

From the Director's Desk



Agricultural engineering in coming decades is poised for fundamental changes in the scope of its agenda and would in all likelihood embrace biological, environmental, food and nutrition engineering for comprehensive and holistic solutions. Agricultural engineering would not only be involved in problem solving but would be playing important role in policy formulation and social engineering. Modern engineering interventions in agriculture that we aim at, are to provide right timing and right sizing of the mechanical inputs, to improve input use efficiencies, to reduce cost of cultivation, to provide better control over the pre and post-harvest operations, to reduce post-harvest losses, to add value to produce, to harness

energy through clean sources, to prevent burden on environment, manpower and animal power, and to make agricultural operation safer, more comfortable and gender neutral.

Precision farming, automation of unit operations, robotics, machine learning, artificial intelligence, internet of things, autonomous farm vehicles, smart packaging, mobile based applications for farm machinery, irrigation and storage management are some of the areas that we aspire to put our thrust in the development of indigenous, cost effective, faster and reliable machinery, tools and applications for the prosperity of farmers and agri-businesses. This institute has been instrumental in mechanization of Indian agriculture since inception. The need of small and medium farmers as well as entrepreneurs has remained a matter of concern. In last five years the institute has licensed around 40 technologies. The economic impact of some of our selected technologies has been estimated as Rs. 4400 Crore per year. Our efforts have also resulted in progress of agricultural machine manufacturing industry and related businesses. For example, there are around 1000 agri-machinery custom hiring centers operating in the Madhya Pradesh who have been trained by us, there are around 200 soy processing entrepreneurs across the country to whom we have imparted required training and around 100 farmers have adopted protected cultivation due to our efforts.

This issue of the newsletter focuses on equipment involved for pigeon pea culture like the Tractor drawn battery operated drum type pneumatic precision dibbler/ planter, Tractor front mounted hydraulically operated two-row

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pigeon pea harvester, Tractor operated single row cassava harvester cum lifter, Vertical cup type vegetable transplanter for cell feed nursery etc. Apart from these, few other equipment like Tractor operated auger plough for green manuring and straw incorporation, Water level indicator for rice fields, Banana sucker paring device, Power operated carrot harvester cum detopper for hilly region are also being presented in this issue.

In this quarter, a couple of ICAR sponsored Winter Schools were organized besides Skill Development Training and Training on Entrepreneurship Development Programme etc. On the occasion of the 44th Foundation day of the Institute, Agri-Tech-Expo was organized which had events like Kisan Mela and Academia-Industry Interaction meet. Above 2000 farmers and around 50 manufacturers participated in the event. Other major events of the quarter include Research Advisory Committee and Institute Management Committee meetings, celebration of International Women Day, National Seminar on 'Role of Indian Standards in Testing, Quality Control and Safety of Agricultural Machinery'. I also take this opportunity to wish best of luck to our superannuated staff, and congratulate our colleagues who got promoted during this quarter. It is my proud privilege and pleasure to present this volume of the CIAE Newsletter.

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Boom sprayer for small tractor

Small tractors of less than 20 hp are getting popular for orchards management as well as for field crops in small farms. A boom spraying system suitable for field and orchard crops was developed for small tractor mounted on three point linkage has been developed. The system consists of a tank of 300 I capacity, three cylinder axial piston pump, boom fitted with hollow cone nozzles, solenoid valve, non-return valve and solenoid valve control system. The pump has been fixed over the drawbar and driven by the PTO of the tractor by belt pulley arrangement. A tank was fitted on the ROPS of the tractor. The total length of the boom has been kept as 7 m. Flexible type hinges have been fabricated to five folds the booms easily. The fold system has been arranged in such a way that, the spray boom could be fixed in horizontal as well as in vertical position according to the need of orchard crop canopy geometry.

Three point linkage system has been developed to mount the nozzles boom in variable height according to crop height. Normally open (NO) type solenoid valve fitted in the delivery line stops the discharge at the head land during turning by activation of a switch mounted at the dashboard. Performance of the developed spraying system was evaluated in *rabi* maize sown at 450 mm row spacing. The effective field capacity of the sprayer has been observed as 1.8 ha/h at forward speed of 2.8 km/h.



Pneumatic precision dibbler/ planter for pigeon pea

A tractor drawn battery operated two-row drum type pneumatic precision dibbler/planter has been developed for pigeon pea. It consists of an aspirator, cylindrical drum as metering device, seed ejector, seed delivery tube, shoe type furrow openers, pair of ground wheels and chain sprocket type power transmission system. It is suitable for sowing of single and two seeds of pigeon pea per hill. The planter can be adjusted to plant the seeds at row spacing of 75 and 90 cm and plant spacing of 10-90 cm. Metering mechanism consists of 90 mm diameter PVC pipe. About 10 orifices of size 4 mm at desired row spacing have been provided. The metering unit is powered by a ground wheel. Seed boxes have kept inclined to ease the seed flow. Laboratory results at the forward speed of 1.0 km/h at 1.5 kPa operating pressure with 4 mm orifice size gave 88-90% picking of two seeds as desired, 6-7 % three seeds and 4-5% single seeds with the variation in set plant spacing of $\pm 1-3$ cm. The same unit of two-row drum type pneumatic planter was evaluated in the field and it was observed that it could successfully be operated up to the forward speed of 4-6 km/h at operating pressure of 2-3 kPa and orifice size of 4 mm. Similar results have been obtained in the field as well as in the laboratory conditions. The field capacity of the developed machine varied from 0.5-0.6 ha/h with field efficiency of 80%. The approximate cost of the developed machine is about Rs. 50,000/- and the cost of the operation has been estimated as Rs. 1000-1200/ha.



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Technical specifications of tractor operated two-row pigeon pea pneumatic planter

Parameter of planter	Details
Overall frame dimensions, mm	1000 x1250 x350
Seed type	Pigeon pea
Type of metering mechanism	Pneumatic type
Suction unit	Blower (Make: Makita, Model: DUB362)
Power source for blower	Two rechargeable batteries (Capacity: 5Ah; 18V)
Working pressure, kPa	1.2
Orifice diameter, mm	4
Number of rows	2
Number of Seed boxes	2
Number of ground wheels	1 or 2
Diameter of ground wheels, mm	450
Seed box dimensions, mm	250×130×90
Number of furrow openers	2
Field capacity, ha/h	0.5-0.6
Field efficiency,%	80 %
Approximate cost of machine, Rs.	50,000/-
Cost of operation, Rs/ha	1000-1200

Pigeon pea harvester

Traditionally harvesting of pigeon pea is done manually with sickle, which demands considerable amount of labour, drudgery and time to harvest. A suitable tractor operated machine for harvesting of pigeon pea crop has been an immediate need which can remove drudgery, reduce losses and increase productivity, reduce turn about time in two crop season, avoid weather risk, achieve low cost of harvesting and derive benefit from early marketing of produces.

A tractor front mounted hydraulically operated two-row pigeon pea harvester has been developed. It consists of two cutter blades mounted over front hydraulic platform and a row divider fitted between these two blades for dividing crop rows during harvesting. Hydraulic system developed for operating blades at high speed and setting the cutting height with the help of hydraulic platform over which blades move up and down. The hydraulic system is powered by PTO rotating at 540 rpm. Oil sump has been provided at rear of the tractor for stability purpose. High speed of blades with high torque is obtained by using hydraulic gear motors in the blade assembly. Due to high speed of blades rotating in opposite direction the crop cuts and falls down outside in a row. The machine can cut the pigeon pea crop at 10-15 cm above the ground level.

The field capacity of the developed harvester has been observed as 0.5-0.6 ha/h with field efficiency of 83%. The approximate cost of the developed harvester is Rs. 40,000/- and cost of the operation is Rs. 1800-2000/ha. It can help to save the manual labour to the tune of 96% in harvesting operation.



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Technical specifications of tractor operated two-row pigeon pea harvester

Parameter of Harvester	Details
Overall dimensions, cm	520×110×100
Type of cutting mechanism	Rotating blades
Blade dia., mm	400
Blade revolution speed, rpm	1000-1500
Power unit	PTO (540rpm)
Power source for blades	Developed Hydraulic system
Vertical adjustment, mm	250-350
Horizontal adjustment, mm	150-200
Suitable for Row spacing, mm	700-900
Number of blades	2
Oil sump dimension, mm	610×310×530
Row Divider front angle	60°
Number of rows	2
Material used: main frame, hydraulic system	Mild steel
Blades	High carbon steel
Hydraulic pipes	Rubber
Propelling unit	20 hp tractor
Power transmission system	Hydraulic

Impact assessment of custom hiring centres and high-tech machinery hubs in Madhya Pradesh

Conducted a survey of 51 CHCs and high tech agricultural machinery hubs in three districts namely Jabalpur, Katni and Narsinghpur during the quarter. Custom hiring centres with average investment of Rs.20-25 lakhs of are equipped with two tractors, rotavator, reversible plough, cultivator, seed drill, raised bed planter and other equipment as per requirement and are earning average annual profit in the range of Rs. 1.5-3.5 lakhs with an average turnover of 4.5 to 9.0 lakhs with saving in time and critical inputs. High tech agricultural machinery hubs of sugarcane have also been set up which include sugarcane harvester, tractors, infielders and trolleys with a total investment of about Rs.150 lakhs are harvesting sugarcane crop in the range of 6000-10000 tonnes per season.

