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Coordinator's Report

2011 - 2012

XXIX WORKSHOP of
AICRP on POST HARVEST TECHNOLOGY

(23 - 26 September 2013)

held at
MAHARANA PRATAP UNIVERSITY OF AGRICULTURE & TECHNOLOGY
UDAIPUR (Rajasthan)

AICRP on PHT (ICAR)
CENTRAL INSTITUTE OF POST HARVEST ENGINEERING & TECHNOLOGY
LUDHIANA - 141 004

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Nanda

September 23, 2013
MPUAT, Udaipur

(S. K. Nanda)
Project Coordinator, AICRP on PHT
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AICRP ON POST HARVEST TECHNOLOGY

Background

The All India Coordinated Research Project on Post Harvest Technology was launched by the Indian Council of Agricultural Research, Department of Agricultural Research & Education, Ministry of Agriculture, Government of India, in September 1972. Coordinating Cell of the Project was established in the Division of Agricultural Engineering at Indian Agricultural Research Institute, New Delhi. In the beginning, the Scheme was started at ten locations, namely: PKV Akola, UAS Raichur (later shifted to Bangalore), CRRI Cuttack, TNAU Coimbatore, GAU Junagadh, JNKVV Jabalpur, IIT Kharagpur, PAU Ludhiana, GBPUA&T Pantnagar, and RAU Udaipur.

The Co-ordinating Cell of the Project was shifted to CIAE Bhopal in February 1976. During the V Five-Year Plan, four more centres were added, viz. CIAE Bhopal, CAZRI Jodhpur, CTCRI Trivandrum and CPCRI Kasargod. Later, during the VI Five Year-Plan period, Feasibility Testing and Extension (FTE) Centres were started at 3 locations namely; APAU Bapatla, RAU Pusa, and NDUA&T Faizabad. One R&D centre was also started at AAU Jorhat. With the establishment of the Central Institute of Post Harvest Engineering & Technology at Ludhiana, the Coordinating Cell was further shifted from CIAE Bhopal to CIPHET Ludhiana in December 1990. The centre located at CRRI, Cuttack was shifted to OUA&T Bhubaneshwar in the year 1995. During IX Plan, three more centres viz. VPKAS Almora, IGKV Raipur and SKUAS&T Srinagar has been established. In X Plan EFC, eight new centres were approved and four existing centres had been given enlarged mandate on dairy, fisheries, horticulture, and meat products. Besides it five ongoing centres of AICRP on Jaggery and Khandsari has been merged with AICRP on PHT w. e. f. April 2004. During XI Plan 4 new centres commenced at BAU Ranchi, CAU Gangtok, KVA&FSU Mangalore and MAFSU Mumbai. One centre (CAZRI Jodhpur) was closed as per QRT recommendations. Thus the Project has now been operating from 37 centres in India, covering almost all states and agro-climatic regions.

The Project Coordinators for the Project so far have been: (1) Prof. T.H. Nirmal (1972 - 1977), (2) Dr. Anwar Alam (1978 -1981), (3) Dr. Nawab Ali (1981-1985), (4) Dr. B. D. Shukla (1985 - 1989), (5) Dr. R. P. Kachru (1989 - 1991), (6) Dr. Jai Singh (1991 - 1996), (7) Dr. B. S. Bisht (1996 - 2002), (8) Dr. S. M. Ilyas (2002 - 2005) and (9) Dr. S.K. Nanda (2005 onwards).

Objectives of the Project

The Project aims to develop location and crop specific post harvest technologies and equipment to minimize quantitative and qualitative post harvest losses and to produce value added products from food grains and other crops. It is also to develop technologies for making available primary processed materials in the rural areas at cheaper rates and assure better economic returns to the farmers from their marketable surpluses and by-products and generate employment in the rural areas contribution to the overall economic development and improvements in quality of life.

The specific objectives of the Project have been as given below:

- To study the prevailing post harvests practices and identify unit operations, equipment and their components that need improvement or substitution, adequacy and inadequacy of the prevailing practices.
- To develop and adopt farm level cleaners, graders and dryers for cereals, pulses, oilseeds, plantation crops, tubers, other field crops, livestock produce and fish.

- To develop simple processes, low cost equipment and pilot plants for farm/village level processing of food grains, oilseeds and other crops for rural consumption, as well as selling value added products to semi-urban and urban areas for better economic returns.
- To develop simple processes and equipment farm/village level for better economic utilization of bio-wastes and by-products as food/feed/fuel etc. for increasing profitability of the commodity and income of the farmer.
- To undertake studies on techno-economic feasibility and economical viability of on farm/village level processing industries and other enterprises.
- To field evaluate laboratory proven technologies and carry out operational research trials on the developed technologies for villages to identify technical, managerial and social constraints and take remedial measures before releasing for popularization.
- To facilitate creating of post harvest technology consciousness and transfer of proven technologies in selected villages and monitoring its effects on economics and social development.
- To generate income and employment in rural areas through adoption of proven technologies and equipment through establishing agro-processing centres.

List of the Cooperating Centres of AICRP on PHT

State and Central Agricultural Universities

1. College of Agricultural Engineering
   Dr. Punjabrao Deshmukh Krishi Vidyapeeth,
   Akola (Maharashtra)

2. University of Agricultural Sciences,
   Bangalore (Karnataka)

3. College of Agriculture,
   Acharya N.G. Ranga Agri. University,
   Bapatla (Andhra Pradesh)

4. College of Agricultural Engineering,
   Orissa University of Agri. & Technology,
   Bhubaneshwar (Orissa)

5. College of Agricultural Engineering,
   Tamil Nadu Agricultural University,
   Coimbatore (Tamil Nadu)

6. College of Agricultural Engineering,
   Acharya Narendra Dev University of Agri. & Technology,
   Faizabad (Uttar Pradesh)

7. College of Agricultural Engineering,
   Jawaharlal Nehru Krishi Viswa Vidyalaya,
   Jabalpur (Madhya Pradesh)

8. College of Agriculture,
   Assam Agricultural University,

Jorhat (Assam)

9. College of Agricultural Engineering,
Junagadh Agricultural University,
Junagadh (Gujarat)

10. Indian Institute of Technology,
Kharagpur (West Bengal)

11. College of Agricultural Engineering,
Punjab Agricultural University,
Ludhiana (Punjab)

12. College of Technology,
G.B. Pant University of Agri. & Technology,
Pantnagar (Uttaranchal)

13. College of Agricultural Engineering,
Rajendra Agricultural University,
Pusa (Bihar)

14. Indira Gandhi Krishi Vishwa Vidyalaya,
Raipur (Chhattisgarh)

15. Sher-e-Kashmir University of Agri. Sciences and Technology,
Srinagar (Jammu & Kashmir)

16. College of Technology & Agri. Engg.,
Maharana Pratap Agricultural University,
Udaipur (Rajasthan)

17. Faculty of Agricultural Sciences
Aligarh Muslim University
Aligarh (Uttar Pradesh)

18. College of Agricultural Engineering
CCS Haryana Agricultural University
Hisar (Haryana)

19. Kerala Agricultural University
KCAET, **Tavanur** (Kerala)

20. College of Horticulture
Dr. Y.S. Parmar University of Horticulture and Forestry,
Nauni, **Solan** (Himanchal Pradesh)

21. Tamil Nadu Veterinary and Animal Sciences University,
Chennai (Tamil Nadu)

22. Rajasthan Agricultural University
Agricultural Research Station
Durgapura, **Jaipur** (Rajasthan)

23. West Bengal University of Animal and Fishery Sciences,
Kolkata (West Bengal)

24. College of Agricultural Engineering and Technology
University of Agricultural Sciences
Raichur (Karnataka)

25. Regional Sugarcane & Jaggery Research Station,
Kolhapur (Maharashtra)

26. Sugarcane Research Station : Assam Agricultural University,
Buralikson (Assam)

27. Birsa Agricultural University,
Ranchi (Jharkhand)

28. Karnataka Veterinary, AH & Fishery Science University
Mangalore (Karnataka)

29. Maharashtra Animal and Fisheries Science University
Mumbai (UP)

30. Indian Institute of Technology
Kharagpur (West Bengal)

31. CAEPHT, Central Agricultural University
Gangtok (Sikkim)

ICAR Institutes

1. Vivekanand Parvartiya Krishi Anusandhanshala,
Almora (Uttaranchal)

2. Central Institute of Agricultural Engineering,
Bhopal (Madhya Pradesh)

4. Central Plantation Crops Research Institute,
Kasargod (Kerala)

5. Indian Institute of Sugarcane Research
Lucknow – 226 002 (U.P.)

6. Central Tuber Crops Research Institute (ICAR),
Thiruvananthapuram (Kerala)

MAJOR ACCOMPLISHMENTS DURING XI PLAN

1. Post Harvest Loss Reduction

- Popularization of insect trap for domestic storage – Coimbatore centre
- Alternative to use of hooks (*kundi*) in handling grain bags – Ludhiana centre (Modified hook), Bhubaneswar centre (Modified bag), Udaipur centre (Modified bag)
- Control of Pulse beetle through custard apple seed extract (93.33% mortality) - Udaipur centre
- Development of indigenous ethosorb technique for enhancing the green shelf life of banana - Akola centre
- Biocontrol of crown rot of banana fruits - Jorhat centre
- Tubular aeration system for improved on farm storage of potato - Bangalore centre
- Kitchen purpose zero energy system to store assorted vegetables for a whole week.
- Technology for preservation of milky mushroom - Coimbatore centre
- Technologies for processing and preservation of drumstick (canning, retortable pouch, dehydration) - Coimbatore centre.
- Water jet system for peeling safe musli roots - Bhopal centre

2. Prototype Development / Refinement

- Pilot Plant for tender wheat shoot powder (1 kg powder/day), with multi-tier rack growing system - Akola centre
- Dehuller for barnyard millet (5 hp, 45 - 50 kg/h) - Almora centre
- Pedal operated winnower-cleaner-grader for millets, also suitable for wheat, paddy, lentil and soybean (250 - 300 kg/h) - Almora centre
- Pearler for minor millets (foxtail millet, little millet, common millet) - Coimbatore centre
- Continuous grain pearler-polisher for pigeon pea milling, wheat and maize pearling and coriander de-awning / de-bearding (75 kg/h, Rs 40000) - Udaipur centre
- Continuous hot air puffing system for RTE snacks from rice mill and pulse mill byproducts - Akola centre
- Small capacity animal feed plant (100 kg/day) utilizing dal mill byproducts - Akola centre
- Pulse mill plant of 0.5 t/h capacity (75 - 78% recovery) based on the design of earlier CIAE mini dal mill - Bhopal centre
- Small scale sunflower oil dewaxing system - Bhubaneswar centre
- Groundnut kennel testa remover (40 kg/h, 66.68% efficiency) - Jabalpur centre
- Development of a natural convective walk-in type poly house for solar drying of chillies (season) and for nursery raising (off season) - Bapatla centre.
- Modification of the existing fruit and vegetables washing machine for additional use as blancher - Ludhiana centre.
- Pricking machine for petha preparation (Aligarh Centre + Hisar Centre)

- Pineapple peeling-cum-coring device (15-20 fruits/h, simultaneous peeling, core removal and slicing) - Bhubaneswar centre
- Mango fruit stone remover (1150 kg/h, 98% pulping efficiency) - Coimbatore centre
- Black pepper decorticator (0.5 hp, 91.8% efficiency) - Tavanur centre
- Adoption of Improved Turmeric boiler for Arecanut - Coimbatore centre
- Garlic peel remover for dehydrated flakes (Rs.17000, 50 kg/h) - Udaipur centre
- Garlic clove grader (Rs.35000, 10 kg/h) - Udaipur centre
- Manual and power operated *Mahua* seed decorticator - Bhubaneswar centre
- Fully mechanized honey filtration unit (50 kg capacity) - Ludhiana centre
- Hand operated bitter apricot decorticator (5 kg/h, 87% efficiency) - Pantnagar centre
- Apricot stone grader - Pantnagar centre
- Dried apricot grader (200-250 kg/h, 92.5 - 81.4% efficiency) - Srinagar centre
- Development of a low cost hand operated aloe vera gel extractor - Bhubaneswar centre.
- Development of a small scale power operated aloe vera gel extraction machine - Udaipur centre.
- Device for stripping Senna leaves (a thorny medicinal shrub) - Bhopal centre
- Optimization of boiling pan size for jaggery making - Kolhapur centre
- Jaggery powder making unit – Anakapalle centre
- Mechanical cane juice filtration unit - Lucknow centre
- Boiling juice churning device - Lucknow centre
- Sugarcane peeler - Lucknow centre
- Small cane crushing unit - Lucknow centre
- Development of an electrical stunner for humane slaughtering of small food animals - Chennai centre
- Scalding tank for poultry processing - Chennai centre
- Process for extraction of flavour from shrimp waste and value added products such as fish soup and vegetable soup with shrimp flavour – Kolkata centre
- Fish deboner machine (45 - 65 kg/h, Rs.60000) - Raichur centre

3. Value Addition through Process / Product Development

- Process optimization for production of spray dried soymilk powder - Akola centre
- Mahua based value added products, viz Mahua wine (Udaipur centre) and Mahua RTS beverages, squash and jam from dried flowers - (Bhubaneswar centre and Udaipur centre)
- RTS beverage from Jamun and Banana - Jorhat centre
- Complete process protocol for probiotic fruit juice (apple) - Coimbatore centre
- Process for extraction of vanilla oleoresin - Tavanur centre

- Candy from Khasi mandarin peel - Jorhat centre
- Safe and low cost *holi* powder from tapioca - Jorhat centre
- Shelf stable dehydrated quick cooking cassava tubers and amorphophallus tubers - Trivandrum centre
- Process for powder, tablet and extract from Stevia leaves, a natural sweetener and sugar substitute - Bhubaneswar centre.
- Low calorie ice cream (using stevia powder) for diabetic patients - Pantnagar centre
- Standardization of anti caking agent to make jaggery powder free flowing - Kolhapur centre
- Cocoa based jaggery chocolate nuggets - Pantnagar centre
- Soy protein isolate and pectin incorporated buffalo meat sausage -Aligarh Centre
- Chicken based and beef based extruded food products - Chennai centre
- Process for production of shrimp papad and fish papad - Kolkata centre
- Fish fingers and Smoked fish using low value marine fish - Raichur centre
- Fish sausage in natural casing - Mangalore centre
- Technology for micro-encapsulation of fish oil as spray dried powder - Raichur centre

4. Byproduct Utilization

- Extraction of natural dye from biomass (henna and chicory waste) for textiles application - Aligarh centre.
- Utilization of spent charge from distillation of patchouli oil in the manufacture of agarbatti - Bangalore centre
- Preparation of bile concentrate (following slaughter of buffalo) - Mumbai centre
- Pet food based on buffalo slaughterhouse offals containing 'low fat high protein' (heart, liver, udder, lungs and tongue) - Aligarh centre
- Pet food based on pig and poultry slaughter wastes - Chennai centre

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SWOT Analysis of AICRP on PHT

STRENGTHS

1. Surplus agricultural production is available for processing and therefore opportunities exist for developing agro-processing enterprises.
2. A strong nation wide network for design, manufacturing and testing of any type of post-harvest machinery.
3. AICRP on PHT caters to all crops and commodities (cereals, millets, pulses, oilseeds, fruits and vegetables, spices and plantation crops, and of late jaggery and khandsari, milk and milk products, meat and fish, poultry and egg).
4. Multidisciplinary expertise is available within as well as at hand to the PHTS teams because of functioning in SAUs and ICAR institutes.
5. Specific objectives of the AICRP on PHT have helped to channelize efforts into applied research in order to develop useful and transferable innovations which have proved to be technologically feasible and economically viable.
6. AICRP on PHT has been receiving adequate support from the Headquarters as well as from the Heads of the organizations where its centres are functioning.
7. Agro-Processing Centres (APC) initiated under AICRP on PHT centres in and around their locations have proved to be very successful. The concept of APC is now gaining recognition and popularity at national and international levels.
8. About 130 of the technological developments have been made by the individual centres and about 30 of these translated into use by the entrepreneurs and farmers-cum-processors.

