principal Scientist	:	In-charge
3	Dr S Gangil, Principal Scientist	:	Secretary
4	Dr KN Agrawal, Principal Scientist	:	Member
5	Dr Dipika Agrahar-Murugkar, Principal Scientist	:	Member
6	Dr UR Badegaonkar, Senior Scientist	:	Member
4	Shri Achuthan NM, Technical Officer (up to January 31, 2015)	:	Technical Officer
5	Shri K Shankar, Jr Stenographer	:	Administrative Support

Official Language Implementation Committee

1	Director, CIAE	:	Chairman
2	Dr Tarun Kapur, Principal Scientist	:	Member
3	Dr Anurag Dubey, Principal Scientist	:	Member
6	Dr KP Singh, Senior Scientist (w.e.f. 01.10.2013)	:	Member
7	Shri Ravi Kumar, CAO	:	Member
8	Shri Prashant Kumar, SFAO	:	Member
9	Dr SP Singh, Technical Officer	:	Member Secretary

RFD Committee

1	Director, CIAE	:	Chairman
2	Dr PS Tiwari, Head, AMD	:	Member
3	Dr PC Bargale, Head TTD	:	Member
4	Shri Prashant Kumar, Sr. F&AO	:	Member
5	Dr KN Agrawal, Nodal Officer-RFD	:	Member Secretary

Institute Joint Staff Council (IJSC)

1	Director, CIAE	:	Chairman
2	Dr RC Singh, Head, AEP	:	Member
3	Dr KN Agrawal, Principal Scientist	:	Member
4	Dr GS Chouhan, Senior Scientist	:	Member
5	Shri SK Dwivedi, Chief Technical Officer	:	Member
6	Shri Prashant Kumar, SFAO	:	Member

7	Shri Ravi Kumar, CAO	:	Member Secretary (Official Side)
8	Shri P K Dukhande, T-5	:	Member
9	Shri A C Gupta, T-5	:	Member
10	Shri P V Sahare, LDC	:	Member
11	Shri Krishna Bagde, SS-III	:	Member
12	Shri A K Kumre, SS-II	:	Member
13	Shri LK Manikpuri	:	Member Secretary (Staff Side)

Women Cell

1	Dr Sumedha S Despande	:	Chairperson
2	Dr Debabandya Mohapatra	:	Member
3	Dr Neeraja Lalan		Member
4	Smt Jolly John	:	Member
5	Smt Deepa Shinde	:	Member
6	Shri MK Raut	:	Ex-officio Member Secretary

EVENTS ORGANIZED

Krishi Parivartan Yatra

The World Bank funded National Agricultural Innovation Project (NAIP) of ICAR has been highly successful and has delivered more than 200 innovative technologies services and models that benefitted farmers and entrepreneurs across the country. To highlight and publicize the overall outcome of the Project, the ICAR–NAIP organized a Krishi Parivartan Yatra which started from ICRISAT Hyderabad on May 11, 2014 with a stopover at CIAE, Bhopal during May 14-15 , 2015 before its scheduled conclusion at IARI-NASC New Delhi during May 18-19 through a two day conclave.

At CIAE before the formal inauguration, a visit to Institute Labs and facilities was conducted for the 35 Yatris and the technologies developed by the Institute were demonstrated on May 15, 2014.

Besides the yatris, about 250 local stakeholders - farmers, researchers & extension functionaries, financial institutions, manufacturers/entrepreneurs, industrialists and policy makers participated to witness and extend the benefit of achievements of NAIP to all the stakeholders.

During the inaugural session, success stories of NAIP were presented through videos to share with the farmers/entrepreneurs of local geography. The inaugural session was followed by panel discussion on agribusiness opportunities in India. It was an interaction between Yatris from different states of India and local farmers and entrepreneurs. Few Yatris namely Shri Ritesh Paliwal (Madhya Pradesh), Shri Prem Sankar (Rajasthan), Shri T Prasad, Shri Sravanakumar and Shri Ramanathan (Tamil Nadu), Shri Abdul Khalek (West Bengal) and Shri Satisha (Karnataka) shared their experience and success stories. Several queries were raised by the farmers regarding fish production, vegetable production, organic farming, floriculture and scented rice production and package of practices. A press conference was also organized after the panel discussion in which more than 20 journalists/ reporters from Press Information Bureau interviewed the yatris.

NAAS Silver Jubilee Symposium

As part of the Silver Jubilee Celebrations of NAAS, CIAE organized a symposium on "Mechanization of Small Farms: Review and Road map for 25 years" on July 18, 2014 in collaboration with the Directorate of Agricultural Engineering, Madhya Pradesh. An exhibition on modern agricultural machinery was also held on the occasion for the benefit of the participating 400 farmers from all over the state and the delegates. The symposium and exhibition were inaugurated by Shri Gouri Shanker Bisen, Hon'ble Minister of Farmers Welfare and Agriculture Development, Govt. of Madhya Pradesh; Shri Lakhan Patel, MLA, Patharia, Dist. Damoh, M. P.; Dr. Anwar Alam, Convenor of the Symposium, Ex-Secretary, NAAS; Shri M. M. Upadhyay, Agriculture Production Commissioner, Govt. of Madhya Pradesh; Dr. V. S. Tomar, V. C., JNKVV, Jabalpur and Shri Rajeev Choudhary, Director, Directorate of Agricultural Engineering, Madhya Pradesh shared the dais in the inaugural function. The symposium was planned to present the road map for mechanization of small farms with the existing status of machinery availability and to project actions to be initiated for continued growth in mechanization leading to sustainable growth in Indian agriculture.