Power operated carrot harvester cum detopper for hilly region

Harvesting is the one of the critical operation for carrots and can be harvested when they are about an inch in diameter. For digging and pulling out one hectare area of carrots, on an average, about 350 – 450 man-hours are required which is very costly for farmers. The operator has to stoop forward while digging/pulling carrot from the bed and also during picking up. Stooping posture results in a lot of bio-mechanical stresses in the back and has higher energy consumption as compared to other working positions. Continuous use of bare hands for pulling out carrots may cause bruises on hands leading to infection. Due to this, the crop is cultivated on small scale and is one of the main bottlenecks in increasing the area under the carrot cultivation. The large scale diversification and reduction in cost of cultivation in carrot crop is possible through mechanization of carrot sowing and digging process. Carrot cultivated in hilly regions requires specially designed small power operated equipment for harvesting. To cater the above need, a selfpropelled carrot harvester has been developed.



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The developed power operated carrot harvester consists of the following units say, 1. Digging unit 2. Conveying unit 3. De-topping unit 4. Collecting unit 5. Main frame 6. Prime mover with Power transmission system. The digging unit consists of two circular blades placed vertically before the conveying unit. The conveying unit consists of two endless belt rotating in opposite direction, which is able to hold the carrot crop, lift and conveyed to the end of conveying unit. The developed unit is self-propelled type with 6 hp petrol engine. The detopping unit consists of circular blade to detop the crop canopy from the carrot root. From the field test data the digging efficiency, conveying efficiency, detopping efficiency and carrot damage was observed as 92.16, 97.14, 97.84 and 7.35 per cent respectively. The actual field capacity of the unit is 0.028 ha h⁻¹.

Banana sucker paring device

Before planting, banana rhizomes need to be trimmed and treated with fungicides, bio-control agents or hot water for control of nematodes. It is traditionally done by knife or sickle which is a tedious operation. To mechanize this operation, a banana sucker paring equipment with rotating grating blade mechanism has been developed in collaboration with ICAR-National Research Centre for Banana, Trichy, Tamil Nadu. The equipment consists a grating blade that rotates in vertical plane operated by 1 HP motor. The banana sucker to be trimmed is held against the rotating grating blade (300 mm) and adjusted as per the area and the depth of the banana sucker. A variable speed motor is attached to the unit to adjust the operating speed. To clean the grating blade, it is rotated in the opposite direction while a cleaning brush is held against the metallic



grating area to be cleaned. The capacity of the equipment is 90 suckers/hour at an efficiency of 70%.

Auger plough for green manuring and straw incorporation

In traditional practice, the green manuring and straw incorporation involve high labour requirement and cost. The green manure and straw need to be cut effectively and incorporated in single pass for well preparation seedbed. To address the problem of incorporation of green manure and straw by farmers of Punjab, a tractor operated two bottom auger plough has been developed by PAU Ludhiana centre of AICRP on FIM. The machine is a combination of cutting unit, truncated/shortened mould board and vertical rotating clod-crusher/soil-ripper. The cutting unit cuts the crop mass into small pieces. The share of MB plough cuts the furrow slice and the shortened mould board lifts it. Finally, the vertical rotating auger behind each bottom pulverizes the furrow slice and buries the crop biomass. Initial field trials were conducted to incorporate green manure crop dhaincha (Sesbania bispinosa) at two stages of crop growth viz 36 days and 50 days with biomass density of 15.4 and 22.5 t/ha, respectively. The average depth of operation of auger plough ranges 175-179 mm. During tests the effective field capacity and fuel consumption for auger plough have ranged between 0.25-0.28 ha/h and 6.68-8.22 l/h, respectively at the forward speed of 3.5 km/h. The soil pulverization index with the machine has varied from 5.60 to 10.40 mm. The density index of soil ranged 27.95-31.03%. The





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mixing index i.e. crop mass coverage with soil has varied from 93.69 to 96.22%.

Vegetable transplanter for cell feed nursery

The higher missing index, high labour requirement, high mortality rate of seedlings are major hindrances in promotion of existing transplanters in India. To overcome these lacunae, a two row semi-automatic vegetable planter having cup type metering mechanism for cell feed nursery has been developed at PAU Ludhiana centre of AICRP on Farm Implements and Machinery. The metering unit consists of 5 vertical cups mounted over a disc of 500 mm diameter. The cross section of the cups is 71 x 71 mm and length is 240 mm. A cam is provided on the periphery of the plate, which controls the opening and closing of vertical cups. The developed transplanter was evaluated with vegetable seedlings grown in nursery tray having 105 cells of truncated pyramid shape volume of 16.28 cm³, using PAU soil-less media at forward speeds of 1.00, 1.25 and 1.50 km/h. The plant to plant spacing for tomato, brinjal and chilli has been kept as 300, 450 and 600 mm, respectively. The transplanter could transplant tomato, brinjal and chilli nursery with plant missing of less than 4%. The effective field capacity of the machine for transplanting tomato, brinjal and chilli was 0.11, 0.12, and 0.15 ha/h, respectively at forward speed of 1.00, 1.25 and 1.50 km/h respectively. About 85, 86, and 86% saving in manual labour with the use of the machine have been observed over the manual method for transplanting for tomato, brinjal and chilli respectively; whereas the cost have reduced by 24, 31 and 29%, respectively.



Package of bullock drawn implements for maize in hilly terrain

In AICRP-UAE, OUAT, Bhubaneswar Centre has developed a package of bullock drawn implements for production and post-harvest operation of maize. The package of equipment comprised of MB plough, stubble collector, seed drill, fertilizer applicator cum ridger for maize and maize dehusker cum sheller for mechanization of maize at hilly terrain. OUAT mould board plough has been used for land preparation for maize crop at farmers' field in Village Kalameri and Mohana in Gajapati district. Its field capacity has been observed as 0.02 ha/h with 65.8% field efficiency. The OUAT bullock drawn stubble collector has been operated to remove the stubbles and weeds from the field prior to the operation of bullock drawn five row multi crop



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seed cum fertilizer drill. The field capacity of the seed drill was found to be 0.13 ha/h with 62.4% field efficiency. The OUAT bullock drawn fertilizer applicator cum ridger was operated for simultaneous application of fertilizer and ridging in two rows which had the actual field capacity of 0.04 ha/h with 61.5% field efficiency. A bullock operated maize dehusker cum sheller has been developed and its output has been found to be 150 kg/h with 95% shelling efficiency. These packages have been demonstrated to tribal farmers and they have used in 22.6 ha. It saved 15-20% time in sowing and 25-30% labour cost in weeding as compared to the traditional practice.

Fish dressing platform for women workers

Fish dressing and peeling process is mostly carried out in sitting postures by farm women in Dapoli region. These women workers use inverted crates and sit in squatting posture. The prolonged use of crates and squatting posture causes discomfort (leg/ back pain, etc.) problems which not only reduces the work efficiency and capacity but also aggravate health issues for the worker. Therefore, a fish dressing platform has been developed by BSKKV, Dapoli Centre of AICRP on ESA. The optimum hand reach envelope and relevant anthropometric body dimensions have been considered for proper workplace layout (placement of raw material, finished product and cutting blade) for fish dressing operation. The total length and width of dressing table is 1100 and 660 mm, respectively. The height has been kept adjustable between 630 to 700 mm and the cutting has been blade located at 405 mm from SRP.



Cassava harvester cum lifter

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Cassava harvesting and lifting it from field has been very tedious and drudgery involved operation. Tractor operated single row cassava harvester cum lifter has been designed at RC, Coimbatore. It consists of a main frame, digging unit, lifting and conveying unit and transmission system. The main frame has been designed on a tubular structure to provide sufficient strength under torsional stresses. The main frame size of 2000 x 100 mm provided for mounting the digger bottoms, the hitch frame and conveying system with a beam with two parallel channel sections of size 75 mm x 40 mm x 6 mm separated by a distance of 150 mm between the two centers. The conveying system consisted of two parallel endless belts fitted in the rectangular frame of size 1500x40 cm with guide pulleys, tensioning pulleys, and a set of counter rotating rubber wheels. Equipment is attached to a 50-60 hp tractor to dig the tubers from the ground, lift the tubers from the ground and convey and collect the tubers in the end. The actual field capacity of the planter is 0.22 ha h^{-1} .