WEAKNESSES

1. Inadequate scientific and technical manpower has caused delay in execution of programmes at many of the centres (lengthy process of recruitment, vacant posts, additional responsibilities such as teaching in universities and institute research projects in ICAR institute, different rules/procedures in different organizations).
2. All promising technologies have not been commercialized through adoption by entrepreneurs.
3. Efforts of the individual centres are concentrated to their own work on a specific equipment or process (in order to meet the needs of the region where the centre is located).
4. In spite of globally increasing interest of experts and R&D organizations in the area of post harvest technology and growing export opportunities for Indian agro-products, there has not been any international collaboration or external HRD for PHT centres.

OPPORTUNITIES

1. Increased agricultural and livestock production offers huge potential in India for processing.
2. Rapid technological advancement in the fields of electronics, computer science, biotechnology, manufacturing techniques, etc. has contributed positively to post-harvest handling, processing and value addition.
3. Demand for processed foods (breakfast cereals, convenience food, ready to cook (RTC) , and ready to eat (RTE) products) has been fast increasing in the country. Consequently the market for relevant processes and machinery has also grown.
4. Low cost of our technology and labour puts our products in an advantageous situation due to their price competitiveness. Proper attention to qualitative standards can vastly improve the export opportunities for Indian products.

THREATS

1. Competition from imported technology to local products, and machinery.
2. Non-availability of appropriate transportation of raw and finished goods.

GLIMPSES OF TECHNOLOGIES from AICRP on PHT

ANIMAL FEED MILL
(Akola centre)

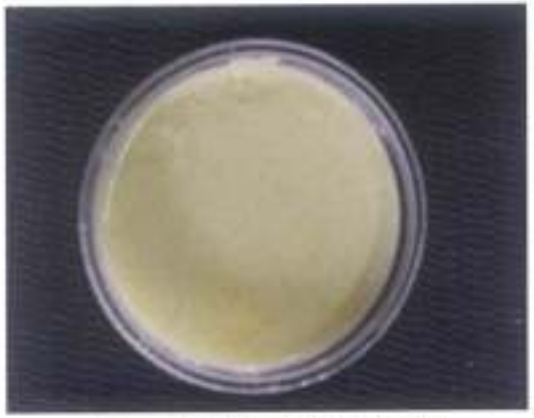
CONTINUOUS HOT AIR PUFFING SYSTEM
(Akola centre)

ONION SEED EXTRACTOR
(Akola centre)

BARNYARD MILLET HUSK PILLOW
(Almora centre)

MEDIUM CAPACITY PROTOTYPE MILLET DEHULLER
(Almora centre)

GLIMPSES OF TECHNOLOGIES from AICRP on PHT



PROBIOTIC DAHI FROM BARNYARD MILLET
(Bangalore centre)

CONTINUOUS CARROT WASHER
(Hisar centre)

GROUNDNUT TESTA REMOVER
(Jabalpur centre)

MILLET KURKURE
(Bangalore centre)

Sanjeev Jangra Engg Works
(Hisar centre)

VALUE ADDED PRODUCT FROM BAMBOO SHOOT
(Jorhat centre)

GLIMPSES OF TECHNOLOGIES from AICRP on PHT

CASHEWNUT KERNEL PEELER
(Kharagpur centre)

WALNUT CRACKING MACHINE
(Srinagar centre)

TRAINING IMPARTED IN BANGLADESH ON PH MACHINERY FOR TUBER CROPS
(Trivandrum centre)

BANANA PEELER
(Tavanur centre)

BLACK PEPPER DECORTICATOR
(Tavanur centre)

GARLIC PROCESSING BY WOMEN
(Udaipur centre)

GLIMPSES OF TECHNOLOGIES from AICRP on PHT

GRANULAR JAGGERY MAKING UNIT
(Anakapalle centre)

POLYHOUSE SOLAR DRYING OF GRANULAR JAGGERY
(Anakapalle centre)

JAGGERY CHOCO - NUGGETS
(Pantnagar centre)

JAGGERY PILOT PLANT
(Pantnagar centre)

GLIMPSES OF TECHNOLOGIES from AICRP on PHT

MOBILE POULTRY PROCESSING UNIT
(Chennai centre)

FISH and MEAT BASED FOOD
(Nuggets, Ham, Patties, Sausage)

MODEL RETAIL MEAT SHOP
(Chennai centre)

FISH VENDING AND DISPLAY UNIT
(Mangalore centre)

PET FOOD and PET TREATS
(Chennai & Mumbai centres)

MODEL RETAIL OUTLET FOR CHICKEN
(Mangalore centre)

GLIMPSES OF TECHNOLOGIES from AICRP on PHT
Trainings & Demonstrations

HONEY FILTRATION UNIT
(Ludhiana centre)

GRANULAR JAGGERY MAKING
(Aanakapalle centre)

GROUNDNUT DECORTICATION AND MAIZE SHALLING TO TRIBALS
(Bangalore centre)

PAPAD CUTTER
(Akola centre)

CUMIN CLEANER - GRADER
(Junagadh centre)

TURMERIC WASHING - POLISHING
(Ludhiana centre)

PROGRESS REPORT OF THE CENTRES
(2011 – 2012)

	AKOLA CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1	Development of continuous hot air puffing system for oil free RTE snacks	1. To develop continuous hot air puffing system. 2. To evaluate the quality parameters of puffed product.	• Continuous hot air puffing system of 6 kg/h capacity. • Puffing cylindrical fryums prepared from dal and rice brokens at 250 °C • Shelf life 5 to 9 months
2	Development of onion seed extractor	1. To study physical properties of onion seeds. 2. To develop onion seed extractor. 3. Performance evaluation of machine.	• Onion seed extractor to separate the seed from umbels • Working capacity of onion seed extractor was found 105 kg/h of umbels • Cleaning efficiency 98.59 % • Extraction efficiency 90.28 % • Seed loss 1.82 % • Germination 90 %
3	Development of RTC snack products from sorghum	1. Standardization of process for preparation of value added products (Ambil powder/ sorgo papad). 2. To study shelf life of the product and popularization of technology	• Process technology for ready to cook instant *Ambil* powder • Process technology standardized for sorgo papad • Papad cutter of 6.23 kg/h capacity developed for providing convenience in packaging
4	Process technology for value added products of pumpkin	1. Development of process for ready to use dehydrated powder of pumpkin 2. Development of RTS value added products	• Process developed for preparation of pumpkin pulp powder • Process technology standardized for value added products (sweet pakoda, kheer and chakali)

		3. Development of process technology of cherry/ tutty-fruity from pumpkin 4. Development of small capacity (100 kg/day) pilot plant for cherry/ tutty – fruity 5. To assess economic feasibility and transfer of technology	• Pilot plant (100 kg/day capacity) inclusive of Peeler, Cutter, Slicer and Cuber developed for making cherry/tutty- fruity from pumpkin
5	Development of small capacity (100kg/day) animal feed mill using dal mill byproduct	1. To develop a small capacity animal feed mill for compacting dal mill byproduct into animal feed pellets. 2. Testing of the mill for preparing pellets.	• Animal Feed Mill developed to process 100 kg of dal mill byproduct (husk + powder) per day @ 15.6 kg/h. • The Animal Feed Mill consists of hopper, mixing chamber, compaction chamber, outlet /die, 1 HP motor and frame.
6	Development of Roselle calyces detacher	1. To develop a detacher for Roselle calyces. 2. Testing and evaluation of Roselle calyces detacher (RCD) for detaching Roselle calyces from Roselle fruit.	• Roselle calyces detacher developed consisting of cutting blade, cutting blade holder, spring and rivet arrangement. • Roselle Calyces Detacher has 96.8 % efficiency for detaching calyces from Roselle fruit compared to manual calyces detaching efficiency of 68.9 % • Capacity 5.62 kg/h, which is five times more than manual detaching of Roselle calyces.
7	Development of technology for bio-pesticide from Custard apple seed	1. To study the physical properties of custard apple seed 2. To study the effect of particle size on insecticidal activity of custard apple seed extract against Helicoverpa armigera (Gram pod borer) 3. To study the effect of custard apple seed extract on *Helicoverpa armigera* on chickpea crop in rabi season, by using different concentration and *Spodoptera litura* (tobacco leaf eating caterpillar) on soybean crop in kharif	• Process technology developed to prepare aqueous extract from custard apple seed powder (CASP) with biopesticidal characteristic.

		season. 4. To study the laboratory insect Bioassay with different CASP solvent extract.	
	ALMORA CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1	Adaptive trial on improved post harvest equipments suitable for N_W Himalayan region	1. Feasibility testing of identified post harvest technologies/equipments and need based modification for suitability in N-W Himalayan region. 2. To demonstrate these technologies on large scale and assessing their impact on local population.	• Soybean processing unit (soy cow machine), Mini Dal mill (PKV Akola), Millet thresher cum pearier, CIAE cleaner cum grader and Tubular maize sheller were evaluated and demonstrated to farmers. • 20 millet threshers and 220 tubular maize shellers were purchased by the farmers.
2	Establishment of Agro Processing Center, training and demonstration of technologies	1. Establishment and Techno economic evaluation of APC in N-W Himalayan region for generating income and employment. 2. Demonstration and adaptive trial of improved post harvest technologies at farmer's field and assessing their impact. 3. Training of farmers/ officials/ manufacturers in processing of primary agricultural products and its marketing policy.	• Two new Agro processing centres were established (1.Sh. Shyam Singh Bisht, village Raulshera, District - Almora and 2. Sh. Chandershaker, village- Ganaie Gangoli, District- Pithoragarh) • The entrepreneurs at three APCs in village Takula, Raulsera and Gangoli Ghat generated revenue of Rs 0.98 lakhs, Rs. 1.19 lakh & Rs 0.46 lakh, respectively during 2012-13. • 48 demonstrations programmes were organized in different villages.
3	Post harvest management and value addition of barnyard millet	1. Standardization of value added products of barnyard millets such as composite flour for making bread, biscuits & cake etc. 2. Making of Pillow using barnyard husk.	• Two composite flours CF1 (barnyard millet, wheat and gluten 61.8, 31.4 and 6.8%) and CF2 (barnyard, finger, proso millet and wheat 9.1, 10.1, 10.2 and 70.6%) were formulated based on rheological and textural properties of bread dough. • Barnyard millet husk was utilized for making of pillow (2 kg weight).

4	Development and evaluation of pedal operated low cost light weight winnower-cum-cleaner for millets	1. Development of new prototype of winnower cum cleaner by reducing overall size & weight. 2. Testing of machine for millets and other crops.	• A hand operated prototype of winnower cum cleaner is under development (light weight, 30 kg for easy portability in hills with 565 x 560 x 1000 mm dimension).
5	Development of a medium capacity millet dehuller	1. To design & develop the prototype of the millet dehuller 2. To test its performance in all minor millets and comparison with the traditional system. 3. To commercialize the technology.	• A aspirator type single phase 2 hp electric motor driven millet dehuller has been developed for threshing and de-husking of barnyard, proso, kodo, little and fox tail millets. • The highest dehusking capacity of 20 kg/h and efficiency of 99% is observed at 1100 rpm at 10% mc in two passes.
6	Development of an amaranth thresher	1. Design & Development of light weight amaranth thresher. 2. To test the performance of this developed machine. 3. Adaptive trials at farmers' fields. 4. To commercialize the machine.	• A light weight single phase 1 hp motor operated prototype amaranth thresher has been developed for threshing of Amaranth crop. Preliminary testing carried out. • Weight : 60 kg. • Dimensions : 750x600x1060 mm • Capacity : 20kg/h • Efficiency : 99%.
	BANGALORE CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1	Operational Research Project: Establishment of Agro-Processing Centres, Training and Demonstration of Technologies	1. To oversee the functional performance of installed processing equipments in APCs 2. To initiate and promote value addition activities by SHGs and assist them in developing market tie-ups for their products 3. To oversee the functional performance of installed processing equipments in APCs 4. To organise training programmes for farming community	• A new Dal Mill (PKVA Model) was installed in the APC, Aradeshahalli and the machine is well recived in the surrounding areas of Bangalore Rural District • A new Flour Mill Unit (second) was installed in APC, Kuthinagere

		5. To monitor the progress of established Agro-Processing Centres 6. To establish new Agro-Processing Centres	
2	Post Harvest Management of Patchouli (Pogostemon cablin Benth.) in Pilot Scale Steam Distillation Unit and Utilization of Spent Charge	1. Study and identification of problems / constraints of essential oil extraction from patchouli in the available commercial equipments 2. Standardization of initial raw material handling and drying practices for improved distillation efficiency 3. Development of a simple and efficient on-farm distillation unit for the extraction of aromatic oil from patchouli and optimisation of process parameters 4. Pilot scale testing of the developed distillation equipment in a farmer's field 5. Cost-economic analysis of patchouli oil extraction process	• Operational parameters of Pilot Scale Essential Oil Distillation Unit were optimized for the distillation of patchouli essential oil.(charge packing density : 8-10 kg/m3 and steam distillation period :5 h). • The information has been already communicated to commercial distillation units.
3	Development of Pro-biotic Low Fat Dahi	1. To study the effect of addition of different levels of small millet flours on the quality of dahi 2. To test the suitability of commercially available pro-biotic cultures and optimize their levels for the production of dahi 3. Standardization of protocols for the preparation of Fibre Enriched Pro-Biotic Dahi 4. To identify suitable packaging material for the developed products 5. Popularization of developed products	• Barnyard millet flour or proso millet flour up to 2% level or little millet flour up to 3% could be added to milk to prepare curd • The millet curd could be enriched with whey protein up to 1.0 % level. • Particle size of millet flour was < 0.2 mm for uniform blending. • Study with probiotic cultures is under progress.
4	Development of Techniques for the Control of Stored Grain Insects of	1. To conduct surveys to assess the insect pest complex of milled rice and split pulse dal. 2. To assess the prevailing practices in the	• Status and species of insects infesting milled pulses in Karnataka was determined. • Boric Acid (2%), Zandu Parad tablets (1%) were