Rashtriya Sanghoshti

Rashtriya Sanghosthi (in Hindi) – *Rashtra ke badalate parivesh me krishi abhiyantriki anusandhan evam vikas ke naye aayam* was organized on July 28, 2014. Prof Anil Kumar Singh, Vice-Chancellor, RVSKV, Gwalior was the Chief Guest and Dr. PJ Sudhakar, Additional Director General, Press Information Bureau was the Guest of Honour. About 80 delegates participated in the sangosthi and 48 research papers were presented.

हिन्दी सप्ताह

संस्थान मे ंहिन्दी सप्ताह का आयोजन सितम्बर 22 से 27, 2014 तक किया गया । कार्यक्रम का समापन समारोह अक्टूबर 8, 2014 को पुरस्कार वितरण के साथ सम्पन्न हुआ । डॉ. के के अप्पू कुटटन, निदेशक, मौलाना आजाद राष्ट्रीय प्रौद्योगिकी संस्थान, भोपाल कार्यक्रम के मुख्य अतिथि थे। हिन्दी सप्ताह के दौरान विभिन्न प्रतियोगिताओं जैसे–प्रश्नमंच, तात्कालिक भाषण, वाद–विवाद, श्रुतलेख, तथा वैज्ञानिक शोध पत्र व पोस्टर प्रदर्शन प्रतियोगिताओं का आयोजन किया गया। इसके अतिरिक्त तकनीकी वर्ग हेतु भी हिन्दी प्रतियोगिता आयोजित की गयी ।

Swachch Bharat Abhiyaan

Swachch Bharat Abhiyaan (National Sanitation Campaign) was organized on October 2, 2014. All the employees of the institute participated in the cleanliness drive covering the institute premises and surrounding areas. The Krishi Vigyan Kendra (KVK) of the Institute organized awareness programme in villages for the farmers, farm women & rural youth about the Swatchh Bharat Abhiyan.

World Food Day

The World Food Day was celebrated on October 16, 2014 at CIAE with a theme Family Farming: Feeding the World, Caring for the Earth. Around 150 students from five schools of Bhopal participated in the celebrations. An open quiz show was conducted, which was followed by demonstration of soybean processing facilities.

Workshop of AICRP on ESA

The VII workshop of AICRP on Ergonomics and Safety in Agriculture (ESA) was held at Dr Balasaheb Sawant Konkan Krishi Vidhyapeeth (BSKKV) Dapoli during October 9-11, 2014. About 50 participants from ten co-operating centres and the host institutes attended the workshop. Project Coordinator Dr. LP Gite presented the achievements of the Project of last two years which included agricultural accident data, information on compensation paid by state govts. to agricultural accident victims, safe tractor trailer, spraying safety kit, personal protective equipment for workers for makhana harvesting, cashew-nut processing, and fish processing, pedal and power operated arecanut dehuskers, women friendly three-row rice transplanter, large cardamom harvesting knife, bamboo ladder for apple harvesting, dust minimization in rice mill, and trainings/ demonstrations on farm safety, ergonomically improved equipment and gender friendly equipment. Two publications namely Research Highlights of AICRP on Ergonomics and Safety in Agriculture, and Improved Gender Friendly Tools and Equipment for Rice Cultivation in India were also released on this occasion. During the workshop, progress report of various centres were presented and discussed in detail and further work to be done for taking the research results to the stakeholders was finalized. Research programmes and extension activities to be undertaken for next two years were also decided.

Workshop of AICRP on Farm Implements and Machinery

The XXX workshop of All India Coordinated Research Project on Farm Implements and Machinery (AICRP FIM) was held at Tamil Nadu

Agricultural University, Coimbatore during Feb 4-6, 2015. The inaugural session of the workshop was held under the chairmanship of Dr. K. Alagusundaram, Deputy Director General (Engg.), ICAR and Dr. K. Ramasamy, Vice Chancellor, TNAU, Coimbatore was the Chief Guest of the session. Three publications namely Research Highlights-2015, Directory of Crop Production Machinery Manufacturers in India and AICRP on FIM - At a glance, compiled by the Coordinating Cell were also released during the session. The progress under Research & Development, Prototype Manufacturing Workshop, Prototype Feasibility Testing and Front Line Demonstration activities under the scheme was presented by 24 centres of AICRP on FIM**.** The technical programmes to be taken up for the next two years by different centres was also finalised during the workshop. Special emphasis was given on Sugarcane and Cotton mechanization in association with the related industry. The workshop was attended by around 100 participants from Research & Development organisations from different SAUs and ICAR institutes, farm machinery manufacturers etc.

Workshop of AICRP on UAE

The XIV Biennial Workshop of AICRP on UAE was organized at Maharana Pratap University of Agriculture and Technology (MPUAT), Udaipur during February 18-20, 2015. Dr. KN Nag, Ex-Vice Chancellor, MPUAT, Bikaner was the Chief Guest and Dr. Kanchan K Singh, ADG (Engg), ICAR, New Delhi chaired the inaugural session. Dr NS Rathore, Ex-DDG (Engg.) ICAR and Professor, MPUAT, Udaipur was the Guest of Honour. Four publications namely 1) Status and Utilization of Draught Animal Power in Madhya Pradesh; 2) *Pasuon Ki Samanya Bimanriyan Aum Unka Upchar;* 3) *Pasu Parbandhan Ki Adhunik Taknikiyan*; and 4) Bullock drawn drum-seeder were released during the Inaugural session. The progress reports and technical programmes of different centres were presented by Principal Investigators/ Research Engineers of different centres of UAE during the workshop.