Water level indicator for rice

Rice being the water intensive crop commonly cultivated under submerged condition and remains under ponding water for almost 80% of its cropping duration. A water level indicator for rice field has been developed to monitor field water level above and below the soil surface which can help in maintaining desired depth of standing water. The system has been designed considering mainly the alternate wetting and drying (AWD) method of irrigation. It shows the water levels with the help of colour codes marked



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on the indicator stick. Farmers can monitor the status of water level at their rice field by the colour codes and can operate the pump accordingly. Such a manual water level indicator has been designed and installed at ICAR-CIAE farm. Using this indicator the irrigation water has been applied following the alternate wetting and drying method which gave a water saving of upto 35% as compared to the continuous ponding method of irrigation in rice.



Water balance simulation model for assessment of reliability of rain water harvesting system

The rainwater harvesting (RWH) could be an effective solution against the current and future problems of over population, industrialization, pollution, water scarcity under changing climatic scenario. A GUI based Water Balance Simulation Model (WBSM) has been developed to simulate the performance of RWH system in different climatic regions. The model considers daily rainfall, losses due to leakage, spillage and evaporation, roof area, tank capacity, daily water demand, spillage losses as input parameters. WBSM computes the optimal tank size and analyze the reliability and water saving efficiency of rain water harvesting system. It also estimates various parameters such as inflow volume, storage, release, spillage (tank overflow), deficit, cumulative deficit, cumulative demand and deficit rate. The combination of different roof sizes, demand and tank sizes are important to consider for planning, design and implementation of RWH system in a different climatic conditions. The model inputs could be

manually entered on-screen as well as through digital files. Similarly the output could also be obtained in both on-screen as well as text files. The developed model could be utilized to make the recommendations for design and prioritize the regions where rain water harvesting system adaption which may lead to water saving and water security.



Testing and evaluation facilities for aeroblast sprayers

The spray distribution, droplet size and wind velocity at different heights are the important parameters for testing and assessing the performance of aeroblast sprayers. The vertical patternator (for spray distribution measurement) and platform (for droplet size and wind velocity measurment) has been developed at Farm Machinery Testing Centre, CIAE Bhopal. The overall dimension of vertical patternator is 5181×2255×2140 mm. The setup evaluates the vertical liquid distribution of aeroblast sprayers at different pressures, discharges and heights. Four tractor operated aeroblast sprayers have been tested so far at the developed set up. The water

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sensative paper (WSP) is attached to the grid of 250×250 mm for measurment of droplet size on the platform and tested at different forward speed during commercial testing of sprayers. The wind velocity can be measured at the centre of each grid by placing a hand held annemometre at the centre of each grid and data is recorded.

Sprinkler performance evaluation set up

The testing of different types of sprinkler nozzles is inevitable to characterize the water distribution and application uniformity of the irrigation system. For this purpose a test set up has been established at the experimental field of PFDC, ICAR-CIAE, Bhopal. Design and operational parameters such as sprinkler type, nozzle diameter, sprinkler spacing, working pressure, time of irrigation and wind speed were considered. Irrigation uniformity and wind drift evaporation losses are the two important parameters used to define the performance of sprinkler irrigation system. The performance of brass and plastic sprinkler nozzles of different sizes at various working pressures (2 to 4



kg/cm²) have been initially tested using the developed set up. Performance evaluation and data analysis would be helpful to choose the most suitable combination as design parameters for optimal uniformity and efficiency of the irrigation system for varying field conditions.

Abrasive pre-treatment machine for grape berries to produce raisins

The conventional practice of raisin production uses heavy amount of chemicals and large quantity of water, yet the drying time is very high which leads to quantitative and quality loss, fungal contamination, etc. A novel abrasive pretreatment system has been developed for grape berries for the production of chemical free (organic) raisins. The system consists of a rotating drum of stainless steel with inside abrasive surface. The detached grape berries are fed inside the drum and is rotated at low speed. The protrusions of abrasion have been designed in a such as way that it provide superficial abrasion with removal of waxy (cuticle) layer of grape berries that makes hurdle in drying. The machine has a capacity of about 150 kg/h and is operated by a 0.5 hp electric motor. The rotational speed of 15-20 rpm and treatment time of 2-4 min was found to be suitable for the preparation of raisins. The drying time for different varieties has been found to be reduced to 4 to 7 days in solar tunnel dryer and 2 to 3 days in hot air drying (Temp. 50°C) compared to the existing method that requires around 15 to 20 days for preparation of good quality raisins. Now a day conscious consumers are demanding safe and organic food. Developed machine has potential applications for the preparation of organic raisins.





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Classification of maize kernels based on aflatoxin concentration using Vis-NIR hyperspectral imaging

Presence of aflatoxins in crops like maize, groundnut is a serious threat to food safety. Current acceptable methods for detection of aflatoxin concentration on food products are laboratory based and require high time, skilled personnel and hence expensive. In order to develop a rapid and easy method of aflatoxin detection, Vis-NIR hyperspectral imaging system with wavelength between 400-1000 nm was successfully used to classify the maize kernels based on the concentration of aflatoxin. Aflatoxin was deposited on maize kernels in six different concentrations 25, 40, 70, 200, 300 and 500 ppb. Total number samples for this study was 240 (40 samples for each treatment). The spectral data was pre-processed using four pre-processing techniques to reduce the spectral noise and light scattering. The raw and pre-processed data was classified using PLS-DA and k-NN. It was observed that at 508 nm and 580 nm, maize kernels can be distinguished between healthy and infected. The highest classification rate was observed for raw data using k-NN (95%) with an error rate of 0.05. The lowest classification rate was observed for spectral data pre-processed with second derivative using k-NN (61%) with and error rate of 0.39. Application of defined protocol could enable detection of aflatoxin infected maize kernels within a few seconds.



Model farm machinery package for different agro-climatic zones of India

Selection of appropriate farm machinery, their availability, suitability for different crops in different agro-climatic zones is an arduous task. Although, the data regarding farming and machinery are available from many sources like printed media, audio and visual aids, newspaper, TV, internet, mobile etc. But, since the formats and structures of data are dissimilar, it is very difficult for farmers or even non-engineering professionals to get and understand the information in correct context. Further, many market elements, wherever available cause confusion and mislead the users/ stake holders due to which the appropriate mechanization technology is not reaching to many users.

To support the cause of agricultural mechanization in India, ICAR-CIAE has developed a software that helps in selection of appropriate machinery package for various cropping center in different agro-climatic zones of India. The software is useful for farmers, advisory services, government agencies, NOGs and planners in the sector of agriculture. The software has database of small to large agrimachinery manufacturers, so that procurement after machinery selection becomes easy. It also has economic parameters such as machine cost, per hour operating cost, hiring rate, total annual cost and net return, break-even analysis, payback period, machine specifications and available manufacturers for different agroclimatic zones of India. The developed software has practical application in popularization of various agricultural engineering technologies developed at various locations of the country. The software provide agro-climatic zone-wise package of machinery recommended by agricultural engineering experts. It also gives the detailed economic important calculations related to selected machinery as well as manufacturers of the machinery. The screen-wise navigation and presentation of information has been organized. ICAR-CIAE has launched this software on its website (www.ciae.nic.in).

External Funded Project

Project entitled 'Studies on thermal degradation of crop residues for kinetics, bio-polymeric transitions and value added products' has been approved under NASF with a total budget of Rs.142.70 lakhs.

SUCCESS STORY

Establishment of Soybean Processing Industries

Soybean is an important food commodity on account of its nutritional value and health benefits. It is high in protein, low in fat and carbohydrate and contains no cholesterol. Owing to its amino acids composition, the protein of soybean is called a complete protein. It is an excellent food for babies, children, elderly people and pregnant and lactating women because it contains vegetable protein which is very nutritious and easy to digest. Since it is a rich source of high quality protein at low cost, there is great potential for utilization of soybean has many health-promoting benefits which include antioxidant, anti-obesity, anti-diabetic properties and prevention of osteoporosis and cancers such as breast and prostate cancer. Soybean-based foods have generated much interest because of the evidence that consumption of adequate amount of soybean could lower the risk of chronic diseases such as cardiovascular disease and cancer.

A number of products are prepared from soybean that includes soy milk, tofu (soy paneer), soy curd, soy nuts and various bakery based products. The costs of these products are very low and could be utilized in combating the malnutrition by incorporating the soy based food products in daily diet.

Entrepreneurship Development Programme

Keeping it into consideration, entrepreneurship development programme (EDP) on soybean processing was stared in 1995 at ICAR - Central Instituter of Agricultural Engineering (ICAR-CIAE), Bhopal with the sole aim to develop enterprise in the area of soybean processing for livelihood opportunities, employment generation and production of high quality protein products at low cost. The EDP module on 'soy based bakery products and soy snacks' was added in the year 2002. ICAR-CIAE is the only Institute in India that offers EDP on Soybean Processing. The technical guidance and support was also provided to the participants in the establishment of the enterprise and preparation of the produce as and when needed.

Until February 2017, 167 batches (2524 participants) underwent EDP, out of which 2206 persons participated on soy milk and soy paneer production and 318 persons on soy based bakery products and soy snacks.