	Milled Rice and Milled Pulses	management of insects in milled rice and dal. 3. To develop a protocol for the management of insects in milled rice and dal	found to be very effective in controlling insects in milled Bengalgram dal against Lesser Grain Borer (*Rhizopertha*) and Rice Weevil (*Sitophilus*). • Both the Lesser Grain Borer (*Rhizopertha*) and Rice Weevil (*Sitophilus*) failed to develop in Blackgram dal. • The Pulse beetle recorded in field samples infesting greengram dal failed to develop in all treatments.
5	Development and Evaluation of Extruded Snack Foods Using Different Small Millet Rice Flours	1. Development and optimization of product formulation for small millet based cold extruded pasta product 2. Development and optimization of product formulation for small millet based hot extruded snack food / breakfast cereal 3. Packaging and storage studies of developed extruded products 4. Cost-economics of developed extruded products	• Using a cold extruder, five small millets based (foxtail, kodo, little, proso and barnyard millet) pasta products (after blending with whole wheat atta) have been developed with good organoleptic qualities. • With the help of a Twin Screw Extruder, different types of ready-to-eat kurkure type expanded products have been successfully developed from small millets.
6	Development of protocol and equipment for extraction and utilization of natural colours for food industry to replace synthetic additives	1. Identification of sources that produce spectrum of colours/pigments suitable for extraction 2. Development of protocols for collection and post harvest handling of identified source materials of natural colours/pigments 3. Adoption/development of procedures for the extraction of colours/pigments from identified plant sources 4. Study on the stability of extracted natural colours/pigments to heat, light and other common food preservatives 5. Studies on the application of extracted natural colours/pigments in foods	• A Status Report on Natural Colours has been prepared and published • Protocols for collection and post harvest handling of raw material were developed. • Various natural colour pigment extraction methods like traditional drying and powdering, juice extraction, microbial isolation and solvent extraction were carried out in the laboratory. • Freeze drying of pulps of jamun and mulberry fruits using a Lyophilizer at the temperature of -38 °C, -48 °C, and -50 °C respectively for 48 h did not yield in good colour powders • Mulberry fruits dried at the temperature of 55□C in a

			hot air oven for 22 h and ground into fine powder can be used as a food colorant. • Solvent extraction of colours from mulberry and jamun fruit pulp by blending with 80% acetone- HCL followed by freeze drying at -48 °C resulted in highly hygroscopic colours.
7	Development of symbiotic fermented kokum and tomato beverage juice	1. Isolation and characterization of suitable probiotic cultures (yeast and lactic acid bacteria) from tomato and kokum fruits 2. Screening of prebiotic like honey, casein, pomegranate juice and beet root juice and probiotic cultures for their suitability and efficiency in the development of synbiotic fermented tomato beverage 3. Screening of prebiotics like honey, pomegranate juice, jackfruit juice and sweet potato and probiotic cultures for their suitability and efficiency in the development of synbiotic fermented kokum beverage 4. Standardization of protocol for the development of synbiotic fermented tomato and kokum beverage 5. Determination of quality and study effect of storage on nutrient content	• Among four different strains of Yeasts and Lactic Acid bacteria screened for fermentation of tomato juice and kokum juice, the yeast strain UCD 522 and LAB strain L. plantarum (MTCC 6161) were found to be more efficient in enhancing nutrient contents in fermented tomato and kokum beverages. • Pasteurized tomato juice was found to be more suitable when compared to other processing methods tested namely, unprocessed and autoclaved juice for the fermentation in order to retain the lycopene content and to obtain enhanced nutrients in the final product • Honey @ 5% level as prebiotic blended to tomato juice and honey @5% + sweet potato @20% as prebiotic in kokum juice, fermented either by yeast or by LAB cultures, improved the nutritional parameters of the final products; the resultant products were adjudged to be the best with high organoleptic scores for overall acceptability. • The Protocols for the production of Fermented Tomato Beverage and Kokum Beverage using yeast and lactic acid bacteria has been standardized
8	Development of Nutri-Rich Energy Foods Using Small millets	1. Preparation of nutritious hot beverage from small millets for school children. 2. Development of energy rich nutritious foods for school children by incorporation of small millet	• Developed three type of nutritious food products: ready-to-use Beverage Powder Mix, ready-to-eat Nutri-Mix powder and Calcium & iron enriched Papads from five small millets namely, Little,

		flour, wheat flour and green gram flour and incorporation of shepu, moringa, curry and methi leaves for the development of nutritious food products 3. Computation of nutritional composition of the developed products and their sensory evaluation sensory evaluation 4. Popularization of the developed value added nutri-rich energy foods from small millets.	Barnyard, Proso, Foxtail and Khodo millets.
9	Food Grain Storage Interventions in the Soliga Tribal Settlements of Biligirirangan Hills, Karnataka	1. To study the grain storage and other post harvest practices of Soligas at BR Hills 2. To evaluate the relative benefits of grain and other post harvest practices followed by Soligas 3. To assess and identify the options available for providing modern grain storage and other post harvest practices to Soliga tribes 4. Demonstrate suitable grain storage and other post harvest interventions developed under AICRP on PHT for adoption by Soliga tribes	• Thirteen species of stored grain insects were recorded infesting grains stored by Soliga tribes in BR Hills Tiger Reserve. The rice weevil, Sitophilus oryzae was the most abundant, common and wide spread stored grain insect species followed by *C. theobromae*, *R. dominica* and *C. analis*. • The distribution of each of the stored grain insect species across BR Hills has been mapped. All the storage structures being used by the Soligas were enumerated and their effectiveness was evaluated. • The soligas were found to practice 10 traditional grain storage measures, but none of these measures were very effective in containing stored grain infestations. • Te pulses were the major type of grains stored by Soligas in BRT followed by maize. • Field demonstrations of proven safe storage grain practices were conducted for the benefit of Soligas.of 10 different Podus.

	BAPATLA CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1	Accelerated Ageing of Rice and Value Addition in Discoloured and Cyclone Damaged Paddy	1. To study the ageing in different varieties before and during storage 2. To study the effect of physical, thermal treatments on ageing of rice during storage. 3. To study the effect of various chemical treatments to avoid discolouration of lodged paddy crop 4. To study the feasibility and development of various value added products from discoloured and cyclone damaged paddy	• Results of experiments indicate that for rice of BPT 5204 variety, artificial ageing carried out with incubation temperature of 90 °C for 6 hours improve the cooking and physical properties, viz., Kernel Elongation Ratio (KER), Elongation Ratio (ER), Volume Expansion Ratio (VER), Solid Loss (SL), and Amylose Content (AC).
2	Adaptive Trials of Fuel Briquetting Machine in the Rural Areas of A.P.	1. To study the present status of fuel briquetting industry in Andhra Pradesh 2. To optimize the composition of fuel block from different biomass sources 3. To study suitable binding material for preparation of fuel block from various biomass material and to conduct performance evaluation 4.To demonstrate and popularize briquetting.	• Technology for manufacturing fuel briquettes from the chilly and cotton stalks have been demonstrated. • Production cost : Rs. 3.78 / kg of briquettes
	BHOPAL CENTRE		
1.	Primary processing of medicinal plants	1. To adapt/ develop equipment/ techniques/ processes for primary processing (cleaning, washing, peeling, stripping, dehusking, drying, packaging, storage) of selected medicinal plants. 2. To evaluate the performance of the developed equipment/ techniques/ processes in field conditions.	• Leaf stripper for Senna (Hand tool developed for senna leaf stripping with capacity 8-10 kg/h, reduces drudgery and risk of injuries) • Dryer for Safed Musli & Ashwagandha (Hot air drying at 45°C, @ 0.13 m3/min recommended) • Peeler for Safed Musli (Prototype of continuous peeling system developed, Peeling upto 70%

			achieved) • Dehusker for Isabgol (Available relevant machinery tried out with very limited success)
2.	Surface disinfestation and suitable packaging for shelf life enhancement of carrot and spinach	1. Microbial load assessment of selective micro-flora/ pathogens present on the surface of freshly harvested selected fruits and vegetables. 2. Development of prototypes / adaptation of equipment for surface disinfestation of the selected fruits and vegetables. 3. Development of suitable packaging protocols for treated samples	• Batch type equipment for exposing carrots to UV radiations (280 nm) was developed. Carrots treated with UV light for 320 s could be stored safely till 45 days in normal refrigerator. • A protocol consisting of surface dewatering, packaging in LDPE bags of 150 micron and refrigerated storage has been developed. Using this protocol fresh spinach could be stored successfully for 5 weeks.
3.	Application of modified atmospheric packaging techniques for shelf life enhancement of mango, guava, tomato and capsicum	1. To study the respiration rate of mango, guava, tomato and capsicum under different storage conditions. 2. To develop a modified atmosphere packaging (MAP) system for mango, guava, tomato and capsicum in order to increase shelf life. 3. To study the changes in physico-chemical, textural and microbial properties during storage of mango, guava, tomato and capsicum under MAP storage.	• A protocol consisting of UV treatment, packaging in 300 gauge LDPE bags with potassium-permanganate sachets imbedded in silica crystals, and refrigerated storage has been developed for shelf life enhancement of guava up to 6-7 weeks.
	BHUBANESWAR CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1	Establishment of Agro Processing Centre, Training and Demonstration of Technologies	1. Installation of need based processing equipments at the agro-processing center 2. To run agro-processing complex for commercial production & evaluate its feasibility 3. To provide technical guidance to the rural	• APC established at Rajkanika, Kendrapada has operated successfully for dal processing. The APC has processed 250 q of green gram and 38 q of black gram during 2011-12 and 366 q of green gram during 2012-13 with direct employment for 2

		entrepreneurs interested in setting up agro processing industries.	persons. • A biomass fired dryer developed by the centre has been installed at the APC for drying of dal prior to milling. The dryer could dry 5 q of dal per batch in 2 h with fuel consumption of 40 kg fire wood. • The cost of drying is Rs 50/- per q.
2	Feasibility testing, performance evaluation and popularisation of the prototypes developed at other centers in the state of Odisha	Feasibility testing, performance evaluation and popularisation of selected prototypes	• Akola dal mill was procured and tested for milling of green gram, black gram, pigeon pea (dry milling process) and lentil (wet process). • 95.3% dehusking efficiency (2 pass) and dal recovery of 76.5 % based on initial weight • Akola mini dal mill has been included in the Orissa State Govt. subsidy scheme and 10 such units have been purchased by private entrepreneurs for establishment of dal processing unit.
3	Development of small scale oil refining unit (30 kg/h) for sunflower	1. Survey of sunflower oil processing at farmers' and processors' level 2. Study on sunflower oil expression and refining 3. Development and testing of small scale oil refining unit (30 kg/h) for sunflower	• A small oil refining unit of 30 kg/batch has been developed for refining of sunflower oil.
4	Development and evaluation of ready-to-eat snacks from rice flour–moringa leaf blend by extrusion	1. Standardization of the processing parameters for development of ready-to-eat expanded snacks product from rice-moringa leaf blend 2. To study the physical, functional and nutritional properties of the developed product in comparison with commercially available sample. 3. To evaluate consumer acceptability of the developed product in comparison with market sample	• Extruded product from rice flour and moringa leaf powder blend was found to be nutritionally rich (based on protein, iron, mineral and dietary fibre content) and appreciated by the consumers.

5	Development of vegetable pack house and supply chain management system for major vegetable crops of Odisha	1. Establishment of vegetable pack house for primary processing of vegetables in production-catchment area 2. Development of supply chain management system for linkage of producer to consumers 3. Adoption of proper packages and storage system to reduce post harvest losses.	• A model pilot plant on vegetable pack house has been developed with washing, surface drying, sorting/grading, packing and storage facility for primary processing of vegetables. • Training imparted to more than 100 farmers and one active entrepreneur
	COIMBATORE CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1	Establishment of Agro Processing Centre, training and demonstration of Technologies	1. To promote the improved processing equipment and technologies among the farmers through demonstrations, exhibition, etc. 2. To establish agro processing centres at village level and backward areas 3. To run the agro processing complex for commercial production and to evaluate its economic feasibility	• An APC has been established at Therampalayam village, Karamadai block located about 40 kms from TNAU campus.
2	Design and development of a stone remover for mango fruit and mango stone decorticator and utilization of mango kernel and husk	1. To design and develop a mechanism for stone removal from mango fruit. 2. To develop a decorticator for separation of kernel from mango stone. 3. To extract oil from mango kernel & evaluate its biochemical properties 4. To extract starch from mango kernel and to study its utilization. 5. To utilize the outer fibrous pericarp of mango stone as fuel briquettes 6. To work out cost economics.	• For the Mango Stone Decorticator developed, maximum decortication efficiency (94.83%) was obtained. • Mango stone shell was made into fuel briquettes, at 150°C temperature and 200 kg/cm2 pressure, having density of 1281.04 kg/m^3 and calorific value was 4500 kcal/kg.

3	Adoptive trial on improved jaggery production process	1. To conduct adoptive trials with the following gadgets/processes, developed for the improvement of the quality of jaggery (i) Rail system with tilting mechanism for the transfer of juice from boiling pan to the cooling pit (ii) Striking point indicator (iii) Striking point alarm (iv) Use of natural clarificants in jaggery production 2. To incorporate the modifications if required for its suitability in Tamil Nadu 3. To evaluate the performance of the gadgets/processes in the traditional jaggery processing units/farmer's holding.	• A jaggery processor has been identified at Telugupalayam (about 7 kms from TNAU campus) for adopting the improved gadgets. • The improved gadgets were installed to function in the existing jiggery production unit identified.
4	Development of cocoa pod breaker and drying of cocoa	1. To develop a gadget for breaking the cocoa pods and separation of cocoa bean from pod. 2. To study the effect of different fermentation methods on quality of beans. iii. To develop a solar tunnel dryer with supplement heat for drying of cocoa beans during monsoon season.	• A prototype of pod breaking mechanism was developed for splitting the cocoa pods into two halves longitudinally. After splitting, the beans are removed manually. • The prototype has a capacity of 100 pods per hour with two labourers, compared to 25 pods by a labourer per hour in traditional method. • The unit is under evaluation in a cocoa plantation. • Studies on fermentation of beans under heap, box and basket fermentation methods are in progress
5	Extraction of pectin from mango peel	1. To select the suitable mango variety for pectin extraction. 2. To select the extraction media, conditions and pretreatments for pectin extraction and purification. 3. To develop a pilot plant for extraction of pectin from dried fruit peel. 4. To conduct quality analysis with respect to	• Higher yield of pectin was observed by autoclaving method. • Among peel from different varieties of mango, malgova variety showed higher yield of pectin (22%) followed by totapuri variety (18%). • Qualities of jelly made from totapuri and senthuram pectin were found to be on par with commercial pectin.

		jellying and thickening properties. 5. To workout the cost economics and transfer of technology.	
6	Development of farm level ripening chamber for fruit ripening	1. To standardize the process parameters like dosage of ethylene gas, duration and temperature for uniform ripening. 2. To develop a fruit ripening chamber with ethylene distribution system suitable for farm level operation. 3. To test and evaluate the fruit ripening chamber.	• A bamboo structured, LDPE covered ripening chamber • was developed with provision for regulating ethylene dosage (capacity : 330 litres). • Ripening of mango has been found uniform at the 4th day on 24 h exposure to 200 ppm concentration of ethylene gas.
7	Development of fermented millet based probiotics	1. Optimization of cooking of pearl millet grain. 2. Fermentation of cooked pearl millet and preparation of probiotic fermented products. 3. Evaluation of probiotic bacteria in the fermented product for stability and viability. 4. Formulation of value added products with the probiotic fermented millet. 5. Development of pilot plant and transfer of technology.	• Pearl millet porridge was inoculated with lactic acid bacterial isolates before and after cooking and allowed for fermentation. • Organoleptic tests indicated overall acceptability at 24 h and 48 h of fermentation than at 72 h of fermentation. • combination of LABC 3 and LABC 6 isolates inoculated after cooking of pearl millet porridge improved the nutritional quality compared to the naturally fermented porridge.
8	Adoptive trials on tamarind seed remover developed by UAS, Bangalore and Honey extraction unit developed by PAU, Ludhiana	1. To evaluate the performance of the tamarind deseeder developed by UAS, Bangalore with tamarind fruits grown in Tamil Nadu region 2. Development/modification of the tamarind deseeder suitable for local varieties. 3. To study the optimum condition required for packaging/ storage of tamarind fruits method. 4. To evaluate the performance and suitability of the honey extraction unit (manually operated and	• In progress.

		power operated) and honey uncapping knife, developed by Ludhiana centre at field level. 5. Popularization of tamarind deseeder and honey extractor.	
9	Adoption and commercialization of eco friendly turmeric polisher	1. To conduct adoptive trials with the ecofriendly turmeric polisher at farmers holdings 2. Popularaization and commercialization of the turmeric polisher.	• A dust proof turmeric polisher has been developed. • Capacity : 60 minutes for 900 kg per batch of Finger rhizomes and 70 minutes for 600 kg per batch of Mother rhizomes. • Commercialization is being taken up with Directorate of Agri Business Development, TNAU, Coimbatore.
10	Development of post harvest practices for enhancing the storage life of small onion	1. To study the effect of curing on quality and shelf life onion. 2. To study the effect of curing on weight loss of onion bulbs 3. To study the influence of different storage methods on quality and shelf life of onion.	• Experimental estimation of respiration rate, effect of different gas composition on the shelf life have been conducted. • Storage of onion are in progress with regard to effect of different leaf lengths, chemical treatments, gas compositions, temperature and also in ventilated storage on the physiological loss in weight and sprouting loss.
	FAIZABAD CENTRE		Report not submitted.
	GANGTOK CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1	Scope of agro processing centres for Sikkim ginger and seabuck thorn	1. Status of techno economic feasibility of agro processing centre on ginger 2. Study of techno economic feasibility of agro processing centre on Sea buckthorn	• Status paper prepared and published (Bulletin on Status of spices in NEH, Bulletin on Ginger processing in NEH, and Manual for farmers on organic processing of Ginger for making ginger powder).