Farm Innovators day

Farm innovators day was celebrated on February 16, 2015 alongwith foundation day of CIAE. On this occasion five progressive farmers were felicitated for the success they achieved in their entreprises based on agricultural engineering technologies. Shri Kamlesh Sahu from Begumpura-Raisen, Shri Lakhan Patidar, Misrod, Shri Avtar Singh, Bersia (for custom hiring) and Shri Mohammad Ashfaq, Shahpuramagha-Raisen and Shri Rajkumar Ahirwar, Gudaval-Raisen (for polyhouse cultivation).

National Science Day

National Science Day was celebrated at the Institute on Feb. 28, 2015 with the purpose to promote Engineering Science in Agriculture. As part of the celebration, more than 200 students from different engineering colleges of Bhopal were invited and the whole day event included showcasing of innovative Agricultural Engineering technologies developed by CIAE, Bhopal and other institutes.

International Women's Day

A special programme was organized on March 7, 2015 to mark the International Women's Day. The Chief Guest of the occasion Veena Sablok- Pathak, Freelance Journalist, Bhopal delivered a talk on the situation of women and their rights in Indian society. A quiz on general knowledge was also conducted. Dr. KK Singh, Director, CIAE and Chairman of the programme expressed his views and highlighted the role of women in agriculture as well as other important service sectors. He also distributed prizes to the winners of quiz contest.

CIAE-Millet Mill launch Workshop

ICAR-CIAE Regional Centre- IEP, Coimbatore organized a CIAE-Millet mill launch workshop on April 27, 2014 at Coimbatore. The launch workshop was presided over by Dr. Pitam Chandra, Director ICAR-CIAE, Bhopal. Dr. N. Vijayan Nair, Director, Sugarcane Breeding Institute, Coimbatore, Dr. C. Divakar Durairaj, Dean, Agrl. Engg College and Research Institute, TNAU, Coimbatore, Er. Sivaprakasam, Superintending Engineer, Agrl Engg Dept, Govt. of Tamil Nadu, Coimbatore and Dr PC Bargale, Head TTD, CIAE, Bhopal were the guests of honour. They appreciated the timely development of this much needed equipment. Dr. S. Balasubramanian, Principal Scientist and designer of the CIAE-Millet mill summarized the salient features of the equipment.

Launch Workshop for Equipment for Value Addition of Banana Central Core

ICAR-CIAE Regional Centre- IEP, Coimbatore in collaboration with ICAR- National Research Centre for Banana, Tiruchirappalli, T.N. have developed package of equipment for value addition of banana central core, in partnership with a vegetable processing equipment manufacturer, M/s Ponnmani industries Nallampalayam, Ganapathy, Coimbatore. The package of equipment includes slicing, dicing, fibre removing equipment, surface water removing unit and juice extraction unit. The package of equipment was launched and demonstrated to the entrepreneurs involved in banana central core processing, equipment manufacturers, Self Help Groups and banana farmers on September 21, 2014 by Dr. Ravindra Naik, Senior Scientist of CIAE who has developed the package of equipment. The demonstration was followed by an interaction meet. Dr. SJK Annamalai, Principal Scientist and Head, CIAE Regional Centre gave an introduction of the package of equipment and explained its advantages over the traditional method of processing. Mr. N.R Natarajan, Managing Director of M/s Ponnmani industries, Coimbatore informed that whole package of equipment would cost about 1.00 to 1.75

lakhs depending on the equipment selected. The technology of banana central core stem slicing was transferred to an entrepreneur, Mr.Arumugham of Sri Vel Foods, Adichanallur, Thoothukudi district who is also registered with CIAE.

Meetings of the Institute Bodies

IMC Meeting

The 46th Institute Management Committee meeting was held on July19, 2014 under the chairmanship of Dr. Pitam Chandra, Director, CIAE. Members present during the meeting included Dr. CR Lohi, Director, CFMTTI Budni; Dr GS Rajput, Dean, College of Agricultural Engineering, JNKVV Jabalpur; Shri Rajiv Choudhary, Director, Directorate of Agricultural Engineering, Bhopal; Shri KN Khandelwal, Executive Engineer, Directorate of Agriculture, Jaipur; Dr. CR Thyagraj, PS, CRIDA, Hyderabad; Dr. Sunita Singh, PS, IARI, New Delhi and Shri Ravi Kumar, Chief Administrative Officer, CIAE & Member-Secretary, IMC. The meeting was also attended by Project Coordinators, Heads of Division and In-charges as special invitees.

The 47th meeting of Institute Management Committee (IMC) was conducted on February 21, 2015 under the chairmanship of Dr. KK Singh, Director, CIAE. The other members of the committee who attended the meeting were Dr CR Lohi, Director, CFMT&TI, Budni; Dr. Niranjan Prasad, Head, PPDD, IINRG, Ranchi; Dr Sunita Singh, Principal Scientist, IARI, New Delhi; Sh. AK Maheshwari, FAO, DSR, Indore and Mr. Ravi Kumar, CAO, CIAE. The meeting was also attended by the PCs/Heads/In-charges/ SFAO of CIAE as invitees.