The participants included from all the corners of the country. Maximum number of trainees were from Madhya Pradesh(615) followed by Maharashtra, Punjab, Uttar Pradesh, Haryana, Rajasthan and Delhi.



State wise distribution of Trainees (Total number 2524)

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Impact of Entrepreneurship Development Programme

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An assessment of impact of the entrepreneurship training programme was carried out that included initially telephonic contact with the trainees and followed by personal visits of selected production clusters (Madhya Pradesh, Maharashtra, Punjab, Uttar Pradesh, Delhi, Haryana, Uttarakhand, Gujarat, Rajasthan, Bihar and West Bengal) across the country. One hundred ninety eight soybean processing units are currently operational. The units are distributed in different parts of country and includes 17 states, however, maximum 41 unit are located in Punjab followed by Maharashtra (40 unit), Uttar Pradesh (23 unit), Haryana (21 unit), Delhi (15 unit) and Madhya Pradesh (14 unit). The establishment of units geared up mostly after 2010. Out of total working unit only 36 were established before 2010. More than 166 units have been established after 2010. Number of trainees also increased after 2008.



State-wise distribution of units on soybean processing

There have been some cases of closure of soy processing units, 14% trainees established the enterprises but closed it at the later stage due to marketing constraints.

Distribution of soy products manufacturing across working units indicates that 10.4% trainees are involved only in soy milk production only whereas 46% are engaged only in Tofu production. 30% are producing both soy milk and tofu. Only 3% trainees are involved in producing products other than soy milk and tofu that includes soy curd, soy nuts and soy flour.





Production of Soy based food products by different trainees Quantity of product produced (%) by different trainees

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Around 50 % trainees are producing around 50 litres of soy milk or 50 kg tofu per day. Most of the trainees producing products more than 250 kg are located in Punjab and Maharashtra. Around 15 percent of trainees manufacture soy milk or tofu on demand especially in marriage season. Annual production of different soy products manufactured by trainees is presented below.



Annual production of soy products

Based on the information collected the average annual production of Tofu and soy milk is 2700 ton and 3400 kilolitres, respectively. Total protein content in tofu and soy milk is 14 and 3.5 percent, respectively.

Economic impact

Soybean is processed by 198 entrepreneurs across the country to make different products like milk, tofu, flours, nuts, curd, biscuits, kabab, chaap and halwa etc. Annual working days of these units are 203 while labour employment was analyzed 4.73/unit. These entrepreneurs are generating employment to the tune of 1.90 lakh man days/annum and provide the monetary benefits of 5.70 crores to the 936 workers engaged in running 198 soybean processing units. Annual gross return is Rs 28.18 lakh/entrepreneur with an annual gross expenditure of Rs 17.00 lakh/entrepreneur. Thus, annual net return realized to the extent of Rs 11.20 lakh/entrepreneur with a BCR of 1.66. Annual gross monetary benefit has been generated from 198 entrepreneurs is about Rs 56 crores. One hundred ninety eight units of soybean processing established across the country are generating employment of more than 1.78 lakh man-days/annum. Total monetary benefit from 198 entrepreneurs is about Rs 51 crore/ annum.

Sum-up

The soy food based entrepreneurship development training programme organized by ICAR-CIAE since 1995 has enabled establishment of 198 successful enterprises which are significantly contributing to nation's economy as well in combating malnutrition by adding 768 tons of low cost edible protein every year. The economic impact due to these enterprises is presently about Rs. 56 crore per annum and increasing with popularity of soy based food products. Soy based food processing industries operating at cottage to small scale level has been a successful venture in generating income and employment.

TRAINING

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Training Organized

Winter School on Micro-irrigation

Winter school on "Recent Advances in Micro-Irrigation and Fertigation Systems for Improved Input Use Efficiency of Open and Covered Cultivation through Engineering Interventions" sponsored by ICAR was conducted during 03 to 23 January 2019 at IDED, ICAR-CIAE Bhopal. Twenty Three participants from 12 different states participated in the program. A wide range of topics have been covered mainly related to micro-irrigation and protected cultivation. Starting from the preliminary considerations like that of design and site selection of drip irrigation system to advanced topics such as IoT based irrigation systems, soil less cultivation were covered in 21 days. The course content was designed with balanced theoretical, practical sessions and educational/industrial visits. In the winter school, 04 candidates were from ICAR institutes and 19 from the State Agricultural Universities had participated. Participants of the winter school in their feedback appreciated thematic and in-depth presentations made by various speakers. The knowledge of these high input use efficiency techniques would be helpful in fulfilling 'More crop per drop' agenda of the government. The training was inaugurated by Dr. K.K. Singh, Director, ICAR-CIAE, Bhopal and Dr. G. Singh, Ex. Deputy Director General, ICAR, New Delhi was the Chief Guest. Dr. C.K. Saxena was the Course Director, while Dr KVR Rao and Dr. Yogesh A Rajwade were the Course Coordinators of the winter school.



Winter School on Advanced Instrumentation and Hydraulics in Precision Agriculture

ICAR Sponsored Winter School on "Application of Advanced Instrumentation and Hydraulic Systems in Precision Agriculture for Crop and Environmental Sustainability" was organized at ICAR-CIAE for 21 days during 15 February to 07 March, 2019. Total 14 participants from various, ICAR Institute, KVKs and State Universities attended the Winter School. Under this programme participants were exposed to various advanced tools and techniques of precision agriculture and integration of hydraulic systems for development of precision farm machines for precise input application and its management to improve efficiency and efficacy of crop production systems. Lectures and hands-ontraining on sensor based controllers, precise input applicators, variable rate applicators and their controllers, decision support system (DSS), telemetry and software infrastructure for variability assessment, data analysis and real time monitoring and design of hydraulic systems and circuits were covered during the Winter School. The training was inaugurated by Dr. K.K. Singh, Director, ICAR-CIAE, Bhopal. Dr. P. S. Tiwari was the Course Director, while Dr AK Roul and Dr. NS Chandel were the Course Coordinators of the winter school.



Training program for Drivers of ICAR Institutes

Training programmes on Automobile Maintenance, Road Safety and Behavioural Skills were organized for regular drivers in technical grades of ICAR institutes/HQ in two batches during 16-22 January, 2019 (27 participants)

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and 19-25 February, 2019 (37 participants). Director of the Institute, Dr. KK Singh inaugurated both the programmes. Among main resource persons for different sessions of the training program were Dr. RK Mandloi, Professor, Maulana Azad National Institute of Technology on road safety and traffic management; Mr. RP Dixit, Development Officer (New India Insurance Co. Ltd.) on Insurance claim guidelines. From the academic institutions, Dr. RK Dwivedi, Associate Professor (MANIT) and Lt. Col. (Retd) P.K. Prasad, HoD (Automobile Engineering, OIST) were invited for lectures on effective maintenance of motor vehicles; Dr Ambar Chaturvedi (Faculty Member, CRISP) on effective behavioural and communication skills for vehicle drivers. Mr. NK Rojak, DSP(Traffic), Bhopal was invited for his lectures on general traffic rules, road safety guidelines and motor vehicles act, Er. Uday Paradkar, Group Director (Service), CI Hyundai, Bhopal, on periodical and preventive maintenance of vehicles; Er. Jiten Rajput, Training officer (Motor Mechanic, ITI Bhopal), on breakdown diagnostic management during outside running of vehicles, various operations of vehicle shown through cut Models. Er. DK Dwivedi, CTO (ICAR-CIAE, Bhopal), gave lectures on management of vehicle section with logbook, indent and route management.

Apart from above expert lectures, representatives from M/s. TATA Motors, Hyundai Motors, and Mahindra Automobiles located in



Bhopal visited CIAE along with their respective vehicles to provide on-the-field knowledge about the vehicles. Educational trips were also organized for the trainees Eicher Tractors Plant, Mandideep with hands-on training sessions at local workshops of Hyundai Motors, Tata Motors, Win Win Automobiles Ltd., Bhopal for Mahindra & Mahindra Vehicles.

Skill development training programmes

Two skill development trainings were organized or concluded during the quarter. The first skill development training programme on "Service and Maintenance Technician- Farm Machinery" under Pradhan Mantri Kaushal Vikas Yojana (PMKVY) was organized during 24 December, 2018 to 19 January, 2019. Total 18 trainees from selected districts of Madhya Pradesh (Sironj, Raisen, Bhopal, Vidisha and Sehore) have participated in the training programme. The training had practical oriented lessons and exercises. Besides visits to different labs and facilities within the institute, visits to the farm equipment manufacturers were organized for the participants.



The second skill development training programme was organized under PMKVY on "Agriculture Machinery Demonstrator" was organized during 15 January to 8 February, 2019. The programme was targeted to impart skill for demonstration of various machines used in farming processes such as tilling, sowing, irrigation, plant protection, harvesting and postharvesting etc. During the training participants were updated on demonstration of new technologies on farm mechanization, irrigation systems and agro-processing. They were given training on making critical adjustments, repair

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and maintenance of machinery, working with improved agricultural technologies. Visits to different laboratories were also organised to get exposure of different available agricultural engineering technologies. The participants practically carried out all the field operations using farm machinery facilities available at the Institute. Exposure visits to Kachhi Barkheda village, Eicher Tractor manufacturing plant, Kubota Tractor dealership and Lalwani Industry were also organised during training programm.