2	Correlation of physical parameters with the auction price of large cardamom	1. To standardise some of the quality parameters of cured large cardamom 2. To quantify some of the quality parameters while trading	• Investigative status paper prepared and document submitted/published (Production potential of organic ginger, its processing and marketing strategies in NEH Region of India)
3	Design , fabrication and evaluation of large cardamom dryer and / or testing of adopted drier	1. To evaluate the existing large cardamom driers 2. To find out the constraints in the existing large cardamom driers 3. To find out the necessary biological properties of Large Cardamom 4. Performance evaluation of the existing driers 5. To make a new modified drier for large cardamom	• Physical properties were measured for fresh and dried large cardamom. • Drying parameters (drying temperature and loading rate standardised for large cardamom. • Solar polyhouse tunnel dryer evaluated for drying large cardamom.
4	Studies on detailing of large cardamom and modification & evaluation of large cardamom detailing machine	1. To evaluate the existing large cardamom detailer 2. To evaluate manual detailing 3. To find out the constraints in the existing large cardamom detailer 4. To find out the necessary biological properties of Large Cardamom 5. To make suitable detailer (electric power operated as well as manual) for large cardamom 6. Evaluation of the detailer machine	• Information on manual detailing has been collected. Small clippers have been identified for manual detailing. • Existing cardamom detailer evaluation is to be completed in the ensuing season (by Dec. 2013). • Pre-treatment for the mechanical detailing has been finalised. • One pedal cum power operated detailer designed.
5	Design, fabrication and evaluation of ginger washer	1. Development of a small ginger washer suitable for NEH region	Design finalized and ordered to be fabricated (one in Udaipur and the other one at Hisar) Could not be purchased due to funds. The one fabricator has already sold the washer to his local market.

			Ginger washer
6.	Evaluation of traditional flue type (spice board) bhatti and various other large cardamom curing units.	1. To evaluate the spice board bhatti and the traditional bhatti used by the farmers in Sikkim	Evaluated and suggested modifications for improved functional performance.
7.	Shrink packaging of Sikkim oranges / tomatoes and its shelf life with and without edible coating	1. To design suitable packaging for shrink packaging of Sikkim oranges and tomatoes 2. To demonstrate and evaluate the commercially available technology of shrink packaging for Sikkim oranges and tomatoes	Preliminary experiments were conducted with tomatoes and oranges.
	HISAR CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1.	Establishment of agro processing centre, training and demonstration of technologies	1. To train manufacturers to produce improved machines 2. To demonstrate improved machines	• One APC on aonla preserve was established in village Bhatrai (Bhiwani district, Haryana). • Small machines manufacturer Mr. Krishan Jangra of M/s Sanjeev Engg. Works was imparted training and given technical guidance for manufacturing carrot washer (continuous type).
2.	Field evaluation and testing of equipments developed at other centres	1. Field testing of TNAU pearler, carrot washing machine (continuous type), and Garlic Peeler and Garlic grader from Udaipur centre	• Field evaluation of continuous carrot washing machine, Garlic Peeler and Garlic grader has been undertaken.
3.	Development of coca based mulhati guava products (bar, nuggets and their commercialization)	1. To manufacture coca based mulhati guava products	• Mulhati-guava bar and nuggets prepared from 1 kg pulp, 600 g sugar and 40 g mulhati powder were found most acceptable. • A significant decrease in overall acceptability of treatments was noticed during 90 days of storage. • Cost of production : Rs. 120/ kg.

	JABALPUR CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1.	Operational Research Project in AgroProcessing Centre with Techno-EconomicFeasibility	1. To impart training to the villagers and women of the area. 2. To provide technical guidance to the rural entrepreneurs interested in starting post-harvest industries 3. To develop Agro Processing complex at adopted site	• APC has now been established as per ICAR norms in the adopted village of JNKVV at Gudgawan. One paddy sheller, one rice polisher, one CIAE Dal Mill and one hand operated water chestnut decorticator were installed. • APC on diversified uses of soybean has also been established at College of Agricultural Engineering. This APC is utilized for training and manufacturing soy products like blanched soy dhal, plain &flavoured milk, Tofu, sweet Dahi (Yoghurt), Soy fortified biscuits
2.	Design, Development of Testing of Groundnut Testa Remover	1. To design and develop a power operated machine for remove testa from groundnut Kernel. 2. To test this machine in a commercial scale snacks manufacturing unit	• Average capacity of the prototype developed was found to be 40 kg/h. • Processing cost is Rs 0.80 per kg. • Best Shelling efficiency are 72.24%, 65.48% and 69.70% over nylon fiber mate, denim cloth sheet and canvas sheet, respectively.
3.	Field evaluation and testing of equipment developed at other centres	To evaluate the performance of (a) PKV Akola Dal Mill, (b) CIAE Grain pearler and (c) CFTRI dal mill	• Performance evaluation of the stated machines were carried out. • Maximum milling efficiency was 75.7 % for CFTRI Dal Mill and 68.3 for Akola Dal Mill.
4.	Post-Harvest Management of Medicinal Crops	1. Survey of different selected medicinal crops grown nearly Jabalpur district and their existing procedure for processing and storing. 2. To design and develop a composite unit for peeling and processing of medicinal crops.	• Maximum peeling capacity 101.6 g/hr was obtained when peeling is done by knife and the least 41.6 g/hr when the sample is pre balanced and peeled by knife. • Drying of SafedMusli takes more times when dried in

		3. To find out the suitable drying method for drying the medicinal crop. 4. To study physico-chemical attributes of selected medicinal crops.	shade than any other method but the lightness and saponin content was found to be maximum in this condition of drying. • Maximum loss of saponin content was observed when dried in cabinet dryer in which the temperature lies in the range of 57-92oC with the air velocity of 1.62 m/s and 1.88 m/s respectively.
	JAIPUR CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1.	Post-Harvest Management of Aonla and Aloe vera	1. Self life improvement of aonla for off season use. 2. To develop alove vera juice extractor to obtain peel free clear juice from aloe vera leaves and standardisation of juice preparation technique. 3. Value addition of aonla and Aloe vera products/ by products.	• A prototype for grinding of aloe vera pulp and making peel free juice has been developed (Output capacity: 210 kg /h, Efficiency: 82.06 %). • Process technologies were standardized for different products of aonla, viz. Aonla candy and Aonla syrup.
2.	Post-Harvest Management of Henna	1. Standardization of henna leaves drying and separation process. 2. Development and testing of a mechanical henna harvester.	• A reciprocating cutter bar type harvester, operated with 5 hp diesel engine was successfully tested for harvesting the henna crop. • The problem of excessive vibration associated with earlier petrol engine model, could be overcome having. the rotary steel blade and prime mover mounted on framework with a pair of wheels, which travel in forward direction.
3.	Standardization of harvesting time, drying and grinding process for fennel, fenugreek and coriander	1. To study the effect of harvesting stage on quality of seed production of fennel, fenugreek and coriander. . 2. To standardize the drying process for fennel	• Optimum harvesting stage for maintaining different processing properties of fennel, fenugreek and coriander seed was investigated and umbels harvested at post mature stage (41-45 DAFI) was

	cabbage)		
7.	Value addition of indigenous fruits of Assam	1. To evaluate the quality of value added products made from indigenous fruits of Assam through non fermentation and fermentation technology. 2. To standardize the process for optimum production of value added products from indigenous fruits by non-fermentation and fermentation technology.	• Technology for utilization of jamun to make squash (one with sugar only and another with both using sugar and salt) and local nutritious banana (bhimcol) fruit powder is ready to transfer.
8.	Value addition to indigenous citrus (khashi mandarin, pummelo and citron) peel waste by candy making	1. To standardize the method of candy making from citrus peel. 2. Storage studies of different candies.	• Methods have been standardize for candy making from different citrus peel. • Storage studies for shelf life is in progress
9.	Development of: a storage regimen for a standardized biopesticide for the control of *Callosobruchus chinensis* in pulse storage and a small scale production unit	1. Standardization of storage regimen for developed formulation in scaled up bins vis-à-vis traditional structures with improvisations, if necessary. 2. Process standardization of drying – grinding – packaging line, ready for commercialization 3. Popularization of the technology through participatory appraisal mode and other popular audio-visual aids.	• It has been conclusively found that three gram of Black pepper seed powder per kg of green gram can effectively control the infestation of *Callosobruchus chinensis* during storage when green gram seed is kept in plastic jars or jute bags with inner lining of polythene.
10.	Value addition to bamboo shoot through an improved fermentation process.	1. To develop an improved bamboo shoot fermentation method. 2. To improve the drying process of fermented bamboo shoot	• Fermentation of bamboo shoots with garlic extract is found to be better in comparison to ginger, common salt and control.

	JUNAGADH CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1.	Operational research project on Agro-processing centre	1. Survey of selected villages to identify the available agro-processing equipment. 2. To transfer the developed and improved agro-processing equipment to the selected village to give value added product. 3. To evaluate the techno-economic feasibility of the agro-processing centre.	• Two new agro processing centres were established at Virol and Loej of Mangrol Taluka of Junagadh District. These were established in collaboration with Aga Khan Rural Support Programme, Gadu. Oil mill and grader were installed at both the APCs.
2.	Extraction of enzymes from potato peels substrate using Bacillus group of bacteria.	1. To study the growth habit of microbes on standard media. 2. To standardize the conditions for growth of microbes using potato peel. To measure the efficacy of filtrate as enzyme source.	• Amylase and protease enzymes can be extracted economically from potato peel substrate to utilize biowaste potato peel from potato processing industries.
3.	Development of Sapota cleaner	1. To carry out survey of Sapota cleaning methods. 2. To develop a Sapota cleaning unit. 3. To evaluate the performance of Sapota cleaning unit.	• A prototype sapota cleaner has been developed. • The cleaning efficiency for jute surface was maximum 99.50 % at 70 rpm for and for cotton surface maximum 80.26 % at 60 rpm. • Maximum capacity of the machine was 270 kg/h
4.	Extraction of pectin from Kesar mango peel by resins	1. To study the processing parameters on the recovery and quality of mango peel pectin by using cation exchange resin at laboratory scale. 2. To study the process parameters on pilot scale. 3. To study the cost economics of pectin extraction.	• Average pectin content in the Kesar mango peel was found 15.35%. • Total recovery of pectin was 79.38 % to 88.68 %, the yield decreasing with an increase in the temperature from 80 ^{0}C to 100 ^{0}C.

5.	Storage study of mechanically damaged wheat harvested by combine harvester	1. To study insect infestation in different mechanically damage seeds 2. To find out the safe storage for wheat grains, with castor oil and different packing materials.	• Percent weight loss was found 0.40 to 4.64 after three months of storage. • Percent germination was found 82.5 to 95.0 after six months of storage. • 9% damage grain can be stored with 15 ml/kg castor oil in metal bin for eight month of storage with minimal pest population, damage by insect and weight loss.
	KASARAGOD CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1.	Development, evaluation and modification of processing gadgets / equipments (main project)	1. To develop machineries/ equipments/ gadgets for value addition of coconut products and byproduct utilization 2. To evaluate the machineries to assess the techno economic feasibility of the same	• Performance evaluation of the agricultural waste fired coconut chips dryer showed its input capacity to be 10 kg fresh coconut slices and output capacity to be 5.75 kg coconut chips dried in seven hours. • Modification and performance evaluation of agricultural waste fired (Biofuel) Virgin Coconut Oil Cooker. Capacity: 100 coconuts in three and a half hours. Oill recovery: 23.54 % • A double screw coconut milk expeller has been developed (to be evaluated).
	KHARAGPUR CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1.	Frontline demonstration of appropriate technologies, machines and products		• Shelling of cucumber seeds with/without conditioning was demonstrated. • Dehydration of cabbage, cauliflower, green chilli using recirculatory tray drying along with freezing of fresh vegetables have been demonstrated to the members of 'Bhangar Farmers Company' as a

			minimal processing technology for commercialization.
2.	Management of safe storage of pulses in West Bengal	1. To evaluate of different storage structures against insect pests of stored pulses and to select improved structures. 2. To study chemical, thermal and bio-control methods for the control of stored pulses and residual analysis of used bio-insecticides and fumigants in the pulses. 3. To use of plant products and different oils against insect pests of pulses. 4. Biochemical analysis of stored pulses during different control measure.	• Two control strategies viz., microwave and fungal treatment, were successfully applied for insect disinfestations without affecting the quality of green gram seed. • Optimized microwave treatment (808 watt and 79 sec) of green gram resulted in its shelf life increase without any significant effect on its nutritional quality, with 99.5 % insect mortality. • The shelf life of seeds increased from 30 days in control to 134 days after microwave treatment at 90 % RH, 30 °C in MP package. • Optimized fungal treatment of 4 x 105 conidia mL-1 for 8 days resulted in 97.83% insect mortality with no significant changes in nutritional profile. • The shelf life of the fungal treated seeds was found to be 115 days at 90 % RH, 30 °C in MP package.
3.	Development of an integrated system for processing of cashew nut	1. To optimize parameters for cashew nut sheller 2. To develop cashew kernel peeler 3. To standardize the conditioning of cashew nuts and kernels for shelling and peeling 4. To study the suitability of centrifugal sheller and peeler by field testing 5. To study the techno-economic feasibility of developed system	• A centrifugal cashewnut sheller has been developed. • A rubber roll type cashew kernel peeler fabricated (performance evaluation is in progress). • A quick infrared cashew kernel conditioning treatment standardized for pre-peeling stage. • A pre-peeling conditioner for cashew kernel has been designed.
4.	Development of products of commercial importance from minor millets *Setaria*, *Paspalum* and *Panicum sp.*	1. To develop flaked products from Setaria, Paspalum and Panicum sp. and examine their physical, chemical and product characteristics. 2. To develop and characterize papads using	• Functional kodo millet-soy-fenugreek extruded RTE snack has been developed. • Its antidiabetic effect on normal human and diabetic

		Setaria, Paspalum and Panicum sp. 3. To develop dosa, idli mixes from Setaria and Panicum sp. 4. To develop extruded product from minor millet. 5. To examine economic feasibility of products developed	animal models has been investigated.
5.	Development of Technology for Enhancing Shelf-life of Onion (Allium cepa L.) in Hot and Humid Region of West Bengal	1. To estimate the different types of losses in onion during storage. 2. To screen chemical agents for enhancing shelf- life of onion. 3. To screen physical agents for enhancing shelf-life of onion. 4. To screen varieties with long shelf- life.	• Extension of shelf-life of onion with effective treatment with aqueous solution of ethanol (71.8 %, v/v) and potassium sorbate (0.76 %, w/v) during postharvest storage for 90 days in dark and at ambient room temperature.
6.	Development of a dehuller for Pumpkin, Bottlegourd and Cucumber seeds	1. To standardize pre-conditioning treatment before dehulling 2. To develop a mechanized dehuller for pumpkin, bottlegourd and cucumber seed dehulling Long-term Objectives: 3. To study the performance of the developed dehuller 4. To study techno-economic feasibility of the developed system	• Centrifugal sheller could be used for shelling of properly conditioned (1.15 kg-f/cm2 pressure, 60 minutes and 1500 rpm of the sheller) cucumber seeds. • At the optimum process parameters, the shelling efficiency, whole kernel yield, split kernel yield and broken kernel yield were 87.63%, 64.97%, 4.92% and 30.08% respectively.
7.	Mathematical modeling of on-farm cooling systems	1. Design and development of a low cost on-farm water spray based cold storage 2. Design and development of a vapour absorption refrigeration based cold storage 3. Monitoring and assessment of produce quality	• Psychrometric properties were determined for few assumed environmental conditions required for designing farm storage chambers. • A MATLAB programme has been prepared for parameter estimation based on varied product load.

		in the storages 4. Mathematical modeling of air and moisture circulations in the cold stores	• Mathematical models of air and moisture circulations in the cold chamber have been developed.
8.	Production of Shelf-stable Dehydrated Mushroom	1. To determine thermo-physical properties of mushrooms. 2. To standardize the pre-drying treatment conditions for mushrooms. 3. To optimize the process parameters for vacuum drying of mushrooms. 4. To optimize the process parameters for microwave drying of mushrooms. 5. To optimize the process parameters for radio-frequency drying of mushroom.	• Based on colour, texture chemical dip i.e., metabisulphite (0.5%) and citric acid (0.25%) treatment was selected as suitable pretreatment. • Drying kinetics have been studied for tray drying of mushroom slice as well as whole mushroom.
9.	Development of a continuous system for low capacity milk sterilization	1. To identify an appropriate time-temperature combination for milk sterilization without impairing the milk flavour. 2. To develop a continuous milk sterilizer with a low capacity of about 100 L/hour. 3. To evaluate the performance of the developed system.	• A continuous solar powered milk sterilizer with a low capacity of about 100 lph has been designed.
10.	Development of Technology for Processing and Preservation of Ripe Palmyra Palm (*Borassus flabellifer* L.) Fruits.	1. Development of new products and new technologies for processing and preservation. 2. Development of a new "Solar Dryer" instrument. 3. Shelf life assessment of newly developed product. 4. Performance study of the new technologies.	• Shelf life of the fruit pulp has been found to extend with the help of modern technologies up to 10 to 12 months. • "Taal Drink" has been prepared from dried fruit pulp powder.

rice bran oil extraction.