RAC Meeting

The first meeting of newly constituted Research Advisory Committee (RAC for 2015-17) was conducted during March 23-24, 2015, under the chairmanship of Dr. BS Pathak, Ex-Director, SPRERI, VV Nagar. The other members of the Committee included Dr Jaskaran Singh Mahal, Dean, CAET, PAU, Ludhiana; Dr. DC Joshi, Dean, Faculty of Food Processing and Bioenergy, AAU, Anand; Dr. Murari Shyam, Director, SPRERI, VV Nagar; Dr. Rajendra Singh, Dean, UGS, IIT Kharagpur; Dr. KK Singh, Director, CIAE; and Dr. PC Bargale, Head (TTD) & Member-Secretary, RAC.

During two days meeting, the RAC members were apprised of the achievements of XI plan and new projects proposed to be taken up vis-à-vis XII Plan thrust areas. Besides an overall presentation by

Dr. KK Singh, Director, CIAE in this regard, detailed divisional level presentations by all heads of divisions were also made. Project Coordinators of FIM, EAAI, UAE and ESA also presented the countrywide scenario of achievements, on-going and future activities under their respective All India coordinated projects. The RAC members also visited various divisions and laboratory facilities.

Dr. BS Pathak, Chairman, RAC appreciated the on-going research and development activities and the achievements of the Institute. He stated that the mechanization has become an essential and integrated part of Indian agriculture and this provides an opportunity to CIAE to make its intervention effective and visible at National level through development of need based and efficient technologies. The committee members expressed that extension wings of CIAE should be initiated in different parts of the country especially in NEH region to cover mechanization, processing, energy and agricultural management aspects.

The RAC also stressed that the major emphasis of R&D should be to reduce cost of production, enhance input use efficiency and to reduce drudgery in agricultural operations and hoped that CIAE would rise to the occasion to accept and effectively address the new challenges for supporting Indian agriculture through engineering interventions.

DISTINGUISHED VISITORS

Shri Radha Mohan Singh, Hon'ble Minister of Agriculture, Govt. of India

Shri Gouri Shankar Bisen, Hon'ble Minister of Farmers Welfare and Agriculture Development, Govt. of MP

Ms Kusum Mehadele, Minister for Animal Husbandry, Food Processing and Public Health Engineering, Govt. of MP

Shri P.K. Pujari, Additional Secretary & FA (DARE/ICAR), New Delhi

Dr. K. Alagusundaram, Deputy Director General (Engg.), ICAR, New Delhi

Dr. R.C. Maheshwari, Former VC, SKDAU, Dantewada (Gujrat)

IAS Probationers on two days visit to CIAE

Dr. K. Alagusundaram, DDG (Engg.), & Dr. Kanchan K Singh, ADG (FE),ICAR, New Delhi visiting adopted village Kachhibarkheda

Dr. Manoj Nardeosingh, Assistant Secretary General, African-Asian Rural Development Organization (AARDO), New Delhi

RAC Chairman and Members

ICAR–NAIP Krishi-Parivartan Yatris

Dr. Anwar Alam, Former DDG (Engg), ICAR, New Delhi

Ms Kinkini Dasgupta Mishra, Division Head, GTCD, Vigyan Prasar, New Delhi

Prof. G.M. Karna, SIS, JNU, New Delhi

Faculty from IIFM, Bhopal

School Children on World Food Day

ONGOING RESEARCH PROJECTS DURING 2014-15

Sl. No.	Title of the Project	Investigators
	Agricultural Mechanization Division	
1	Tillage and manure interactive effects on soil aggregates dynamics, soil organic carbon accumulation and bypass flow in vertisols	RC Singh BK Garg
2	Development of spectral signature based variable rate granular fertilizer applicator for top dressing in rice and wheat crop.	BB Gaikwad RR Potdar Ajay Roul PS Tiwari
3	Adoption and resource assessment of agricultural machinery for resource conservation for permanent bed cultivation of cereals, pulses and oilseeds	RC Singh CD Singh KP Singh
4	Draft requirement of selected farm implements operating in vertisol for tractor implement matching	AK Roul HL Kushwaha BN Murhari
5	Development of On-the-go soil electrical conductivity and pH measurement device	PC Jain S Neenu (IISS)
6	Demonstration of conservation agricultural machinery in selected village cluster of MP State	K P Singh Manish Kumar Dr K P Saha
7	Development of GPS based variable rate granular fertilizer applicator for basal dose application	NS Chandel CR Mehta
8	Yield mapping through grain combine harvester fitted with yield monitors in soybean -wheat cropping system	KN Agrawal NS Chandel
9	Economics and energetic of rotary assisted bed maker -cum-seeder for cultivation of soybean and wheat crop	KP Saha KP Singh
10	Adoption of package of animal drawn implements for conservation agriculture under soybean-wheat and soybean -gram crop rotation	Manish Kumar AP Magar
11	Demonstration model for Transfer of technology for drudgery reduction of farm women in agriculture leading to enhancement in livelihood	A Khadatkar UC Dubey AK Dubey
12	Development of seeding system for kodo millet little millet carrot jute and adoption of mechanization package for production of kodo and little millet	BM Nandede NS Chandel Senthil Kumar
13	Development of spreader -cum-seed-fertidril for two stage differential depth placement of fertilizer	KP Singh KN Agrawal
14	Development of image based nitrogen fertilizer recommendation system for top dressing in rice and wheat crops	BB Gaikwad
15	Development of multipurpose vehicle for operations in vegetable crops	AK Roul D Singh
16	Design and development of a three row automatic vegetable transplanter for potted Seedling	A P Magar Dr. BM Nandede
17	Development of a tractor operated front mounted two row harvester for grain sorghum	BM Nandede D Singh AK Roul
	Agriculture Energy and Power Division	
18	Development of fast pyrolyser for agro residues	S Gangil AK Dubey
19	Development of micro-processor based single axis sun tracker for SPV panel	P L Singh P C Jena
20	Establishment of biogas cum solar energy based hybrid electricity generation system	P C Jena P L Singh
21	Development of solar PV based vapour compression refrigeration system (2.5 TR) for short duration transient/on-farm storage of fresh horticultural produce	PL Singh PC Jena S K Giri
22	Design and development of reactor for bio-char production and characterization	VK Bhargav S Gangil
Agro Produce Processing Division		
23	Development of soy and multigrain based nutritionally balanced functional foods for children(National Fellowship)	D Agrahar-Murugkar