Training on operation and adjustments for optimal performance of harvesters

United Nation Development Program (UNDP) Training on "Operation and adjustments for optimal performance of Harvesters" was organized for harvester owners of Madhya Pradesh during 22-23 and 24-25, January 2019. Total 27 participants were trained. The participants were selected by UNDP team and sent to ICAR-CIAE, Bhopal for the training. Harvester owners were given an overview of different harvesting machinery available and used in the country. The operation, adjustment and servicing of different harvesting and threshing machineries such as reaper, reapercum-binder, threshers, combine harvester, straw reaper and balers were demonstrated to the participants. The trainees were also given an overview of the technologies developed by ICAR-CIAE, Bhopal at CIAE display hall.

Entrepreneurship Development Programmes

Entrepreneurship Development Programme on Preparation of soymilk and tofu and Preparation of soybakery foods and soyflour for upcoming entrepreneurs was organized during 11-16 February, 2019, attended by 7 participants.

Entrepreneurship Development Programme on Custom hiring of agricultural machinery was organized during 1-7 January and 1-7 February, 2019, attended by 72 participants.

Entrepreneurship Development Programme on Technology Package for value addition of Banana

Pseudo Stem was organised Regional Centre, Coimbatore in collaboration with ICAR-KVK, Coimbatore on 5 February, 2019. About 25 banana growing farmers participated in the training programme. The trainees were given hands on training on the operation of package of machinery for minimal processing of banana centre core from pseudo stem namely, slicer, dicer, fibre extraction and centrifuge. The programme also covered operation of juice making equipment viz. juice extractor, filter press etc. The trainees were exposed to effective utilisation of banana stem outer sheath for rope making in the machine developed by the centre and making of handicrafts from the banana rope. The operation of banana shredder for vermi compost making was also demonstrated to the farmers. Apart from post-harvest machinery on banana pseudo stem, hands on training on preparation of value added products viz., candy, pickles, RTS beverage from banana pseudo stem was also imparted to the trainees at M/s. Ramasamy Chinnammal Trust, Coimbatore.



Practical training for students

Practical training for 2 PG (Vigyan University, Andhra Pradesh) and 37 UG (CAE, Parbhani, J&K, CG, TNAU, JNKVV & RKDF) was organized in different divisions and units.

Training for farmers

CIAE Regional Centre, Coimbatore organized training for farmers on "Operation and maintenance of farm equipment" in 4 batches. It was attended by 73 farmers.

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Participation in Exhibitions

CIAE technologies/ products were displayed in the following exhibitions:

- Agri-exhibition at Motihari, Bihar (9-11 February, 2019)
- Farmers Mela at Karunya Institute of Engineering, Science and Technology, Coimbatore (27 February, 2019)
- Agri Exhibition Smart Agro Tech at Raipur (1-2 March, 2019)
- Purvanchal Kisan Mela at Chaukmafi, Peppeganj, Gorakhpur (2-3 March, 2019)
- Coastal Agri Expo at Goa (2-4, March 2019)
- Krishi Vigyan Mela at IARI, New Del hi (5-7 March, 2019)
- Exhibitions organized by ICDS, Hoshanagabad and Govt. P. G. College, Pipariya for awareness of soyfood utilization to the Atal Bal Palaks, students and local population. Display of developed soy products in the exhibition was the attraction for students/ upcoming entrepreneurs/participants for creating small enterprise in the study area.



Farmers Field Day cum Demonstration

Farmers Field Day cum Demonstration on Precision Irrigation Technologies for Small Farms (two programs) was organized on 25 February and 27 March, 2019. About 50 farmers from Chanderi and Guradiya village(s), block- Phanda, Bhopal District participated. Farmers were given an overview of different micro irrigation technologies and protected cultivation techniques which can enhance income by



improving input use efficiency. Demonstrations on low head (Gravity fed) drip irrigation system, pressurised drip irrigation system under different crops such as chickpea, maize were elaborated. Also, application of sprinkler irrigation for wheat cultivation of ongoing experiments at CIAE farm and recently developed automatic rice irrigation system were displayed. Different types of protected cultivation technologies such as natural and ventilated green houses, shade nets were explained at PFDC, ICAR-CIAE farm. Operation and maintenance of micro irrigation systems were elucidated on field. Farmers encouraged to adopt micro irrigation technologies for better production and productivity.

Demonstration on use of biomass briquetted fuel in rapid combustion system was organized for women of solidarabad on the occasion of womens week (1-8 March 2019) on 5 March, 2019. About 50 women participanted.





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KVK News

KVK organized following training programmes, attended by 119 farmers:

- Rabi crop management
- Oilseed crop production technology
- Crop management and post-harvest techniques of grains (cereals and pulses)
- Women friendly tools

Field Day Organized

Field day-cum-demonstration on Small hand tools for agricultural operations was organized on 27 March, 2019 at Village-



Guradiya of Block-Phanda, Bhopal. About 50 farmers showed interest in small hand tools especially, hand ridger, tubular maize sheller, groundnut decorticator and naveen dibbler.



Kisan mobile advisory/through farmers' portal, advisory and diagnostic

SI.	Discipline	Scientist visited at	Advisory services		
No .		farmers / farm women field	КМА	Advisory to farmers	Diagnostic services by visiting at farmers field
1.	Agronomy	18	05	53	16
2.	Engineering	00	03	00	00
3.	Home science	03	08	43	06
	Total	21	16	96	22

MGMG Activities

Mera Gaon Mera Gaurav		Number	Beneficiaries (No.)		
			SC/ST	Others	Total
1	No. of Villages covered	19	23	182	224
2	No. of Visits made	12	3	98	113
3	No. of Demonstrations	29	11	121	161
4	No. of farmers' meeting	19	1	119	139
	Total	79	38	520	637

Organized 2 Nutrition Melas at Itarsi and Pipariya. About 625 participants of ICDS, SHG, students benefitted.

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Technology Demonstration Mela

Eleven centres of AICRP on Ergonomics and Safety in Agriculture organized Agricultural machinery cum technology demonstration mela on 15-16 February, 2019. The centres located at PAU Ludhiana, Dr. BSKKV Dapoli, IARI, New Delhi, IIT, Kharagpur, CAEPHT Gangtok, NERIST, Nirjuli, CSKHPKV, Palampur, CIAE Bhopal, MPUAT, Udaipur, OUAT Bhubaneswar and TNAU Coimbatore conducted the programme. The centres located at TNAU, OUAT, CIAE, CAEPHT and MPUAT jointly conducted the programme with other schemes such as AICRP on Farm Implements and Machinery, Utilization of Animal Energy and Post Harvest Technology. Total 5,366 farmers have participated in these programmes.

Improved machinery developed by the scheme such as Pratap wheel hoe, solar operated Maize Dehuskar Sheller, Orange fruit harvester, arecanut desheller, cashewnut desheller, ergo refined cono weeder, tree climber, Pneumatic nursery pro tray seeder, head geras for protection from heat stress, remote controlled power tiller, light weight power tillers with different attachments like cultivator, multi-crop seed drill, puddler and potato digger, ladders for harvesting of fruits, manually operated ergonomically designed hand tools and other



devices, Safety gadgets for chaff cutters, threshers, sprayers, safe tube well connection, gas detection kit for tube well pits, gas extraction machinery, ROPS for tractors, hydraulic/ air pressure brakes, small engine operated equipment and light weight rice thresher were demonstrated to farmers..

S. No	Media	Subject	Recording Date	Person
1	Krishi Darshan, Bhopal	Protected cultivation practices	04.02.2019	KV Ramana Rao
2	News 18	Crop management in vegetable crop (onion)	08.02.2019	RD Soni
3	News 18	Crop management in vegetable crop (garlic)	08.02.2019	RD Soni
4	Radio Talk	Saur urja evam gramin vikas krishi karyon mein tractor aur krishi yantra machinery ke upyog mein savdhaniya	19.02.2019	RK Tiwari
5	DDK, Bhopal	Saamayik krishi karya	25.02.2019	RD Soni
6	DDK, Bhopal	Live telecast on Pradhan Mantra Kisan Samman Nidhi programme	28.02.2019	RD Soni
7	News 18	Lauki mein samayik fasal prabandhan	19.03.2019	RD Soni
8	News 18	Varsha jal sanchayan, jal bachat evam sanrakshanh evam ial pradushanh nivaranh	22.03.2019	Ramadhar Singh

Media Activities

TECHNOLOGY TRANSFER/ AWARDS & RECOGNITION

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Exhibition of improved equipment were also organized at few centres. The improved equipment and safety gadgets developed by centres and manufacturers of nearby areas were displayed during these exhibitions. Seventy (70) manufacturers participated in these exhibitions. Apart from that many eminent personalities were also present during the Inaugural Session and Demonstration of the improved equipment and package of safety practices. The mela was given due coverage by DD1, DD Kisan and e-TV at different locations.