	LUDHIANA CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1.	Establishment of Agro Processing centre, training and demonstration of technologies.	1. To study the machinery management in different Agro-processing complexes 2. To study the economic management in these agro-processing complexes 3. To popularize the concept of agro-processing complexes	• Eight agro-processing complexes were established during the period. All these complexes were found to be economically viable units, providing employment to 2-4 persons. • Forty farmers were guided for establishment of various Agro Processing Complexes. • One modern Haldi Processing Plant was established in village Jodhan under our guidance.
2.	Demonstration and commercialization of developed equipments and technologies for honey extraction	1. Dissemination of equipment/ prototype/ technologies i.e PAU electric-cum-battery heated uncapping knife and PAU honey heating -cum-filtration system developed under AICRP on PHT	• Twenty prototypes of honey uncapping knife were fabricated, and tested for their performance in the laboratory and at different locations of Punjab at Beekeepers Apiaries for its performance. • The fully automated honey heating cum filtration system was evaluated at different process conditions. Time for heating, holding and filtration of honey was 108 and 142 min for 25 kg and 50 kg capacity of machine. • The biochemical and microbiological quality of filtered honey through the developed unit caters to the international standards set for the honey.
3.	Process development for improvement in grain milling (rice milling and pulse milling) through enzymatic pretreatment	1. Production of hydrolytic enzymes by solid state fermentation. 2. Extraction and purification of the enzymes and use of partially purified enzymes for hydrolysis of grain layer. 3. Evaluation of milling characteristics and quality of enzymatically pretreated grain and comparison with the untreated sample.	• An enzymatic process technology to improve the milling performance of both Basmati (Basmati 370) as well as a non- Basmati (Pusa 44) variety has been developed at the laboratory level. • It resulted in an increase of head rice yield by an average of 4.5%, lowering of the percent brokens by 2% and resulted in decrease of polishing time by 35 sec., reduction in optimal cooking time of the

			polished rice by 5.5 min. and a reduction of moisture content by 4% in the treated samples. • For large scale production of microbial enzymes, a solid state fermenter(10kg cap.) has been developed to produce 250g enzyme by fermenting rice straw in one batch ,which is sufficient to pretreat brown rice obtained from 10 tonnes of paddy.
4.	Development of strategies and techniques for the control of stored grain insects/pests/microflora/ mycotoxin in Bengal gram.	1. To evaluate the effect of Turmeric powder and Neem leaf powder as grain protectants against Collosobruchus sp. 2. To evaluate the effect of thermal treatment with different time-temperature combinations. 3. To select the best packaging material for storage of Bengal gram.	• Neem powder (0.5% and 1.0%) in mustard oil @ 3ml/kg grain) proved better than all other treatments viz., Turmeric, thermal and control in controlling pulse beetle in Bengal gram grains during four months of storage. • LD packaging encountered significantly lower incidence of pulse beetle (only 4.33% insect infestation). • Mustard oil with neem powder was also the most effective treatment in controlling the mycoflora in Bengal gram as compared to all other treatments. • Germination percentage remained unaffected in all the treatments except control.
5.	Replacement of existing hook system (kundi) for minimizing the pilferage losses during handling/lifting of bags in markets/ware houses/ godowns.	1. Grain bag lifting / handling system to minimize spillage losses in warehouses	• After testing in the warehouses and keeping in view the strength, easy availability and cost, the 7mm hook made of MS material was adjudged to be the best for the operation and also in reducing the pilferage loss.
6.	Utilization of de-oiled rice bran for food purpose	1. To study the effect of physical processing on biochemical and bio functional compounds of deoiled rice bran. 2. To select the best method of protein extraction	• The deoiled rice bran samples of size 0.355 mm from hammer mill and ultrafine grinder showed higher protein content, crude fiber and lowest ash and silica content.

		from deoiled rice bran for its better utilization in food. 3. To optimize the percent utilization of physically, chemically (extracted protein concentrate) and enzymatically processed deoiled rice bran in wheat based food products.	• The deoiled rice bran subjected to solid state fermentation, resulted in decreased cellulose and hemicellulose content and increased protein and crude fibre contents significantly. • The nutritionally upgrade deoiled rice bran was used to make cookies (by substituting wheat flour by 5% to 10%) with improved palatability and adequate physical and sensory characteristics as compared to control.
7.	Protocol and pilot plant for extraction of pectin from kinnow peel/waste	1. To compare the different methods for extraction of pectin in order to identify the most effective method for extraction of pectin from kinnow waste 2. To characterize the pectin extracted by different methods. 3. To optimize the process parameters of selected methods under lab conditions. 4. To develop the pilot plant for extraction of pectin	• Pectin extraction process from kinnow peel was standarized. • Optimum process variables for pectin extraction with HNO3 method were 73.41 ℃ temperature, 2.0 pH of solution and 62.97 min of extraction time which gave pectin yield 15.57%, DE 91.85%, viscosity 0.0304918 pas and MW 90801.4 of extracted pectin. • Optimum process variables for pectin extraction with HCl were 75.0 ℃ temperature, 2.0 pH of solution and 60.48 min of extraction time which gave pectin yield 15.65%, DE 89.27%, viscosity 0.0288 pas and MW 75443.8 . • Purification of pectin by dialysis and DEAE-cellulose column chromatography resulted in better color quality.
8.	Technology for production of probiotic and synbiotic juice from guava, kinnow and mango	1. Microencapsulation of the probiotic strains. 2. Production of novel probiotic and synbiotic juices 3. Microbiological, physiochemical and sensory analysis of the developed products. 4. Development of a Pilot plant to produce probiotic and synbiotic fruit juices.	• The probiotic guava, kinnow and mango juices were successfully formulated, with stable and viable beneficial bacteria content in the recommended dose (106 cfu/ml) with a shelf life of one month. • The sensory evaluation of the developed juices indicated that the consumer preference was more for the juices with free probiotic cells as compared to the ones with microencapsulated cells owing to the

			mouthfeel of the probiotic beads. • Undesirable organisms like Coliforms and E. coli were not found in these probiotic juices. • A Patent on 'Production of Probiotic fruit juices using free probiotic cells from guava, kinnow and mango", was filed on 5th Feb, 2013.
	PANTNAGAR CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1.	Establishment of Agro-processing complex	1. Survey in selected villages to identify major crops grown, their processing pattern, consumption and site selection to establish a new agro-processing complex. 2. Selection, procurement, installation and demonstration of agro-processing equipments. 3. Techno economic evaluation of the agro-processing complex.	• For establishment of new APC, two farmers were selected on the basis of a survey
2.	Post harvest management of underutilized crops of Uttrakhand	1. To design and develop a apricot pit decorticator 2. To design and develop a apricot pit husk-kernel separator	• A prototype apricot pit decorticator has been fabricated.
3.	Biochemical characterization of nutraceutical components of millets of Uttarakhand		• Quantitative estimation of Phenolics, Ca^{+2} Content, Total Portein, N content, protein digestibility in seeds of Barnyard millet and Finger millet cultivars has been carried out.
4.	Post harvest management medicinal plant of Uttrakhand	1. To develop a mixed mode solar polyhouse type tunnel dryer (STD) for drying of medicinal crops of Uttarakhand 2. Drying characteristics of fenugreek foliages	• A mixed mode solar tunnel dryer was fabricated for controlled drying condition using auxiliary electrical heating system. Performance evaluation of the dryer for fenugreek foliages is under progress.

5.	Development of a protocol for Microbial certification of selected fruits in Uttrakhand	1. Investigation and identification of indigenous microbial loads on the surface of fresh fruit. 2. Rapid detection of microbial pathogens from the surface of fresh and processed fruits. 3. Development of microbial index for quality determination of fresh and processed fruits.	• Samples of 3 fruits (Guava, Pear and Apple) were procured from local market and bacterial load on fruits was enumerated for microorganisms which may cause spoilage and diseases in human population. • A primer specific for *Escherichia coli* and another specific for *Salmonella* have been selected to detect presence of these bacteria from surface of fruits. • Washing of fruits after purchase is found useful, but it does not remove the bacterial population completely.
6.	Shelf life enhancement of malta using ethylene, CO_2 and O_2 scavengers	1. Comparative study of different active packaging materials (i.e. ethylene scavenger, CO_2 scavenger and oxygen scavenger) and their combinations for storage of malta and their optimization. 2. To study the storage behavior of malta for the selected scavenger.	• Storage behaviour of malta has been studied in paper box and polythene packaging, with ethylene scavenger and oxygen scavenger.
7	Development of jaggery based nuggets with dry fruits and spice	1. Development of jaggery nuggets 2. Optimization of the process and the product composition	• The jaggery nuggets were developed by Conching process from a mixture of cocoa powder, jaggery powder, cocoa butter, skim milk powder, nuts (almond) and spices (black pepper powder).
8.	Development and adoption of equipment for jaggery chocolate manufacturing plant (mixing, chilling, moulding and packaging)	1. Development of pilot plant 2. Performance evaluation of the pilot plant	• The procurement of selected equipment is under process.
9.	Development of a pilot plant for manufacturing of solid and liquid jaggery	1. Development of pilot plant 2. Performance evaluation of the pilot plant	• The pilot plant has taken a constructed area of 20 x 20 m with 33 x1 33 m for material handling and other work. • It houses heavy duty crusher, furnace with four pan,

			water supply system and power supply. • The successful trial runs were conducted and the plant is ready for processing of jaggery.
10.	Use of membrane technology for micro filtration decolourization of Sugarcane Juice and development of pilot plant	1. To study the effect of membrane filter on juice clarity. 2. To study the effect of different adsorbent materials for removal of coloring compounds. 3. To investigate the change in physico-chemical properties of sugarcane juice.	• Experiments have been conducted with 5 different sizes of membrane filters. Analysis of data is in progress.
11.	Improvement of jaggery quality during storage by application of edible coating	1. To study the effect of protein/ polysaccharide/ lipids coating on shelf life of jaggery 2. To study the effect of different edible coating on biochemical changes and colour of jaggery during storage	• Jaggery samples collected from Jaggery Manufacturing Unit (village Kanakpur, Dist. Udham Singh Nagar) were coated with 20 and 40 % of whey protein concentrate (WPC) and kept in Jaggery Storage Bin under ambient conditions. • Effects of various treatments on quality characteristic of jaggery such as pH, colour, total ash, reducing sugar, moisture content and sensory evaluation were recorded.
	PUSA CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1.	Establishment of Agro-processing center, training and demonstration of technology	1. To popularize the scheme by creating awareness. 2. To prepare and submit detailed project report (DPRs) for establishment of APCs 3. To establish the approved APCs and their technical supervision. 4. To conduct trainings & demonstrations for farmers/entrepreneur/KVK Scientist.	• Training-cum-awareness programmes (3 one-day and 2 two-days) were conducted for about 100 farmers on Post Harvest Primary Processing & Value Addition. • Demonstrations of different post harvest machinery under APC were given to different groups of school children and SMSs of Bihar Govt/KVKs.

2.	Status of Agro-processing Industries in Bihar State	1. Development of survey schedule for gathering required information for success stories of Agro-processing Industries in Bihar. 2. Survey work for gathering required information in developed proforma. 3. Scrutiny/compilation of gathered information and report writing for success stories of Agro-Processing Industries in Bihar.	• Ten success stories have been prepared.
3.	Design and development of Litchi Peeling machine and destoner.	1. Survey of existing machines/technology for litchi processing particularly for peeling & destoning of litchi. 2. Design and development of Litchi Peeling machine and Litchi destoning machine / Improvement or modifications in existing machines. 3. Testing and evaluation of developed/ modified machines.	• Supply of CIPHET Litchi Peeling Machine (as per decision taken in CCM 2011) is awaited for testing. • Technical bulletin on Post Harvest Management of Litchi has been published.
4.	Adaptive trials of Jackfruit Processing Technology developed by UAS, Bangalore center of PHTS	1. Survey of existing practices for post harvest processing & management of Jackfruit in local areas. 2. Training and acquiring jackfruit processing technology from UAS, Bangalore centre. 3. Adaptive trials of the technology at Pusa centre. 4. Transfer of technology to farmers/ entrepreneurs	• Survey of existing practices for jackfruit processing has been conducted. • Scientific personnel of Pusa centre have been trained at UAS, Bangalore on products development from ripened jackfruit.
5.	Studies on byproduct utilization of Litchi peels and Litchi stones/seeds	1. Survey of existing practices for post harvest management & utilization of Litchi peels and stones/seeds. 2. Preparation of status report on post harvest management & utilization of Litchi peels and	• Survey of existing practices for post harvest management & utilization of Litchi peels and stones/seeds was carried out. • Engineering properties of litchi peels and

		stones/seeds. 3. Development of new technology / product to utilize Litchi waste / byproducts.	stones/seeds were determined.
	RAICHUR CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1.	Adaptive Trials on Onion Dehydration Technology for the Benefit of Onion Growers of Karnataka	1. To study the existing dehydration technologies for onion and modify to suit the local varieties 2. To evaluate economics of the technology 3. To promote the technology among onion growers of Karnataka	• The onion dehydration technology was standardized for the local varieties of onion using different pre-treatments and drying methods • The technology was demonstrated to the onion growers of North Karnataka through participation in Krishi Melas and Field Day programmes held at Raichur, Gulbarga, Bidar, Bheemarayngudi, and at UAS, Dharwad • Marketing linkages were developed with Sunil Agro Exports Ltd, Tumakur, and HOPCOMS, Bijapur
2.	Adaptive Trials on PKV Dhal Mill for its Promotion among Pigeon Pea Growers of North Karnataka	1. To standardize the milling process for selected local varieties 2. To evaluate the performance of PKV Mini Dhal Mill for the regional varieties and modify (if required) 3. To demonstrate the technology to promote among the stake holders	• Dhal milling process was standardized for the local varieties of pigeon pea • Dhal milling process, operation and maintenance of PKV dhal mill were demonstrated in different places of North Karnataka though Krishi Melas and Field day programmes held at Raichur, Gulbarga, Bidar, Bheemarayngudi and at UAS, Dharwad. • One day training cum demonstration programme on the operation and maintenance of the PKV dhal mill was conducted for the Assistant Agricultural Officers (AAO) of Raichur district for its promotion through Dept.of Agriculture, Government of Karnataka. • Four number of farmers have adopted the technology and established their own mini dhal mill.