Sl. No.	Title of the Project	Investigators
24	Development of process and equipment for cleaning and dehusking of kodo and kutki minor Millets	SD Deshpande S Balasubramanian
25	Impact of defatted soyflour supplemented food products on health of children	SS Deshpande
26	Defatted soy flour for food uses – Survey of soybean industries and policy issues for soy food promotion.	SD Kulkarni SSDeshpande S Mangraj
27	Use of machine vision for distinguishing among crop varieties	N Kotwaliwale K Singh Manoj Kumar V Bhushan Babu
28	Study on health response of differently processed soy foods consumed in India	P Chandra
29	Technology for production of probiotic culture and development of probiotic soy cheese spread and soy milk powder	MK Tripathi SK Giri
30	Technology for preparation of soy protein based hydrolysates	LK Sinha P Chandra D Mohapatra
31	Development of an automated packing line for spherical horticultural crops for a pack house	SK Chakraborty NKotwaliwale K Singh
32	Development of draft Indian standards for different soy based food products	SD Kulkarni P Chandra
Irrigation and Drainage Engineering Division		
33	Establishment of PFDC and its operations in MP	KVR Rao AK Nayak
34	Fertigation Strategies for fruit and vegetable crop(s) in vertisols	CK Saxena Ramadhar Singh RH Wanjari –IISS B L Lakheria-IISS
35	ORP on soil moisture based micro sprinkler (PC) irrigation	Ravi Kishore CK Saxena
36	Automatic green house management system using wireless sensors network	CD Singh KV Ramana Rao
37	Evaluation of drip irrigation systems in paddy-wheat cropping system for optimizing emitter spacing	KVR Rao
CIAE-IEP Coimbatore		
38	ORP on package of equipment for millet processing in tribal areas	Dawn CP Ambrose
39	Adoption of mechanization package for sugarcane single bud technology *(In collaboration with Sugarcane Breeding Institute, Coimbatore)*	SJK Annamalai P Govindaraj T. Arumuganathan
40	Demonstration/trails of post harvest mechanization package for banana central core. *(In collaboration with National Research Centre for Banana, Tiruchirapalli, Tamil Nadu)* *(Funded by MoFPI, New Delhi)*	R Naik DC P Ambrose KN. Shiva
41	Development of mechanization package for rope making from outer sheath of banana pseudo stem.*(In collaboration with National Research Centre for Banana, Tiruchirapalli, T. N.)*	R Naik SJK AnnamalaiKN Shiva
Technology Transfer Division		
42	Promotion of manufacturing of agricultural equipment through prototype production, capacity building and support to manufacturers/ entrepreneurs	AC Saxena
43	Capacity building through trainings & out-reach programmes	D Singh MB Tamhankar PC Bargale
44	Development of national database and its user friendly retrieval system on commercially manufactured agricultural equipment/ technologies.	MB Tamhankar Dushyant Singh K Singh PC Bargale RT Patil R Naik

RESULTS - FRAMEWORK DOCUMENT (RFD)

SECTION 1:
Vision, Mission, Objectives and Functions

Vision

To integrate engineering with agriculture for higher productivity, profitability and sustainability

Mission

To make Indian agriculture profitable, sustainable and globally competitive enterprise through engineering interventions of farm mechanization, irrigation and drainage, energy management in production and post-harvest activities.

Objectives

- To design, develop/refine and test equipment for crop production, higher input use efficiency, reduced dependency on conventional energy sources and value addition
- Transfer of agricultural engineering technologies
- To develop products and processes related to agricultural mechanization, energy management and post-harvest handling and value addition
- To develop and manufacture hardware and technology in co-operation with other ICAR Institutes and manufacturers in the area of field crops, horticulture, aquaculture and animal husbandry for production and processing
- To provide leadership and co-ordinate network of research with state agricultural universities for generating location specific technology and value addition
- To provide energy management in agriculture, irrigation and drainage and post-harvest technology
- To act as a centre for training in research methodologies and technology and conduct post graduate research programme leading to Master's and Doctoral degrees in Agricultural Engineering and to collaborate with relevant national and international agencies

Functions

- To undertake adaptive, applied and basic research leading to development/ improvement of equipment, technology, process for production, post-harvest technology and processing and energy use in agriculture and rural industries

SECTION 2:

Inter se Priorities among key Objectives, Success Indicators and Targets

S. No.	Objectives	Weight	Actions	Success Indicators	Unit	Weight	Target/Criteria Value				
							Excellent	Very Good	Good	Fair	Poor
							100%	90%	80%	70%	60%
1.	To design, develop/refine and testing of equipment for crop production, higher input use efficiency, reduced dependency on conventional energy sources and value addition	40	Design/development refinement of agricultural equipment	Improved equipment/safety gadget	Nos.	25	32	30	27	25	23
			Performance evaluation of agricultural equipment including irrigation equipment	Feasibility report and feed back on machinery and equipment	Nos.	15	34	32	28	25	20
2.	Transfer of agricultural engineering technologies	26	Capacity building of stake holders as SMSs/ farmers/ rural youth/women farmers	Trainings conducted	Nos.	10	105	95	85	80	75
			Dissemination of Agril. Engg. technologies through exhibition/On farm trials/Front line demonstration	Demonstration/OFT organized/Exhibition participated	Nos.	8	150	140	130	120	110
			Fabrication of prototypes of improved engineering technologies	Prototypes fabricated for various stakeholders	Rs. (in lakhs)	8	75	70	60	50	40
3.	To develop products and processes related to agricultural mechanization, energy management and post harvest handling and value addition	23	Processes for biofuel conversion from biomass and post-harvest value addition	Process protocols	Nos.	8	08	07	05	04	03
			Development/ evaluation of products	Innovative products	Nos.	6	04	03	02	01	00

S. No.	Objectives	Weight	Actions	Success Indicators	Unit	Weight	Target/Criteria Value				
							Excellent	Very Good	Good	Fair	Poor
							100%	90%	80%	70%	60%
			Database on agricultural accidents	No. of village for data collection	Nos.	5	600	500	400	300	200
			Energy management system	Energy audit report	Nos.	4	3	2	1	0	0
	Efficient functioning of the RFD system*	3	Timely submission of draft RFD 2013-14 for approval	On-time submission	Date	02	15/05/13	16/05/13	17/05/13	20/05/13	21/05/13
			Timely submission of results for 2012-13	On-time submission	Date	01	01/05/13	02/05/13	05/05/13	06/05/13	07/05/13
	Administrative Reforms	4	Implementation of ISO 9001 as per the approved action plan	% implementation	%	2	100	95	90	85	80
			Prepare an action plan for innovation	On-time submission	Date	2	30/07/2013	10/08/2013	20/08/2013	30/08/2013	10/09/2013
	Improving internal efficiency / responsiveness / service delivery of Ministry / Department	4	Implementation of Sevottam	Independent Audit of Implementation of Citizen's Charter	%	2	100	95	90	85	80
				Independent Audit of Implementation of public grievance redressal system	%	2	100	95	90	85	80

SECTION 3:

Trend Values of the Success Indicators

S.No.	Objectives	Actions	Success Indicator	Unit	Actual values for Year 2011-12	Actual values for Year 2012-13	Target values for Year 2013-14	Projected values for year 2014-15	Projected values for year 2015-16
1.	To design, develop/ refine and testing of equipment for crop production, higher input use efficiency, reduced dependency on conventional energy sources and value addition	Design/development, refinement of agricultural equipment	Improved equipment/safety gadget	Nos.	29	30	30	31	31
		Performance evaluation of agricultural equipment including irrigation equipment	Feasibility report and feedback on machinery and equipment	Nos.	37	30	32	32	34
2.	Transfer of agricultural engineering technologies	Capacity building of stake holders as SMSs/ farmers/ rural youth/women farmers	Trainings conducted	Nos.	130	91	95	105	110
		Dissemination of Agril. Engg. technologies through exhibition/On farm trials/Front line demonstration	Demonstration / OFT organized / Exhibition participated	Nos.	136	135	140	150	150
		Fabrication of prototypes of improved engineering technologies	Prototypes fabricated for various stakeholders	Rs (in lakhs)	73.74	78.98	70.00	75.00	80.00

3.	To develop products and processes related to agricultural mechanization, energy management and post harvest handling and value addition	Processes for biofuel conversion from biomass and post-harvest value addition	Process protocols	Nos.	05	05	07	07	07
		Development/ evaluation of products	Innovative products	Nos.	01	03	03	03	04
		Database on agricultural accidents	No. of village for data collection	Nos.	NA	NA	500	500	600
		Energy management system	Energy audit report	Nos.	NA	NA	2	2	3
	Efficient functioning of the RFD system	Timely submission of draft RFD 2013-14 for approval	On-time submission	Date	-	-	16/05/13	-	
		Timely submission of results for 2012-13	On-time submission	Date	-		02/05/13	-	
	Administrative Reforms	Implementation of ISO 9001 as per the approved action plan	% implementation	%			95		
		Prepare an action for innovation	On-time submission	Date			10/8/2013		
	Improving internal efficiency/responsiveness/service delivery of Ministry/Department	Implementation of Sevottam	Independent Audit of Implementation of Citizen's Charter	%			95		
			Independent Audit of Implementation of public grievance redressal	%			95		

SECTION 4: Acronyms

Sl. No.	Acronym	Description
1	OFT	On- Farm Trial
2	FLD	Front Line Demonstration
3	ICAR	Indian Council of Agricultural Research
4	SMS	Subject Matter Specialist
5	KVK	Krishi Vigyan Kendra
6	PPP	Public Private Partnership
7	MAP	Modified Atmosphere Packaging
8	SAU	State Agricultural University
10	AICRP	All India Coordinated Research Project
11	MoU	Memorandum of Understanding
12	R & D	Research and Development
13	PPC	Prototype Production Centre
14	CAD	Computer Aided Design
15	EMS	Electrical Management System
16	VMS	Vehicle Management System
17	PME	Prioritization Monitoring and Evaluation
18	RW	Research Workshop

SECTION 4: Description and Definition of Success Indicators and Proposed Measurement Methodology