Regional Centre, Coimbatore organized Technology and Machinery Demonstration Mela in association with AICRP on FIM Centre, TNAU Coimbatore on 15 February, 2019. More than 900 farmers from different districts of Tamil Nadu participated. Dr. K. Alagusundaram, DDG (Engg), ICAR inaugurated the Mela. During the demonstration, equipment and technology developed by CIAE RC like Package of equipment for sugarcane bud chip technology, Package of equipment for minimal processing of banana central core, package of equipment for cassava cultivation, Banana pseudostem shredder, Moringa leaf stripper, Multiplier onion peeler, Potting machine, Curry leaf stripper, Package of equipment for rope making from banana pseudeostem, Millet mill, package of equipment for banana cultivation etc., were demonstrated.



Patent Application

e-Patent application on "Process technology for production of protein-energy rich, stable and ready to eat complimentary food spread (RTE Comfo spread)" was filed on 15 January, 2019.

License Agreement

License Agreement for commercial production of CIAE technologies (Tubular maize sheller, manually operated pull type three row planter for millets – inclined and vertical type, hand held vegetable transplanter, manually operated portray type nursery seeder, manually operated push type single row vertical plate planter with fertilizer drill for millets – multi-crops, tractor drawn six row planter with fertilizer drill for millets/multi-crop – inclined and vertical type) was signed with M/s Vasundhra Krishi Yantra, Bhopal.

Contract Research/ Contract Service Agreement

Contract Research on 'Design, development and commercialization of Modular Backyard Poultry Cage' was signed with M/s Burgeon Agri Pvt. Ltd, Nasik on 14 March, 2019.

Contract Service Agreement on 'Testing of rice whiteners' was signed with /s Grindwell Norton Ltd., Mumbai pm 18 February, 2019.

Awards and Recognition

Young Scientist Award

Dr Bikram Jyoti, Scientist was awarded "Young Scientist award" in Agricultural Sciences category at M.P Young Science Congress, organized by MP Council of Science and Technology at RGPV, Bhopal during 28 February, 2019 to 1 March, 2019.



AWARDS & RECOGNITION

ISAE Awards

Institute Scientists received following ISAE Award during 53rd ISAE Annual Convention, held at BHU, Varanasi during 28-30 January, 2019:

Ashutosh P Pandirwar received Best paper award for the paper entitled **Soil bin studies on plug and finger-type onion seedling transplanting mechanisms**. Journal of Agricultural Engineering, 55(1), 1-14; coauthored by Pandirwar, AP, Kumar A, Mani I, Gaikwad BB, Sawant CP and Bhoumik A.

Rudragouda Chilur received Best paper award for the paper entitled "Auger conveyor type metering device for transplanting of vegetable seedlings raised in paper pot", published in Agricultural Engineering Today. 42(4):28-36; co-authored by Chilur Rudragouda, Nandede BM, Tiwari PS, Mehta CR.

SK Chakraborty received Best Paper Award for the paper entitled '**Processing and value addition of millets in tribal production catchment – A success story**' published in *Agricultural Engineering Today*, 42(3), 56-62; co-authored by Chakraborty SK, Raza RR, Ambrose DCRP, Kotwaliwale Nachiket, Azad SR, Dubey AK.

Other Awards

Dr. R. Senthil Kumar received Best Book Award for contribution of Scientific Tamil Book by Agri. Scientific Tamil society, New Delhi from Tamil Nadu Chief Minister on 4 February, 2019.

Paper Presentation Awards

Er. AP Magar received Best paper for oral presentation award for the paper entitled "Seedling metering device for onion transplanter" in "Ist International symposium on edible alliums: Challenges and opportunities" held at YASHADA, Pune during 9-12 Feb 2019

Ravindra Naik, Principal Scientist received Best Poster Presentation award, presented in XIV Agricultural Science Congress, held at New Delhi during 20-23 February, 2019. Er Swapnaja Jadhav received Best Paper Award for oral presentation of paper entitled 'Biomass Briquetting Plant: An opportunity of entrepreneurship for rural youth of India', presented in International Conference on Entrepreneurship in Agriculture and Renewable Energy Sector on 15-16 March, 2019 at Dr. PDKV, Akola.

Recognition

ICAR-CIAE Bhopal and its Regional Centre, Coimbatore has been authorised to test the Post Harvesting Technology Equipment and Machinery by DoAC, Ministry of Agriculture and Farmers Welfare.

Ph.D. Awarded



Er. Abhijit Khadatkar was awarded Ph.D. for his thesis entitled 'Development of a Tractor Operated Vegetable Transplanter for Plug-type Seedlings' on 8 February, 2019. He completed his Ph.D. under the

guidance of Dr. SM Mathur, Professor & Head (FMPE), CTAE, MPUAT, Udaipur.

Foreign Deputation

Dr. Debabandaya Mohapatra, Senior Scientist was deputed to Myanmar for teaching post graduate students under the prgramme of ACARE, Myanmar under bilateral agreement between DARE & MEA at YAU, Myanmar during 15 February, 2019 to 4 March, 2019.



REPORT/ PUBLICATIONS

Study Leave Granted

Er. RD Randhe has proceeded on Study Leave for 2 years wef 1 April, 2019 to 28 October, 2021 to pursue Ph.D. in the discipline of AE/S&WCE at ICAR-IARI, New Delhi.



Research Papers Published

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Chandel NS, Tiwari PS, Singh KP, Jat D, Gaikwad BB, Tripathi H, Golhani K. 2019. Yield prediction in wheat (*Triticum aestivum L.*) using spectral reflectance indices. *Current Science*, 116(2): 272-278.

Chandraker AK, Shantaiya S, Victor VM. 2019. Testing and performance evaluation of animal drawn inclined plate planter for hybrid rice. *Journal of Phar. & Phyto*, 8(2):38-40.

Chethan CR, Tewari VK, Nare B, Kumar SP. 2018. Transducers for measurement of draft and torque of tractor-implement system: A Review. *Agricultural Mechanization in Asia, Africa and Latin America*, 49(4): 81-87.

Name and Designation	Course Title	Duration	Venue
Shri Krishna Mairade Technical Officer	Gas tungsten Arc weldingon stainless steel plate	07-11 Januray 2019	ATI, Mumbai
Shri Banmali Bhaskar Technical Officer	Bearing and lubrication	07-11 Januray 2019	ATI, Mumbai
Mukesh Kumar Abhishek M. Waghaye Ravindra D. Randhe Scientists	Winter School on Artificial Intelligence	18-21 January, 2019	IIT, Delhi
SK Bharti Assistant Chief Technical Officer	Information and Communication Technologies for Empowering Farm Women	1-6 February, 2019	ICAR-NAARM, Hyderabad
RK Sahni Scientist	Application of advanced instrumentation and hydraulic systems in precision agriculture for crop and environmental sustainability	2 February to 7 March, 2019	ICAR-CIAE, Bhopal
Sweeti Kumari Swapnaja Jadhav Scientists	Environmental leadership and life skills	11-15 February, 2019	IIFM, Bhopal
RK Sahni Bikram Jyoti Syed Imran S Scientists	IoT and its application	26-30 March, 2019	RGPV, Bhopal

Human Resource Development

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Mehta CR, Chandel NS, Jena PC, Jha A. 2019. Indian agriculture counting on farm mechanization. *Agricultural Mmechanization in Asia, Africa and Latin America* (AMA), 50(1): 84-89.

Mohapatra D, Patel AS, Kar A, Deshpande SS, Tripathi MK. 2019. Effect of different processing conditions on proximate composition, antioxidants, anti-nutrients and amino acid profile of grain sorghum. *Food Chemistry*, 271: 129-135.

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Rao KVR, Gangwar S. 2019. Energy assessment of wheat under conventional and drip irrigation systems. *International Journal of Chemical Studies*, 7(1): 664-669.

Rao KVR, Aherwar P, Gangwar S, Soni K, Yadav D. 2018. Growth, yield, economics, water use efficiency and microbial functions of pigeon pea crop influenced by drip irrigation with plastic mulch. *International Journal of Current Microbiology and Applied Sciences*, 7(12): 2284-2290.

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44th Foundation Day

To commemorate its 44th foundation day, the Institute organized two-day Programme during Feb. 15-16, 2019.

On 15th February celebrations were held in attendance of all present and past employees of the institute. This programme was chaired by Dr. Panjab Singh, Chancellor, Rani Laxmibai Central Agricultural University, Jhansi and President, National Academy of Agricultural Science (NAAS), New Delhi; Dr. Nawab Ali, Former Deputy Director General, Engineering was the Guest-of-Honour.