3.	Development of Packaging Technology for Fresh Figs to Enhance their Shelf life	1. To determine the physical, biochemical & textural characteristics of selected fig fruits grown in North Karnataka. 2. To develop suitable packaging technology for fresh Fig fruits to enhance their shelf life. 3. To study the influence of developed technology on shelf life/quality of figs. 4. To study the economics of the developed technology	• During transportation of fresh fig fruits, weight loss of 18.38, 22.80 and 23.70 % was recorded on sixth day of storage for 150, 300 and 500 km respectively in one kg capacity CFB box with double layer of fruits. • The shelf life of transported fresh fig fruits was found to be in the range 4-6 days. • One kg capacity CFB boxes with single layer or double layer of fruits were found to be best suited for packaging of fig fruits for minimizing transportation losses.
4.	Development of Large Capacity Multimode Dryer for Drying of Food Crops/ Commodities	1. To study the existing multimode drying technologies 2. To design and develop a large capacity (5 tonnes/batch) multimode dryer 3. To evaluate the performance of developed dryer for selected crops/commodities 4. To study the economics of developed dryer	• A large capacity (5 tonnes/batch) multi mode dryer was designed for drying commercial crops such as grapes, fig and chilli. • Trials were conducted to produce premium quality raisins from the grapes in solar tunnel dryer covered with 75 % shade net and equipped with forced air circulation system for maintaining the desired temperature. • Drying time required to produce raisins was found to be about 5 days (110-120 h)
5.	Development of Methionine Enriched Probiotic Poultry Feed to Improve Quality of Eggs	1. To isolate and characterize methionine producing probiotic microorganisms 2. To screen in vitro and select efficient methionine producing probiotic micro-organisms 3. To Develop and evaluate methionine enriched probiotic poultry feed	• Bacterial cultures capable of producing methionine were isolated • Methionine enriched probiotic poultry feed was prepared using efficient bacterial culture • Effect of probiotic poultry feed was evaluated on 90 days old Giriraja chicks in terms of weekly body weight, feed consumption and livability for 42 days • Supplementation of methionine producing probiotics resulted in increased body weight gain, feed consumption, liveability percentage and better economic returns.

6.	Development of Protocol for Extraction of Phycocyanin from Algae to Replace Synthetic Colour in Food Industry	1. To standardize protocol for phycocyanin extraction from Algae 2. To evaluate the phycocyanin stability under various storage conditions	• Algae was isolated from muddy soils and water collected from paddy fields • Standardization of media formulations was carried out for maximum production of algal biomass • Natural colouring pigment phycocyanin was extracted from dried algal biomass • Powder form of phycocyanin was obtained using spray drier
7.	Establishment of Agro Processing Centre, Training and Demonstration of Technologies	1. To promote the improved processing equipment and technologies among the farmers 2. To establish agro-processing complex at production catchments 3. To run the agro-processing complex for commercial production and evaluate its feasibility and adoption	• 6 no. of APCs were established in different production catchments of North Karnataka • Different models of agro processing equipment were demonstrated to the farmers, entrepreneurs, SHGs and rural unemployed youths of Hyderabad-Karnataka region • 15 no. of training programmes were conducted to the farmers and entrepreneurs on operation and maintenance of agro processing equipment and production of value added products from fruits, vegetables and food grains.
8.	Design, Development and Performance Evaluation of Fish Deboner	1. To evaluate the developed deboner for different species of freshwater fish 2. To study the economics of the developed process for different fish species 3. To transfer the technology among the stake holders through demonstrations and training programmes	• A portable belt and drum type fish deboner of 50-75 kg per hour capacity had been designed and developed for meat separation from low value and under-utilized fish species • The operational parameters (drum peripheral speed: 10.31 m/min, belt hardness: 45 shore and perforation diameter: 3 mm) were optimized for maximum meat recovery and minimum bone content in minced meat • Highest meat recovery of 0.865 kg per kg of dressed fish and minimum bone content of 2.82 mg per 100 g of minced meat was recorded for Rohu fish (followed by Mrigal and Tilapia).

			• The production cost of the developed fish deboner was found to be Rs. 68,845/- and the cost of operation as Rs. 1.31 per kg of dressed fish. The net pay back period was 95 days of operation with benefit-cost ratio of 3.51 • 12 demonstrations were organized • The technology has been identified for displaying in NAAS Museum, ICAR, New Delhi.
	RAIPUR CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1.	Development of process technology for starch production from *tikhur* rhizomes (*Curcuma angustifolia* L.)	1. To study and document the traditional practice of starch extraction. 2. To develop the process technology for the extraction of starch and mechanization of the process. 3. To study the physico-chemical characteristics of tikhur rhizomes. 4. To standardize the quality of the starch. 5. To study the shelf-life of the tikhur starch over a period of time in different packaging materials.	• Physico-chemical properties of tikhur rhizomes were determined. • Partial mechanization of the traditional technology of the tikhur starch extraction by tribal families resulted in increased yield of 3-4 % of starch, with reduction in processing time. • One extraction unit has been procured from CTCRI for testing in the following season.
2.	Densification, packaging and storability of deseeded tamarind pulp	1. To evolve densification technique/mechanism for the de-seeded tamarind pulp. 2. To study the effect of different packaging material on quality of tamarind pulp over a period of storage vis-à-vis loose pulp. 3. To study the cost economics of densified tamarind pulp blocks (bricks) in comparison to lose pulp.	• A paddle operated prototype has been developed for densification of dehulled and de-seeded tamarind pulp into densified blocks of two standard sizes, viz. 500 g and 1 kg weight. • Low cost (Rs 14,000 per machine) • Capacity : 40 numbers of 500 g briquettes or 30 number of 1 kg briquettes • Cost of briquetting : Rs 1.42 per unit for 500 g and Rs 0.95 per unit for 1 kg

			• The machine is found suitable for both male and female workers without significant difference in output/capacity.
3.	Evaluation of mango cultivars for preparation of mango leather and powder and development of pilot plant for manufacture of mango leather	1. To study the composition of major local varieties of mangoes. 2. To determine the suitability of different locally available mangoes for the preparation of mango leather and mango powder. 3. To standardize the recipes of mango leather/powder with different cultivars of mango. 4. To train the women groups/SHGs on value addition of local mangoes. 5. To deliver pilot plant for mango leather and mango powder comprising mango slicer, mango pulper and dryer for 50 kg batch capacity	• 5 potential local varieties of mangoes have been identified for processing and value addition (mango leather and mango powder). • Standardization of the recipes and process technologies for the preparation of mango power and mango leather was undertaken and completed. • A partially mechanized pilot plant model comprising of mango pulper and tray dryer has been developed for the manufacturing of mango powder and mango leather. • Training organized for women groups/SHGs on mango value addition: 5 • Training on entrepreneurship development on mango processing: 2 • Linkage developed with the entrepreneurs and financial institutions: 2 • No. of entrepreneurs who adopted the activity: 2
4.	Establishment of Agro Processing Centre, training and demonstration of technologies	1. To create facilities for processing of locally produced commodities. 2. To create opportunities for employment generation. 3. To enhance the income of cultivators. 4. To promote the small/rural entrepreneurs/ processors	• One new APC was established in Patari village, about 25-30 km from IGKV Campus, with the technical support and guidance of the Raichur PHT Centre. • This APC is equipped to process wheat and paddy along with turmeric, coriander and chili powder. The turmeric powder processed by the centre is being marketed directly to the consumers. • The entrepreneur has also initiated the processing and marketing of branded Organic Turmeric Powder.

			• About 13 and 16 tonnes of turmeric powder were handled by the processor in the years 2011-12 and 2012-13, respectively. Corresponding profits earned by the owner earned are Rs 1,83,000 and Rs 2,21,000, respectively.
5.	Performance evaluation and popularization of prototype developed at other PHT Centers and other R&D institutions	1. To identify the equipment and processes suitable for post harvest loss reduction and value addition in the selected crops of the region. 2. To make available suitable equipment/ machine for processing and value addition of agricultural commodities. 3. To procure the selected equipment, their installation, testing and adoptive modifications (if any). 4. To assess financial viability of these in comparison to the existing practices.	• Testing and evaluation of following machines/prototype have been done 1. Seed grader (Agrosaw – commercial model) 2. Aloe vera gel extraction machine 3. Maize sheller - power operated 4. Maize sheller – manual 5. Tamarind deshuller cum de-seeder 6. Sun flower thresher – power operated
	RANCHI CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1.	Adoptive Trails and feasibility testing of Equipments developed by AICRP on PHT centres	1. Performance evaluation of selected equipments suitable for processing of selected crops of the Jharkhand state. 2. To assess financial viability of selected equipments.	• PDKV dhal mill was installed and evaluated. • Dhal recovery of 74.56 %, with overall milling efficiency 77.46 % was recorded.
2.	Development of Agro-Processing Centre for Training and Demonstration	1. To establish agro processing centre at BAU, Ranchi. 2. Performance evaluation of selected machines (baby oil expeller with filtration unit, flour mill and pulverizer). 3. Demonstartion of technologies among	• Baby oil expeller and pulverizer have been installed.

		potential users. 4. To impart training to farmers, rural youth, personnel of NGOs and SHGs.	
3.	Studies on Milling Qualities of the Most Popular Cultivar and High Yielding Varieties of Paddy in Jharkhand State to Improve Head Yield.	1. To study the milling quality of the most popular cultivar and high yielding variety (HYV) of paddy in Jharkhand. 2. To impart training to farmers, rural youth and personnel of SHGs.	• Six different most commonly cultivated rice varieties grown in Jharkhand were investigated under this study (viz. Birsamati, Birsa Vikas Dhan (BVD) 110, IR 64, MTU 7029, PHB-71 and 6444). • Variation in Head yield and Brokens percentage, determined at different stages of milling, could be attributed to the varietal characteristics of the rice
	SOLAN CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1.	Development of protocol and pilot plant for extraction of pectin from apple pomace	1. To adopt and evaluate solar cum electric drier for drying of apple pomace. 2. To optimize parameters for continuous acid digestion of pomace, filtration, concentration and alcoholic precipitation for extraction of pectin. 3. To standardize parameters for drying of extracted pectin. 4. To upscale the process for mass production of pectin from apple pomace	• Apple pomace was found to contain 8.87% total soluble solids (sugars, malic acid and ascorbic acid) while the insoluble material constituted about 2.33% pectin (as calcium pectate) and 5.39% crude fibre. • Extraction and precipitation yielded 4.21-9.01% (dwb) pectin, with the highest yield from fresh pomace (9.01%) followed by blanched fresh pomace (8.18%), blanched dried pomace (5.79%) and unblanched dried pomace (4.21%). Blanched dried pomace, however, was considered more suitable for easier handling in upscaled and commercial production. • Extraction of pectin by using 0.05N HCl acid led to higher recovery (8.57% dwb) of pectin compared to water extraction (3.29% dwb). • Precipitation by using 95% ethanol in 1:2 proportion (extract: ethanol) resulted in significantly higher pectin yield (8.79% dwb) than by using aluminium

			chloride (4.81%).
2.	Development of method for estimation and removal of calcium carbide residues in mango	1. To detect & estimate the harmful residues in mango fruits traditionally ripened by using calcium carbide. 2. To optimize method for removal of residues from traditionally ripened mango fruits.	• The unripe mango fruits were ripened naturally (control), by dipping in 1% and 2% calcium carbide for 30 min and by using CaC_2 sachet (10 g/ 5 kg box) in one layer and two layers followed by packing in CFB box for allowing them to ripen for 48h at room temperature. • Mango fruits ripened by CaC_2 sachet were hard at the outer surface, while those ripened by dipping in CaC_2 solution were soft at the outer surface. • The level of arsenic in fruits ripened by using different CaC_2 treatments ranged between 0.079-0.129 ppm, while the maximum arsenic content (0.053 ppm) was observed in mangoes ripened by using CaC_2 sachet. • Maximum phosphorus content (38.6 ppm) was also associated with mangoes ripened by using CaC_2 sachet.
3.	Standardization of processing techniques for honey and honey based food products	1. To standardize the processing techniques of honey for retention of quality 2. To develop honey-based food products 3. To optimize the storage parameters of honey and honey based food products	• Time temperature combination during processing of mixed flora honey was standardized (77 ^{o}C, 30 min). • Mixed flora honey, mustard honey and eucalyptus honey were used as sweetening agents (replacing sugar) for preparation of fruit based nectars. • Honey based Fruit Nectars were prepared from kiwi, mango and guava fruits. • Physico-chemical characteristics of these products confirmed to FSSAI, 2006 specifications.
4.	Development of apple seed extractor for separation of apple seeds	1. To standardize optimum dimensions of the apple fruit and cores of different varieties prior to development of the apple seed extraction machine.	• The apple fruit core was removed by using a fruit corer in vertical and horizontal orientations separately. The removed core was then used for seed extraction by means of a tomato seed extractor