Sl. No.	Success Indicator	Description	Definition	Measurement	General Comments
1.	Design/ development, refinement of agricultural equipment	Development of need based farm equipment/energy gadgets	R&D work on farm mechanization and energy management	Number	NIL
2	Performance evaluation of agricultural equipment including irrigation equipment	Evaluation of the improved equipment/technology	Suitability of improved equipment/technology under identified working conditions	Number of technology evaluated	NIL
3	Capacity building of stake holders as SMSs/ farmers/ rural youth/women farmers	Capacity building activities related to knowledge and skill improvement/ development programme conducted for farmers/SMSs/rural youth/women workers	Training is a process of acquiring new skill, attitude and knowledge in the context of preparing for entry to a vocation or improving productivity	Number	NIL
4	Dissemination of Agril. Engg. technologies through exhibition/On farm trials/Front line demonstration	Trials and demonstrations conducted for technology testing and proving the technology potential production	On-farm trials aims at testing new technology under farmers condition and management by using farmers own practice. FLD is the field level demonstration conducted at farmer's field under close supervision of scientist. Exhibiting the technology for wider publicity	Number	NIL
5	Fabrication of Prototypes of improved engineering technologies	Fabrication of the improved engineering technology	Manufacturing of the improved technology for dissemination by different agencies	Rs.	NIL
6	Processes for bio-fuel conversion from biomass and post-harvest value addition	Methodology to carry out a process	Development of methods to complete a process	Number	NIL
7	Development/ evaluation of products	New product generated through a process/ protocol from raw agro-produce	Development of prepared product	Number	NIL
8	Database on agricultural accidents	Survey carried out for agricultural accident occurred in selected villages	To ascertain the number and cause of accidents	Number of villages surveyed	NIL
9	Energy management system	Estimates of energy flow pattern of any selected enterprise	Estimation of input and output energy and its utilization pattern in the selected system	No. of audit reports generated	NIL

SECTION 5:

Specific Performance Requirements from other Departments

Location Type	State	Organisation Type	Organisation Name	Relevant Success Indicator	What is your requirement from this organisation	Justification for this requirement	Please quantify your requirement from this Organisation	What happens if your requirement is not met.
State Govt.	All states	Other	Other	Fabrication of Prototypes of improved engineering technologies	Requisition for prototypes of improved engineering technologies	Multiplication of research prototypes for multi-location trial	No. of locations to which supply to be made	Dissemination of new technologies would be slow

SECTION 6:

Outcome / Impact of activities of Organization/Ministry

S.No.	Outcome / Impact of organisation	Jointly responsible for influencing this outcome / impact with the following organisation (s) / departments/ministry(ies)	Success Indicator (s)	Unit	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016
1.	Commercialized agricultural engineering technologies	Farm machinery manufacturers	No. of technology for which MOU signed with manufacturer	No.	2	2	2	3	3
2.	Capacity building for production, operation and maintenance and entrepreneurship of engineering technologies	KVKs, State Govt. Departments, Manufacturers	Augmented trained manpower such as entrepreneurs, artisans and mechanics, farmers, rural youths and women	No.	4473	4574	4200	4500	4500

Annual (April 1 to March 31, 2014) Performance Evaluation Report of RFD of RSCs i.e. Institutions for the year 2013-2014

Name of the Division: Agricultural Engineering
Name of the Institution: Central Institute of Agricultural Engineering
RFD Nodal Officer: Dr. K. N. Agrawal

S. no.	Objectives	Weight	Actions	Success Indicators	Unit	Weight	Target/Criteria Value					Achievements	Performance		Per cent achievement against 90% column	Reasons for shortfalls or excessive achievements, if applicable
							Excellent 100%	Very Good 90%	Good 80%	Fair 70%	Poor 60%		Raw score	Weighted score		
1	To design, develop/ refine and testing of equipment for crop production, higher input use efficiency, reduced dependency on conventional energy sources and value addition	40	Design/development, refinement of agricultural equipment	Improved equipment/Safety gadget	Nos.	25	32	30	27	25	23	32	100	25	106.67	
			Performance evaluation of agricultural equipment including irrigation equipment	Feasibility report and feed back on machinery and equipment	Nos.	15	34	32	28	25	20	39	100	15	121.9	Good monsoon and favourable conditions helped AICRP centres to organize PFT activities

S. no.	Objectives	Weight	Actions	Success Indicators	Unit	Weight	Target/Criteria Value					Achievements	Performance		Percent achievement against 90% column	Reasons for shortfalls or excessive achievements, if applicable
							Excellent 100%	Very Good 90%	Good 80%	Fair 70%	Poor 60%		Raw score	Weighted score		
2	Transfer of agricultural engineering technologies	26	Capacity building of stake holders as SMSs/ farmers/ rural youth/women farmers	Trainings conducted	Nos.	10	105	95	85	80	75	107	100	10	112.6	A few custom hiring trainings were also organized on request from state Govt.
			Dissemination of Agril. Engg. technologies through exhibition/On farm trials/Front line demonstration	Demonstration/OFT organized/Exhibition Participated	Nos.	8	150	140	130	120	110	144	94	7.52	102.9	
			Fabrication of Prototypes of improved engineering technologies	Prototypes fabricated for various stakeholders	Rs. in lakhs	8	75	70	60	50	40	75.20	100	8	107.4	Prototypes were supplied as per demand
3	To develop products and processes related to agricultural mechanization, energy management and post harvest handling and value addition	23	Processes for biofuel conversion from biomass and post-harvest value addition	Process protocols	Nos.	8	08	07	05	04	03	08	100	8	114.3	
			Development/ evaluation of products	Innovative products	Nos.	6	04	03	02	01	00	04	100	6	133.33	
			Database on agricultural accidents	No. of village for data collection	Nos.	5	600	500	400	300	200	560	96	4.8	112.0	
			Energy management system	Energy audit report	Nos.	4	3	2	1	-	-	03	100	4	150.0	