The welcome address was delivered by Dr. K. K. Singh, Director, ICAR-CIAE wherein he shared greetings with all the dignitaries which also included a gallery of

retired employees of the Institute and the huge gathering of Institute staff and students. Dr. Singh presented various achievements of the Institute in terms of contribution to development of farm machinery custom hiring centers, soy processing units, farm machinery testing facility and organization of training to farmers and trainers.

Prof. (Dr.) Panjab Singh focussed on the contribution of ICAR technologies in modernization of Indian agriculture and its effectiveness in bringing selfsufficiency in food thereby generating confidence to pass and adopt the ambitious "Food Security Act". He also narrated that future agricultural technologies will be an amalgamation of space, nano, robotics, precision farming and artificial intelligence while providing cost effective solutions for small and marginal farmers. Dr. Nawab Ali delivered the 'Foundation Day Lecture', wherein he deliberated upon the stage-wise development of the institute and future challenges.

Present on this occasion were Dr. A.K. Patra, Director, ICAR-IISS and Dr. V.P. Singh, Director, ICAR-NIHSAD. Both of them addressed the gathering by stating the significant contribution of their respective Institutes and the relevance of agricultural mechanization for holistic development of Indian agriculture.

Prizes and awards were bestowed for various annual events also the staff members serving for more than 25 years to the Institute were given recognition of service.

The programme culminated with the vote of thanks presented by Dr. Nachiket Kotwaliwale, Head, Agro Produce Processing Division.





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16 February, 2019 was celebrated by organizing 'Agri-Tech-Expo' themed at '*Farmers' Prosperity through Agricultural Mechanization*', Farmers' interaction meet and Academia-Industry Interaction Meet in the premises of the Institute. The Director, Dr. K.K. Singh stated in his inaugural speech about the progress made by Institute on development of new agricultural machines and its extension by showcasing new CIAE technologies. He emphasized that the forum of agricultural exhibition along with panel discussion help farmers to know about new agricultural machinery. The policy issues related to standardization of quality checks in agricultural machinery, constraints in testing of agricultural machinery, capacity building on advanced manufacturing technology and mechanism for sharing of information on recent technologies developed by the R&D institutes and industries were discussed.



Er. J.J.R. Narware, Director, CFMTTI, Budni was the chief guest. He stated that in addition to tractors country also needs matching good quality agricultural machines. Shri AbhayMalaiya, President, MP Krishi YantraNirmataSangh in his address advised farmers to use agricultural mechanization as effective substitute to expensive and dwindling agricultural labour requirement and take advantage from schemes of government of MP and India by making themselves aware with them. Shri P.S. Shyam from Joint Director, Directorate of Agricultural Engineering, Govt. of MP, Bhopal elaborated that there has been progress on use of new agricultural machines such as mulcher, shredder, straw combine and raised bed planter with increase in custom hiring centres in MP. He also described about various schemes run by the Govt. of MP for promotion and popularization of agricultural mechanization such as *YantraDoot* and *KissanSarthi* etc. The programme was coordinated by Dr. P.C. Bargale, Head, TTD who had also presented the vote of thanks.

One of most vibrant Machinery Expo 'Agri-Tech-Expo' was organized by the institute on this occasion, wherein around 40 manufacturers from the country participated. The participants includedleading tractor and agricultural machinery manufacturersviz. M/s John Deere, Mahindra and Mahindra, Escorts, New Holland,Eicher, Swaraj, Kubota Maschio, Greaves Cotton Ltd., Shaktiman, LEMKEN India Agro equipment, Dasmesh, Amar Thresher, Jain Irrigation, NETAFIM Irrigation India Pvt. Ltd., Vadodara Premier Irrigation, etc. A large number of local manufacturers of agriculture and processing machinery and members of small farm machinery



manufacturers association of the state of Madhya Pradesh also participated. A few Leading NGOs of leading Multinational firms including Reliance, Lupin Welfare & Research Foundation, Solidarid also showcased their activities.

The ICAR-CIAE also displayed and demonstrated the recently developed advanced technologies such as Mulcher cum planter for maize - wheat cropping system, Inter Intra row weeder, Uniform rate sprayer, T.O. Pre-emergence herbicide applicator, T.O. Rotary assisted broad bed former cum seeder, Power tiller or T.O. planter with fertilizer drill, high clearance vehicle and hydraulic platform for orchard management, automated packing line for spherical fruits, minimal processing of vegetables, millet milling, fermentation of millet flaking leading to product development, Pilot scale production of Comfo-Spread, Biomass utilization and micro irrigation related technologies.

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Live Telecast of Launch of Prime Minister's Kisan Samman Nidhi Scheme

Live telecast of the Launch of prestigious scheme of Govt of India "Prime Minister's Kisan Samman NidhiYojna [PM-KISAN] was arranged on 24 February, 2019. Dr. Thawar Chand Gehlot, Hon'ble Minister of Social Justice & Empowerment, Government of India, was the Chief Guest, About 300 farmers including women farmers from nearby villages and Senior Officials of ICAR-CIAE, IISS & NISHAD, Bhopal were also present. Dr. KK Singh, Director, ICAR-CIAE, Bhopal, in his welcome address highlighted the institute developed technologies which have immensely benefited the farmers. He also pointed out salient features of new scheme of PM-KISAN, being launched by Government of India. Honourable Chief Guest Dr. Thawar Chand Gehlot, Union Minister of Social Justice & Empowerment, Government of India, in his address elaborated on different salient features of Pradhan Mantri Kisan Samman Nidhi Yojna

[PM-KISAN]. He stated that this scheme will benefit about 12 crores small & marginal farmersacross the country having land holding of upto 2 hectares. An amount of Rs. 6000/- per year would be paid to farmers three installments of Rs. 2000 each. A discussion followed his speech and two progressive farmers were also invited to present their views on initiatives taken by the Government of India.



Thereafter telecast of Prime Minister's "Man Ki Baat" and live telecast of launching of *Pradhan Mantri Kisan Samman Nidhi Yojna* [PM-KISAN] from Gorakhpur started, in which Hon'ble Minister of Agriculture and Farmers Welfare, Shri Radha Mohan Singh and Hon'ble Chief Minister of Uttar Pradesh Shri Yogi Aditya Nath highlighted the initiatives taken by the Government of India for the benefit of farmers.

The address by Hon'ble Prime Minister of India, Shri Narendra Modi started thereafter in which the Prime Minister highlighted the salient features of new PM Kisan Scheme and informed that first installment of this novel PM-KISAN Scheme was released today in the accounts of over 1 crore farmers and with few weeks, the money would be transferred in accounts of remaining farmers. The Prime Minster stated that direct transfer of money to farmers account would eliminate the middlemen business and farmers would get pension in their accounts without visiting any Government offices. Dr. A.K. Patra, Director, ICAR-IISS, Bhopal presented the vote of thanks.

Workshop of AICRP on FIM

The 33rd Workshop of AICRP on Farm Implements and Machinery, which aims to provide a platform for interaction amongst researchers, tractor and farm machinery manufacturers and policy makers was held at MPKV, Rahuri during 8-10 January, 2019. The meeting was attended by around 100 participants from Research & Development organisations from different SAUs and ICAR institutes, farm machinery manufacturers etc. The inaugural session of the workshop was held on January 9, 2019 under the chairmanship of Dr. Kanchan Kumar Singh, Assistant Director General (Farm Engg.), ICAR and Dr. KP Vishwanatha, Vice Chancellor, MPKV, Rahuri was the Chief Guest. Dr. KK Singh, Director, ICAR-CIAE, Bhopal and Dr. VM Mayande, Ex Vice Chancellor, Dr. PDKV, Akola





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were the Guests of Honours during the session.Dr. CR Mehta, Project Coordinator, AICRP on FIM presented Project Coordinator's Report on progress of work done by different centres of the scheme. The Farm Machinery Exhibition was also organized at Dr. ASCAET, MPKV, Rahuri.

The "Research Highlights 2018" compiled by Coordinating Cell, one CD on "Khetibadi me Prayukt Hone Wali Urja Kushal Machinery", one technical bulletin, one directory of farm machinery manufacturers, three success stories and three leaflets were also released during the session. Dr. KK Singh, Director, CIAE, Bhopal in his address highlighted the importance of mechanization in present context and asked the PIs of the project to accelerate their efforts in delivery of technologies. Dr. Kanchan Kumar Singh, ADG (FE), ICAR informed the steps taken by subject matter division to strengthen mechanization related activities and present priorities of ICAR. Dr. KP Vishwanatha, Vice Chancellor, MPKV, Rahuri in his inaugural address emphasized the need of joining hands with scientists of other sister disciplines to deliver sustainable mechanization solution. He also stressed the need of promoting small tools and equipment to fulfill the immediate need of farm families.