		2. Design and development of apple seed extraction machine (Apple corer and seed extractor) 3. Evaluation of germination quality of apple seed extracted by using mechanical seed extractor 4. Pilot scale testing of mechanical seed extractor in apple orchards /apple processing plant	(PAU Ludhiana) with 66 % efficiency. • An apple corer remover has been designed and fabricated for evaluation.
5.	Adaptive trial on dehydration of fruits and vegetables using continuous type of drier developed at aicrp on pht centre kasargod; preparation of sand pear candy	1. To evaluate the suitability of continuous type solar cum electricity/biofuel drier developed at AICRP on PHT centre Kasargod for drying of the fruit and vegetable in HP 2. To upscale the process of sand pear candy making at pilot plant 3. To train the rural youth for dehydration of fruits and vegetable and manufacture of sand pear candy for development of entrepreneurship.	• Procurement of solar drier from Raichur centre is under process.
6.	Utilization of kiwi fruit enzyme (actinidin) for value addition	1. To extract actinidin enzyme from kiwifruit. 2. To use actinidin for the production of novel dairy products, alternative to cheese and yoghurt type products.	• The process for extraction of actinidin from kiwifruit was standardized (peeling, pulping, centrifuging, filtration and coagulation at 25% total solids).
7.	Extraction and evaluation of bio-colour from plum fruits	1. Optimization of the suitable method for extraction of the bio-colour from the plum and its waste on pilot scale. 2. Utilization of the extracted plum bio-colour in value addition 3. To study the storage stability of the colour after addition in different food products.	• Preliminary studies on extraction of colour from plum were carried out.
8.	Development and adoption of mechanical grader,	1. To optimize parameters for separation of kernels from decorticated apricot stones	• A mechanical decorticator was developed to for

	decorticator and separator for apricot stones and their kernels	using mechanical separator. 2. Pilot scale evaluation of mechanical separator in oil extraction unit	apricot stones in 3 to 4 passes. • The dust separator attached with the decorticator was modified by adding three vertically arranged sieve trays having 12.46mm, 7.8mm and 6.15mm diameter perforations to be used as a stone grader separating into four fractions, viz. (i) unbroken stones, (ii) whole kernel mass, (iii) broken kernel mass and (iv) fine crushed shells. • Broken kernels can be reduced to 2.7% compared to 11.3% brokens in decorticator without a screens, with corresponding recovery of whole kernels increased from 88.7% to 97.3%. • A prototype mechanical separator has been developed consisting of a coarse rubber belt inclined at 22° from base and moving in opposite direction from the flow of decorticated stones (shells and kernels). The kernels roll on the belt while shells (being coarse) are carried by the moving belt to other end of the separator. Forced air is supplied to enhance separation.Overnight dipping of decorticated stone mass in water resulted in 70-78.6 % separation efficiency. • A method for extraction of essential oil from apricot kernel press cake was standardized to result 3.3 % recovery of essential oil from the cake without HCN.
9.	Technology for extension of shelf life of white button mushroom and preparation of white button mushroom powder by dehydration	1. To standardize the washing treatments for freshly harvested white button mushrooms 2. To optimize the packaging system and to evaluate the suitability of using moisture absorbers for extension of shelf-life for distant marketing and storage of fresh mushrooms. 3. To develop method for drying of	• Fresh mushrooms treated with a solution containing 0.5% each of CaCl2, citric acid and KMS experienced minimum loss of weight and least changes in quality attributes during storage. • Packaging of white button mushrooms (after washing in the above prestandarized solution) in jute bags containing sachet of 3g MgO (CO_2 scavenger)

		mushroom and conversion into powder for extension of shelf life	improved the storage life under refrigerated conditions. • From the experiments on effect of pre-treatments and drying methods, maximum yield of dried mushrooms (9.6 %) could be obtained by water blanching + 0.05 % KMS + 0.1 % citric acid + 125 ppm EDTA + freeze drier.
10.	Pretreatment and process for preparation of intermediate moisture product from plum fruits	1. To optimize osmo-dehydration method for preparation of low acid plum fruits. 2. To evaluate storage stability of osmo dehydrated plum in different packaging materials. 3. To utilize left over syrup for preparation of value added products. 4. To develop pilot plant for commercial manufacture of osmotically dried plum fruits.	• Plum fruits have been used for preparation of low acid dehydrated plums (intermediate moisture plum). • The process comprising immersion of plum fruits in boiling 0.5% NaOH solution for 10- 15 sec, overnight soaking in 40 0B sugar syrup followed by raising the strength of sugar syrup by 5 0B everyday till 70 0B, rinsing with boiling water and dehydration in a mechanical dryer at 55 ± 2 0C) for 3-4 h, was found satisfactory for osmotic dehydration of the plum fruits (cv Santa Rosa) with respect to good colour, texture, appearance and overall acceptability.
11.	Operational research project on Agro-Processing Centres	1. Establishment of Agro-Processing Centre in the main campus of the university with the aim for total utilization of all the fresh produce of the university into different value added products. 2. To evaluate and demonstrate the oil extraction technologies at existing APC at Solan, Kinnaur, Kullu and Rohru. 3. Establishment of Agro-Processing Centres in the fruit growing areas.	• Four Agro-Processing Centres on Fruit Processing and Apricot Kernel Oil Extraction have been established under the University for demonstration and use by the farmers and prospective entrepreneurs, at 1. College of Horticulture, Nauni, 2. KVK, Shimla, 3. KVK, Kinnaur and 4. HRS Seobag (Kullu) • Sushree Khormoshu, SHG, Spillow, Distt Kinnaur (HP) has adopted technology from the centre and established one apricot oil extraction unit and an APC for wild apricot processing. • Technology of apricot oil extraction has been transferred and 2 units established in Uttarakhand state.

			• World Wide Fund (WWF) for Nature-India, Rakcham (Sangla Valley) Distt Kinnaur (HP) has adopted the technology of apricot oil extraction and established one oil extraction unit.
	SRINAGAR CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1.	Feasibility testing, performance evaluation and popularization of walnut dehuller	1. Procurement of selected equipments, their installation, testing and adaptive modifications. 2. To assess financial viability of these equipments in comparison to the existing practices. 3. Technology, promotion, entrepreneurship development by monitoring. 4. Commercialization of equipment.	• An available Walnut dehuller was evaluated. Its capacity was recorded 400-500kgs of green walnuts per hour. The machine was quite effective with a dehulling efficiency of 90-95% and only 1-4% breakage of nuts. • It was demonstrated to the stake holders at Shopian and Khag areas of Kashmir division. • However, the machine is quite heavy (weight 220 kg) which makes it practically difficult to transport from one place to another in the hilly topography of J&K.
2.	Development of walnut cracking machine	1. To study the traditional methods of kernel separation from inshelled walnuts in comparison to separation by machine. 2. To design walnut cracking machine. 3. To study feasibility and performance evaluation of machine in comparison to traditional methods of walnut cracking.	• In the traditional process, about 7 kg/h of walnuts are decorticated by one trained person to obtain kernels of 450-500 g. The cost of operation is Rs. 15-20 while breakage of kernels are 2-3 %, 6-9 % and 10-15 % for thin, medium and hard shelled walnuts respectively. • A prototype power operated walnut cracker has been developed. It consists of a hopper, two rollers, 1 hp motor and a collection tray. • Cracking efficiency of the prototype ranged from 95.9 - 100%. However, the kernel damage was relatively high (9.7 to 20.3%).
3.	Development of blended beverages from temperate	1. To standardize the recipe for development of product for health benefits.	• Apricot and Sea buckthorn fruits were subjected to pulping and the pulps were preserved by using KMS

	fruits (apricot and sea buckthorn) for health benefits	2. To study the effect of blending on the overall quality of product formulated. 3. To study the storage stability of formulated product under ambient storage.	@ 2000ppm. • Blended beverage (Nectar) was developed from the pulp of both the fruits having TSS 12%, Acidity 0.3%, Pulp 20% and KMS 70 ppm. • The combination of 10% sea buckthorn and 90% apricot pulp was rated superior to other treatment combinations in terms of physico-chemical and organoleptic quality attributes. • Technology was also standardized for Barley Nectar and Barley- Apricot drink. Both the technologies have been transferred to M/s Ladakhi Foods and M/s Kargil Foods Kargil, Ladakh for preparation of these two products on commercial basis.
4.	Extrusion of rice cultivars of J&K state.	1. To study proximate composition of the crop. 2. To study the milling and cooking characteristics of the crop. 3. To optimize extrusion parameters to get quality product. 4. To study the storage stability of the extruded products.	• Milling losses up to 35 % was found caused by traditional Engle berg hullers. • Seven commercial paddy varieties were evaluated for engineering properties and milling properties on the modern rice mill. Brown rice ranged from 67-80 %. • Brokens percentage ranged between 15-20%.
5.	Establishment of Agro-Processing Centres, trainings and demonstrations.	1. To develop appropriate processing technologies for value addition of horticultural produce. 2. To provide technical assistance to interested persons for entrepreneurship in agro-processing. 3. To organize seminars, workshops and symposiums for creation of awareness in adoption of Scientific Post Harvest Technologies. 4. To provide guidance to entrepreneurs in selection, procurement and installation of	• One modern rice mill with rubber rollers has been installed having 2-3 quintals/hour capacity. • Two training programmes were organized for 35 rice mill owners of Kashmir division to demonstrate the advantage of less brokens (15-20%) compared to more than 35% recorded with huller type of rice mills. • Three training programmes on processing, preservation and value addition of fruits and vegetables were organized for 91 beneficiaries.

		post harvest machinery.	
	TAVANUR CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1.	Establishment of Agro Processing Centre, training and demonstration of technologies	1. Installation of need based processing equipments at the Agro Processing Centre in view of reducing post harvest losses in the catchment area 2. To organize trainings on the equipments/technology for farming community 3. Run the agro processing centre for commercial production and evaluate its feasibility and adoption 4. To monitor the progress of the centre	• A new APC has been established at KCAET campus for coconut oil extraction and production of grain flour and spice powder. • The first APC of this centre at Naduvattom based production of eco-friendly areca leaf plates is running profitably (profits in 2012-13 increased almost three-fold from 2011-12 profits) due to high demand of its products.
2.	Development of black pepper decorticator	1. To incorporate modifications to enhance decortication efficiency 2. To evaluate the modified prototype decorticator for its performance 3. Analyse the quality of white pepper produced 4. Popularize the prototype black pepper decorticator	• A power operated pepper decorticator was developed. All parts including spikes, casing, hopper, shaft, and decorticating drum are made of SS to ensure increased safety and quality criteria of the white pepper produced. • The decorticating efficiency obtained was 92%. • This technology has been included in the package of practice of Kerala Agricultural University.
3.	Development of HACCP protocol for safe pepper and pepper products	1. To conduct a survey among spice farmers of Kerala state to identify critical gaps in production and processing practices with special reference to food safety and quality. 2. Establishment of infrastructure facilities for the assessment of food quality and safety. 3. To create awareness of food quality and safety issues of spices and spice products. 4. To develop HACCP protocols for safe and	• HACCP protocols have been developed for black pepper, white pepper, dehydrated green pepper and pepper in brine. • The protocols have been adopted in their newly installed pepper process line by the Wayanad Social Service Society, Mananthawady, Wayanad District (Kerala).

		high quality spice products.	
4.	Development of pilot plant for osmotic dehydration of green pepper	1. To study the effect of pretreatment on retention of the green colour. 2. Standardization of osmotic parameters to get good coloured osmotically dehydrated green pepper. 3. Development of an osmotic dehydration plant. 4. To study the drying characteristics of osmotically dehydrated green pepper. 5. Evaluation of quality of dehydrated product. 6. Storage and packaging studies of osmotically dehydrated green pepper.	• A steam blancher and a hot water blancher have been fabricated to enhance the green colour of the dehydrated green pepper. • Both blanchers have provision for keeping pepper on trays inside the blanching compartment which facilitated easy loading and unloading. • Testing of these blanchers is to be continued with freshly harvested pepper in next season.
5.	Development of banana (CV Nendran) peeler for making chips	1. Study of existing methods used for peeling of Nendran variety banana for chips 2. Development of a banana peeler for the production of chips 3. Evaluation of the developed banana peeler	• A new prototype motorized banana peeler was developed, which could peel 3 grades (small, medium and large) of Nendran banana (Capacity: 35 kg/h, Peeling efficiency: 88%, Material loss: 9%). • A new improved model is being developed to accept different grades of banana, irrespective of its diameter.
6.	Development of technology for alternative material to areca leaf plates	1. Identification of suitable alternative leaves to the areca leaf sheath. 2. Studies on effect of moisture content on quality of plates 3. Standardization of die temperature and retention time. 4. Development of eco plates from the alternative leaves. 5. Storage studies of plates from the alternative leaves. 6. To conduct entrepreneurship programmes and transfer of technology.	• Process parameters were optimized for production of eco-friendly leaf plate from "vattayila" (*Macaranga peltala*). • Treated leaves were sandwiched with 1 mm thick card board using natural and edible pasting material, for better leak proof quality. • The plates made of vattayila leaves dried at 50 ^{0}C for 20 minutes having moisture content of 41 % wb and packed in LDPE of 400 gauges or PP of 200 gauges, could be stored for 21 days without any change in quality.

		7. Standardization of suitable adhesives for good binding property and to get desired shape.	
	TRIVANDUM CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1.	Development of biofilms from native and modified tuber starches	1. Effect of different plasticizing agent and hydrocolloids on the rheology and biofilm forming properties of tuber starches 2. Development of biofilms from modified starches 3. Effect of addition of antimicrobial agents on rheology and film forming properties 4. Effect of addition of nano materials to starch on biofilm forming properties	• Cassava starch-nano clay composite based biodegradable film with improved physico-mechanical and hydrophobicity were developed. • Films were prepared by using modified starch (hydroxypropylated and cross linked starch)-glycerol and clay (Nanocaliber 100SD and Nanocaliber 100 A) composites. • Physico-mechanical and hygroscopic properties of the film have been analyzed.
2.	Development of functional pasta and spaghetti from yams and aroids based composite flours	1. Developing two types of functional products from amorphophallus and yams viz., pasta and spaghetti (noodles) incorporating the native functional attributes of Dioscorea and elephant foot yam flours as well as through fortification with functional additives.	• Protein and fibre fortified pasta from amorphophallus and yams were developed. • by incorporating maida (21,31,41%), amorphophallus /yam flour (40,50 and 60%) and by fortifying with protein sources (whey protein concentrate and casein, 10% each) and fibre sources (wheat fibre and rice fibre, 10% each) . • Cooking characteristics, biochemical properties, in-vitro starch digestibility, colour properties and the textural properties of the pasta have been studied.
3.	Development of thermoplastic starch composites and biodegradable foam type packaging products	1. To develop thermoplastic cassava starch composites by thermo-pressing methods. 2. To study the physico-mechanical, structural and functional properties of thermoplastic starch composites 3. To develop expanded foam type single	• Preliminary trials were conducted to produce thermoplastic materials from starch added with glycerol at various concentrations using the facilities available at Common Facility Service Centre, Kottayam. • A heating platen was fabricated with temperature

		use disposable articles form thermoplastic starch composites 4. To develop loose fill packaging metrials from thermoplastic starch composites 5. To study the physico-mechanical and functional properties of disposable articles and loose fill packaging from thermoplastic starches 6. To study the biodegradability of the developed packaging product	control and attached with the hydraulic press available at CTCRI for compression moulding.
4.	Production of food extrudates from tuber crop flour/starch	1. To investigate the effect of different process variables on extrusion of sweet potato, yam, and cassava-millets, cassava-rice and cassava-spices blended flour. 2. To determine the various physical, functional and textural characteristics of the extrudates	• Extruded products from different tuber crops have been developed using (1) elephant foot yam and rice blends, (2) Xanthosoma flours, (3) blends of cassava and powdered spices, (4) cassava-millets, sweet potato and banana blends, (5) fermented cassava- rice -wheat blends, (6) fermented and destarched cassava and orange fleshed sweet potato and spices blends. The physico-mechanical, functional and textural properties of the extrudates were measured.
	UDAIPUR CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1.	Establishment of Agro Processing Centre, training and demonstration of Technologies	1. Establishment of location specific unit technologies at the rural site. 2. Study of techno-economic feasibility of APC model at village level. 3. To conduct trainings and demonstration of field worthy technologies.	• Aloe vera processing at village Ogna, ginger processing at village Pargiapada and APC flour and spices milling at village Segwa (Women APC) were monitored. • During the reported period, 36 demonstrations were carried out under CSS-PHTM for different improved machines (garlic grader, garlic bulb breaker, garlic flaker, ginger peeler cum polisher and aloe vera gel extractor) with participation of 2004 farmers.

			• 5 trainings (4 for farmers and 1 for officers) on Post Harvest Technology and Management were organized for 157 farmers and officers. Two entrepreneurs have been trained for fabrication of improved machines. • Post harvest technologies and machines were exhibited in 11 melas / farmers fair. • 44 prototypes were fabricated and supplied to various agencies for total revenue of Rs 16.30 lakh. • Rs. 1.46 lakh revenue has been realized by selling of 1375 kg processed products (chilli powder, coriander powder, turmeric powder. pigeon pea dhal and gram dhal and dhal husk) from college APC. • A carrot washing and cleaning machine (1500 kg/h) manufactured by M/s Vijay Laxmi Enterprises, Mathania (Jodhpur) was evaluated for its performance. • Technical guidance was rendered to Agri. Marketing Board (GoR) for establishing a Garlic Processing Unit at Chhipabarod Mandi.
2.	Adoptive trials on Post Harvest Equipment developed at other centres of AICRP on PHT	1. To evaluate the performance of selected improved post harvest technologies/equipment developed at other centres of AICRP on PHT. 2. To modify/refine the same (if required) to suit the local need. 3. To conduct adoptive trials and demonstrations for popularization of same in production catchment. 4. To impart training to farmers/ entrepreneurs for effective management of improved technology/equipments.	• CIPHET Rotary maize sheller and manual Pomegranate aril extractor have been evaluated and found satisfactory for adoption in the region. • Gunny bags (50 kg capacity) with holding straps, eyeholes have been evaluated based on ergonomic parameters to judge its adoptability.