S. no.	Objectives	Weight	Actions	Success Indicators	Unit	Weight	Target/Criteria Value					Achievements	Performance		Per cent achievement against 90% column	Reasons for shortfalls or excessive achievements, if applicable
							Excellent 100%	Very Good 90%	Good 80%	Fair 70%	Poor 60%		Raw score	Weighted score		
4	Efficient functioning of the RFD system*	03	Timely submission of RFD for 2013-14	On-time submission	Date	02	15/05/13	16/05/13	17/05/13	20/05/13	21/05/13	22/03/13	100	0	-	
			Timely submission of results for 2012-13	On-time submission	Date	01	01/05/13	02/05/13	05/05/13	06/05/13	07/05/13	27/04/13	100	1	-	
5	Administrative Reforms	04	Implementation of ISO 9001 as per the approved action plan	% implementation	%	2	100	95	90	85	80	-	-	-	-	
			Prepare an action plan for innovation	On-time submission	Date	2	30/07/13	10/08/13	20/08/13	30/08/13	10/09/13	27/07/13	100	2	-	
	Improving Internal Efficiency / responsiveness / service delivery of Ministry / Department	04	Implementation of Sevottam	Independent Audit of Implementation of Citizen's Charter	%	2	100	95	90	85	80	97.58	95.16	1.90	-	
				Independent Audit of Implementation of public grievance redressal system	%	2	100	95	90	85	80	100	100	2	-	
												Total	**100**	**95.22**		

•Per cent of Achievable Targets = Consolidated Achievements /Targets under 90% Column * 100

SENIOR OFFICERS & SCIENTIFIC STAFF

Director
KK Singh (w.e.f. 04/09/2014)
LP Gite (01/08/2014 to 03/09/2014)
Pitam Chandra (up to 31/07/2014)

Project Co-ordinators
LP Gite (AICRP on ESA) (up to 31/01/2015)
CR Mehta (AICRP on FIM)
KC Pandey (AICRP on EAAI)
M Din (AICRP on UAE)
(The text in the parentheses is the acronym of the scheme).

Heads of Division
PC Bargale (TTD)
R Singh (IDED)
RC Singh (AEP)
PS Tiwari (AMD-Incharge)
N Kotwaliwale (APPD)
(The text in the parentheses is the acronym of the Division).

Principal Scientists
Anil K Dubey (FMP)
AC Saxena (Mech. Engg.)
AK Dubey (FMP)
BK Garg (FMP) (up to 28/02/2015)
CD Singh (Electronics & Instrumentation)
D Agrahar-Murugkar (Food & Nutrition)
K Singh (Comp. App.)
KN Agrawal (FMP)
LK Sinha (AS & PE)
P Chandra (Bio Chemistry)
PL Singh (FMP)
RS Singh (Ag. Economics)
S Balasubramanian (AS&PE)
S Gangil (FMP)
SD Deshpande (AS & PE)
SD Kulkarni (AS & PE)
SJK Annamalai (FMP)
SS Deshpande (Home Science)
S Ganesan (FMP)
T Kapur (AS & PE)

Senior Scientists
CK Saxena (SWCE)
D Mohapatra (AS&PE)
D Singh (Mech. Engg.)
DCP Ambrose (AS&PE)
GS Chouhan (FMP)
KP Saha (Agricultural Economics)
KP Singh (FMP)
KVR Rao (SWCE)
MK Tripathi (Bio Chemistry)
PC Jain (Electronics & Instrumentation)
R Naik (AS&PE)
R Singh (AS&PE) (up to 08/05/2014)
S Mangraj (AS&PE)
SK Chakraborty (AS&PE)
SK Giri (AS&PE)
T Senthilkumar (FMP)
UC Dubey (FMP)
UR Badegaonkar (FMP)
VK Bhargav (FMP)

Scientist (SG)
MB Tamhankar (FMP)

Scientist (SS)
V Bhushana Babu (Agricultural Statistics)

Scientist
A Khadatkar (FMP)
AK Nayak (SWCE)
AK Roul (FMP)

A Yadav (Food Technology)
AP Magar (FMP)
BB Gaikwad (FMP)
BM Nandede (FMP)
Manish Kumar (FMP)
Manoj Kumar (Agricultural Statistics)
NS Chandel (FMP)
PC Jena (FMP)
RR Potdar (FMP)
S Mandal (FMP)
Sadvatha RH (APE)
(The text in the parentheses is the acronym of the discipline)

Chief Administrative Officer
Ravi Kumar

Senior Administrative Officer
Kumar Vivek

Senior Finance & Accounts Officer
Prashant Kumar

Assistant Administrative Officers
A Wabhale
BD Mashoria (up to 28/02/2015)
MK Raut
ML Siyote
RK Raina
KG Sudarshanan

Junior Accounts Officer
Sanjay K. Singh (w.e.f. 17/12/2014)

Incharges
AC Saxena (PPC)
BK Garg (CAD Cell) up to 28.2.2015
GS Chouhan (VMS) (up to 09.11.2014)
K Singh (Library)
KP Singh (CAD Cell) (w.e.f. 1.3.2015)
RK Pajnoo (VMS)
Ravinder Singh (Farm Section)
SK Dwivedi (Guest House and EMS)
T Kapur (PME Cell)
UR Badegaonkar (ATIC and AV Cell)
VK Bhargava (RW)

The text in the parentheses is the name of the section/ cell/ unit