National Seminar on Role of Indian Standards in Testing, Quality Control and Safety of Agricultural Machinery

National Seminar on Role of Indian Standards in Testing, Quality Control and Safety of Agricultural Machinery was organized by Bureau of Indian Standards, New Delhi in collaboration with ICAR-Central Institute of Agricultural Engineering, Bhopal at ICAR-CIAE, Bhopal on 18 March, 2019. The seminar provided a platform for exchange of ideas and information on recent developments on various issues relating to the standardization of agricultural machinery and equipment, ensuring consumers get good quality products, besides creating awareness among stakeholders such as farmers, manufacturers, NGO, etc about the Indian standards for agricultural machinery and equipment.



Inaugural Session of the seminar started with welcome address by Dr. K.K. Singh, Director, ICAR-CIAE, Bhopal. He briefed about major activities of the institute and highlighted contribution of the institute in establishment of farm machinery custom hiring centers, soy processing units, testing of farm machinery and organization of training to farmers and trainers. He also stated the objectives of the seminar to address the issues of testing, quality control and safety of agricultural machinery.

Dr. Sunil Kumar Gupta, Vice Chancellor, Rajiv Gandhi Technical University, Bhopal was the Chief Guest of the session. He focussed on the role of quality, safety and agricultural mechanization in respect to Indian farmers. He also highlighted the need for development of good quality matching agricultural implements and machinery. He also focussed on the contribution of modernization of equipment using Artificial Intelligence (AI), IoT and Electronics and their effectiveness in bringing self-sufficiency in food grains thereby generating confidence to pass and adopt the ambitious "Food Security Act".

Mr. P.Rajesh, Scientist E and Head (FAD), BIS, New Delhi in his address briefed about activities of Food and Agriculture Division of BIS. He also briefed about Agricultural Machinery and Equipment Sectional Committee, FAD 11 of BIS. He stated that FAD 11 of BIS formulated various



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Indian Standards on Tractors, Farm Machinery and Implements to guide the industry, testing institutes and farmers. These standards ensure that the farmers receive good quality product which enable them for sustainable crop cultivation.

Two technical sessions were held during the seminar, chaired by Shri JJR Narware, Director, Central Farm Machinery Testing and Training Institute, Budni and Dr. KK Singh, Director, ICAR-CIAE, Bhopal, respectively. In these technical sessions, seven speakers shared their views and exchanged information on recent developments on various issues relating to the Standardization of Agricultural Machinery and Equipment.

The seminar was attended by about 100 delegates representing various organizations of the country including manufacturers and farmers. The policy issues related to standardization of quality checks in agricultural machinery, constraints in testing of agricultural machinery, capacity building on advanced manufacturing technology and mechanism for sharing of information on recent technologies developed by the R&D institutes and industries were also discussed. The programme was coordinated by Dr. C.R. Mehta, Project Coordinator, AICRP on FIM, ICAR-CIAE, Bhopal.

RAC Meeting

24th meeting of the Research Advisory Committee was held during 7-8 March, 2019. The Heads of the Divisions, Project Coordinators of AICRPs on FIM, EAAI, UAE and ESA and scientists of CIAE attended the meeting. Dr. KK Singh, Director CIAE welcomed the Chairman and the members of the Research Advisory Committee. In his welcome address, Dr. Singh highlighted some of the major achievements of the institute during recent years. Dr VM Mayande, Chairman RAC, stressed on need to plan and prioritize the R&D programmes to address challenges of Indian agriculture sector through effective engineering interventions so as to make Indian agriculture sustainable, profitable and climate friendly. Prof



Mayande, also made a presentation highlighting the areas in which ICAR-CIAE may focus in coming years. Dr. Kanchan K Singh, ADG (FE), ICAR stated that formulation of next plan has been initiated at Council and the ICAR-CIAE should formulate the new flagship programmes with focus on development of technologies for precision agriculture through application of electronic, instrumentation, artificial intelligence, robotics, IOT for agricultural mechanization. ICAR-CIAE may submit a proposal for creation of new Division to address these emerging areas of R&D. The other expert members of RAC who attended and provided valuable advice to CIAE scientists included Dr C Divakar Durairaj, Former Dean, College of Agricultural Engg., TNAU, Coimbatore, Dr. VVN Kishore, Former Head, Department of Energy & Environment, TATA Energy Research Institute University, Delhi, Dr. Debraj Behera, Prof & Head, Deptt of Farm Machinery & Power, Odisha University of Agriculture & Technology, (OUAT), Bhubaneswar also provided valuable advice to ICAR-CIAE scientists for undertaking their R&D programmes. The RAC members also saw demonstration of several new technologies developed by institute recently. Dr PC Bargale, Principal Scientist & Head TTD and Member Secretary proposed hearty vote of thanks to the members.

IMC Meeting

52nd meeting of Institute Management Committee was held on 8 March, 2019 under the chairmanship of Dr KK Singh, Director. Other members present in the meeting include Dr Kanchan Kumar Singh, ADG (FE), ICAR; Dr HS Oberoi, Head, Division of Post-Harvest

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Technology & Agril. Engg., IIHR, Bengaluru; Dr AK Singh, PS (Farm Machinery & Power), IISR, Lucknow; Dr CR Mehta, Project Coordinator, AICRP on FIM, ICAR-CIAE, Bhopal; Dr JJR Narware, Director, CFMTTI, Budni; Shri Rajiv Choudhary, Director, Directorate of Agricultural Engineering, Govt. of Madhya Pradesh, Bhopal; Dr S Patel, Prof. & Head, Department of Agricultural Processing & Food Engineering, IGKVV, Raipur; Shri Padam Singh, progressive farmer, P.O. Kotra Chopra, Berasia and Shri Ravi Kumar, CAO and Member Secretary. The meeting was also attended by the following Pcs/ Heads/ Incharges as an invitee. Dr KVR Rao, Principal Scientist made a presentation on Agri-Business Incubation (ABI) at ICAR -CIAE, Bhopal.

International Women's day

To commemorate the International Women's day on 8 March, 2019 a mega event was organized in Dewas District, Madhya Pradesh. An overwhelming number of around 3000 rural women and their family members participated in the event, which was jointly organized through a consortium of stakeholders and partners representing government and private sector organizations' engaged in advancement of sustainable agriculture, livelihood and women empowerment in Madhya Pradesh. The key partners being Solidaridad and ICAR-Central Institute of Agricultural Engineering (CIAE) along with partners Vippy industries and East-West Seed Industries, East West Seeds, Mahindra, Bio-Nutrients and Reliance foundation and key government agencies i.e. Integrated Child Development Services (ICDS), Mid-Day-Meal Council and Madhya Pradesh State Rural Livelihood Mission (MPSRLM).

Based on the theme of "good farming, good food", the day was celebrated for voicing call-toaction to drive gender balance supporting the theme of International Women's Day 2019; Balance for Better, which means creating balance in Socio-economic, cultural, educational and political sphere of life by giving equal role and participation to women. It was a multi stakeholders' participatory event to jointly discuss and work-together towards improving the availability of safe and nutritious foods, increasing the acceptability and affordability and improving the acceptability and consumption of nutritious foods.





EVENTS/ PERSONNEL NEWS

The event witnessed an overwhelming participation of rural women and their family members from across the state which provided a platform for cross learning and encouraging rural women in agriculture. The occasion was also dedicated to felicitate women leaders, entrepreneurs who have created a niche place for themselves and set an example for others to emulate.

Deliberations by subject experts on nutritional health, importance of soy based diet, women leaders' role in decision making, financial inclusion, development programme and participation of women marked the daylong event. Women community leaders, service providers, elected women representatives shared their experiences of struggles and achievements in pursuit of their chosen paths. A series of panel discussions took place with the participation of women leaders, development practitioners, government officials and subject specialists like nutritionists and dieticians. Technical experts from CIAE shared knowledge on women friendly farm tools, soy nutrition and the potential it holds.

40 different participating organizations and rural entrepreneurs including KVK, ICAR-CIAE Bhopal displayed their products in the exhibition stalls. The event was organized under the tutelage of Resource Centre of Women in Agriculture (RCWIA).

The event facilitated development of common understanding on issues and challenges and derive strategic approaches and way forward towards "good farming- good food".

At ICAR-CIAE, Bhopal, live webcast program of Hon'ble Prime Minister, Shri Narendra Modi was arranged. Not only the women staff but also the male employees attended the webcast program. The success stories of women and the motivational speech of Hon'ble Prime Minister



has inspired the staff. Dr. Debabandya Mohapatra, Chairperson, Women's cell coordinated the programme, which was attended by Heads of divisions, PCs, Incharges of various sections and all administrative and technical staff.

Staff Promoted



Dr VK Bhargav Principal Scientist wef 24 June, 2017



Dr PP Ambalkar Chief Technical Officer wef 1 January, 2018



PERSONNEL NEWS

Staff Superannuated

Following staff superannuated from the Council's service and were given a warm farewell:



Shri Nirbhay Singh Skilled Supporting Staff 31 January, 2019



Shri BM Sharma Asstt. Chief Technical Officer 28 February, 2019



Shri Ramcharan Skilled Supporting Staff 31 March, 2019

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