3.	Development of maize based extrusion cooked ready to use products	1. Evaluation, adoption and refinement of existing extruders 2. Development and standardization of maize based ready to use products 3. Nutritional, Shelf life and packaging studies on the products. 4. Cost economics of the process & technology	• The extruder has been commissioned recently, experimental work to follow.
4.	Development and evaluation of fly ash based organic pesticides for the management of pulse beetle	1. To develop fly ash based organic pesticides. 2. To test the efficacy of developed organic pesticides against stored pulse beetle. 3. To study the effect of fly ash based organic pesticides on the germination of seeds. 4. To study the effect of insecticidal properties of developed pesticides with ageing.	• Authentic fly ash sample from KTPS, Kota and and finely powdered plant products were used in 9:1 ratio (90 % fly ash + 10 % plant product) to prepare fly ash based herbal insecticides.. • The insecticidal effect of plant products (viz., custard apple seed powder, custard apple leaf powder, neem seed kernel powder, neem leaf powder and curry leaf powder) was evaluated individually, and in combination with fly ash against pulse beetle in pigeon pea and cow pea seeds. • All the plant products were found effective. Custard apple seed powder @ 20g/kg was found to be most effective (adult mortality: 83.73 %) followed by neem seed kernel powder @ 20g/kg (adult mortality: 80.33%). • Among the fly ash based herbal insecticides, fly ash + neem seed kernel powder (9:1) caused maximum adult mortality (97.33%) followed by fly ash + custard apple seed powder at dose level 10g/kg seeds. No significant adverse effect on the germination was observed up to 120 days after treatment.
5.	Development of pilot plant for processing and value addition of bottle gourd for	1. To develop pilot plant for processing and value addition of bottle gourd 2. To study the effect of storage on physico-	• Dehydration studies (sun, solar and mechanical tray drying) have been conducted for unpeeled and peeled bottle gourd cut pieces.

	retention of bioactive components	chemical, microbiological and sensory quality of value added products	• Process for making bottle gourd juice has been standardized with ginger and lemon flavour. • Estimation of physico-chemical, microbiological, shelf life and sensory quality of value added products by standard methods are under progress.
6.	Protocol and equipment for depodding, shelling and minimal processing of green Bengal gram	1. To adopt/develop a green Bengal gram depoder cum sheller 2. To study the effect of various pre-treatments and MAP on shelf life, antioxidant status of minimally processed green bengal gram kernels. 3. To record various sensory/quality parameters during storage and standardize the protocol.	• A prototype green Bengal gram depodder cum sheller was developed. • The depodder section, based on combing principle, resulted in 50 kg/h capacity with no damage to pods. • The shelling section, was developed on shear and abrasion principle, resulted in 40-50% shelling with bruises/damage to 8 -10% kernels in 4 passes. • A shelling section subsequently developed on centrifugal splitting, resulted in 70-75% shelling with almost no damage to kernels in 4 passes. • Green Bengal gram kernels under MAP with 2% O_2 and 8% CO_2 at storage temp. 0±1^{0}C was could retain acceptable qualitative and physiological attributes till 15 and 21 days in HDPE and LDPE packaging film, respectively.

JAGGERY CENTRES

	ANAKAPALLE CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1.	Development of Protocol for organic jaggery	1. To study the effect of organic manures on yield and quality of jaggery in relation to those affected by inorganic fertilizers in sugarcane	• Experiments were carried out at RARS, Anakapalle Farm and Jaggery Plant to study the effect of organic practices (from planting to processing) on yield and quality of jaggery. • Cane yield from organic treatments with FYM alone was comparable to the maximum yield obtained from inorganic treatments with 100% RDF (recommended dose of fertilizers) under irrigated conditions. Jaggery recovery was 10.79 and 9.05 % respectively. • Under rainfed conditions, FYM + Jeevamruth recorded cane yield slightly higher than with FYM alone. Jaggery recoveries were 8.68 and 9.60 respectively. • Superior colour readings (as indicated by transmittance of N/2 jaggery solution at 540nm) for organically processed jaggery were obtained by treatment with lime. • Better hardness (as from depth of penetration of needle in cm) was observed for organically processed jaggery with lemon juice as clarificants.
2.	Studies on Quantification and effect of Phenolic compounds of sugarcane juice on colour of jaggery.	1. To study the effect of phenols and phenol related compounds on the colour of jaggery.	• The phenolic compounds in sugarcane grown under in irrigated and rainfed farming and under different fertilizer dosage were determined. • The concentration of polyphenolic compound (µg/g) were also quantified in corresponding jaggery samples. • No clear correlation was established between the

			juice phenolic concentration and corresponding jaggery colour.
3.	Enrichment of granular jaggery with carotenes & beta carotene for dietary allowances	1. Cost effective enrichment of the granular jaggery with precursors of vitamin A.	• Addition of moringa leaf paste to cane juice (@ 10 g / 10 litre) was found to enrich granular jaggery with beta carotenes (163.78 µg / 100g) and total carotenes (1402.28 µg/100g) when compared to control (148.88 and 1240.67µg/100g respectively).
4.	Evaluation of vacuum and modified atmosphere packaging for storage of granular jaggery.	1. Identification of suitable packaging material for vacuum and MAP packing. 2. Identification and standardisation of suitable gaseous mixture for MAP packing. 3. Effect of packing methods and materials on quality characteristics and shelf life of the product.	• Granular jaggery samples stored under vacuum packaging using and MAP using Aluminium foil and 150 gauge polypropylene were analysed. • Biochemical changes during storage included reduction in sucrose by 1.1% in vacuum packaging using Aluminium foil, 0.9% in MAP using PP and 0.5% in MAP using Aluminium foil. • Increase in percent reducing sugars and total non sugars was observed. • Changes were found to be negligible in MAP using 100% N_2 gas in aluminium foil.
5.	Steam boiling system using bagasse for manufacturing of jaggery	1. Design and Development of steam boiling system of (0.3 ton / hr boiler steam capacity) for juice boiling. 2. Testing and evaluation of steam boiling system. 3. Techno economic analysis of the system.	• Steam boiler system has been procured. • Fabrication of steam jacket pan is in progress.
6.	Adaptive trial on (a) Sugarcane juice filtration system developed by Kolhapur for quality jaggery and (b) Pasteurization technology developed by TNAU Coimbatore for storage of	1. To study the quality of the cane juice before and after its clarification and its effect on quality of jaggery during its storage and to test the suitability of the mechanical rotary filtration system to local sugarcane varieties. 2. To establish pasteurization unit developed by TNAU, Coimbatore	• Knowhow of the pasteurization technology developed by for storage of sugarcane juice as a beverage was acquired from TNAU Coimbatore centre. • Fresh Sugarcane harvested, cleaned, freed of rind, crushed, filtered and heated up to 70 oC for 15 min. The supernatant liquid was filtered, preservative

	sugarcane juice as a beverage	3. To test the suitability of the technology for the prevailing cane varieties. 4. To test the keeping quality during its storage. 5. To study the economic feasibility of the technology.	added and stored in sterilized glass bottles. • The juice in bottles maintained acceptable quality up to 7 days with zero microbial growth under ambient conditions and up to 4 weeks under refrigerated conditions. • Procurement of sugarcane juice filtration system from Kolhapur is in process.
	BURALIKSON CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1.	Testing, evaluation and transfer of proven technology and equipment to end users	1. To study the suitability and adoptability of the technology developed at other centers in the local condition. 2. To transfer the technology to the end users.	• Cane Juice was pasteurized by heating the juice to 80 °C temperature for 10 min and packed in sterilized bottles. Its storability was found to be more than 3 months. • Jaggery chocolate was prepared by adding cocoa powder @ 10g/l, milk powder @ 5g/l and soda @ 50 ppm. The product is of marketable quality and the taste comparable to other chocolates in the market. Cost of production is estimated to be Rs 8.30 per 35 g size bar.
2.	Evaluation of low cost storage system for long term storage of jaggery in the humid regions of the NE states	1. To improve the storage system of jaggery for long term storability. 2. To minimize the cost involvement suiting to the need of small scale jaggery manufacturer.	• A low cost village level jaggery storage chamber was made having all six sides of the chamber woven with dried sugarcane leaves and two metal tray shelves carrying quick lime to act as moisture absorber. The door of the chamber is kept open during dry periods and closed during wet season. Temperature recorded inside the chamber was 2 to 3 °C less than the outside atmoshphere. • Jaggery kept in it stored well for more than 4 months.
3.	Establishment of pilot plant for making liquid jaggery (Operational	1. To process in the catchments area and value addition to the product.	• The work of jaggery pilot plant is in the final stage. • One APC at vill. Mahanial, P.O. Missamora, Dist. Golaghat has been established. The unit is engaged

	research project on Agro Processing centre)		in production of jaggey and providing service of cane processing and juice extraction. The unit earned about Rs 30,000/- during 2012-13.
4.	Storage of harvested sugarcane for a limited period before crushing	1. To develop package of treatments and suitable system for storing the harvested cane for a limited period to check the deterioration of quality of sugarcane as well as jaggery.	• A combination of chemical treatments has been standardized to enhance storability of harvested cane, allowing crushing up to 5 days after harvest without deterioration of juice and jaggery quality. • The treatment consists of (1) soil application of ZnSO4 @ 25 kg/ha (2) pre-harvest spray of ZnSO4 @ 100 mg/l and 2% sodium metasilicate, 3 days prior to harvest and (3) post- harvest spray of 1% sodium metasilicate, 100 ppm formaldehyde and 12 mM lauryl sulphate (3.5 g/l). The canes are staked on a tarpaulin sheet and covered with the same.
	Development of fruit based flavoured jaggery for value addition to jaggery	1. To obtain a value added product from jaggery by use of orange juice for better marketability of the product and higher return.	• Orange flavoured jaggery was produced by addition of orange fruit juice @ 5 kg / 100 kg cane. The product enriched with vitamin C (increased to 80 mg/100g from 11 mg/100g in normal jaggery).
	LUCKNOW CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1.	Development of a small capacity cane crushing unit for house hold purpose	1. To design and develop a small capacity cane crushing unit 2. To test and evaluate the developed unit	• The power transmission system of crushing unit was redesigned for smooth functioning. • Crushing capacity of this unit is 25-30 kg/h. • Juice recovery is 55 to 60 % oncane weight basis.
2.	Development of a solar drier for jaggery drying	1. Design of a solar drying system 2. Development of the solar drier 3. Testing of the developed drier	• The solar dryer developed previously was evaluated (capacity: 100 kg per batch). • Jaggery could be dried from about 12% to 6% mc. The temperature difference between cabinet and ambient varied from 11 to 26 ^{0}C. The drying rate of jaggery was found as 0.300 kg moisture per hour.

3.	Evaluation of shrink wrap, stretch wrap and modified atmosphere packaging for storage jaggery cubes and blocks	1. Evaluation of shrink-wrap, stretch wrap and modified atmosphere packaging for storage jaggery cubes and blocks	• Quality parameters (brix, pol, reducing sugar, moisture content, pH and colour) of jaggery freshly prepared from different varieties of sugarcane were determined. • Jaggery samples were packed in nitrogen, shrink wrap and stretch wrap for recording of storage data on monthly basis. The study is in progress.
4.	Evaluation of jaggery furnaces (single, double and triple pan) for emission of green house gases and level of bagasse combustion	1. To evaluate jaggery furnaces for emission of greenhouse gases 2. To evaluate level of bagasse combustion 3. To incorporate related parameters to improve existing design	• Combustion efficiency of 52-73% and flue gas temperature up to 294o C were observed. • Emissions of CO @ 900-2000 ppm, CO2 @ 10-15%) and O2 @ 6-20% were recorded using Flue Gas Analyzer during operation of three-pan furnace.
5.	Refinement of juice extraction process with special reference to sugarcane cleaning and juice filtration for 100 kg jaggery/8 h	1. Development of a refined juice extraction process including cleaning of cane and selective filtration of juice	• Fabrication of equipment designed for continuous mechanical cleaning and washing of sugarcane stalks without green tops is in progress.
6.	Development/Adoption of evaporator for sugarcane juice	1. To design a closed system of evaporation for sugarcane juice 2. To develop the closed evaporator 3. To test and evaluate the developed evaporator	• Under development.
7.	Development of power operated jaggery moulding machine	1. Design and develop a prototype of power operated jaggery moulding machine 2. To test and evaluate the developed prototype	• The batch type mechanical screw press rectangular system for jaggery moulding has been provided with two vertical shafts for smooth movement of rotor pistons into the static moulding frame, and a third rectangular vertical shaft (spring loaded) pressing out the jaggery moulds. A sliding plate, which works as platform for setting of jaggery, has been provided at bottom of the base moulds.

8.	Development/Adoption of suitable mixer for production of value-added jaggery using aonla as natural source of vitamin C	1. Developement of mixer for value-added jaggery with aonla	• A manual mixer has been designed for mixing of dried aonla shreds with jaggery slurry without further cutting of shreds.
	KOLHAPUR CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1.	Effect of anticaking agent on the free flowing nature of jaggery powder	1. To study the effect of anticaking agent on the free flowing nature of jaggery powder during storage 2. To study the effect of anticaking agent on quality of jaggery powder	• Application of calcium silicate as anticaking agent @ 1.5 % to medium size (1-2 mm) jaggery powder was found superior for maintaining the free flow nature of powder jaggery during storage up to six months. • Jaggery quality parameters during storage were not influenced significantly by application of the anticaking agent.
2.	Identification and utilization of non-conventional organic clarificants (Soyabean-DOC, Isabgol seed husk, Aloe vera pulp) for jaggery	1. To test the clarification efficiency of various organic base juice clarificants for quality jaggery manufacturing 2. To standardize application of efficient clarificant and its commercialization	• Conjunction use of non conventional organic clarificants Soybean DOC @ 0.500 kg + Isabgol seed husk @ 0.110 kg per 1000 litres of sugarcane juice resulted in highest removal of scum (8.37 %), although jaggery recovery was low (10.24 %). • Sole application of Soybean DOC @ 1.250 kg per 1000 litres of sugarcane juice recorded the highest recovery of jaggery (12.56 %). • Sole application of soybean DOC @ 1 kg per 1000 litres of sugarcane juice as a organic clarificant showed the superior quality jaggery with maximum recovery of jaggery.
3.	Development of protocol for production of organic jaggery from Sugarcane	1. Identification of concentrated and bulky organic sources and their quantification for sugarcane production. 2. Biological control for disease and pest of sugarcane.	• Standardized processing jaggery organically by using organic sugarcane juice clarificant. • Compiled extensive information on National Standards of Organic Farming with regard to (1) permissible and restricted products/ inputs/ additives

		3. Weed management through green manuring, mulching etc. 4. Standardization of organic jaggery processing by using organic clarification of juice. 5. Standardization of physico-chemical parameters of organic jaggery. 6. Incorporation of National Standards for Organic Production (NSOP) 7. Inclusion of Organic Certification procedure and Certification Authorities 8. Develop complete protocol by compiling set of rules, regulations, standards and procedures for production of organic jaggery from sugarcane	for organic cultivation as well as organic processing and (2) Organic Certification procedure. • Physico-chemical analysis of samples collected from organic jaggery producers of Kolhapur, Sangli and Satara districts in laboratory is in progress.
4.	Development of HACCP Protocol for jaggery manufacturing	1. To conduct hazard analysis for identification of Critical Control Points in jaggery processing 2. To recommend controls, critical limits and procedure for monitoring and verification 3. To develop HACCP protocol for jaggery processing	• Significant physical, chemical and biological hazards associated with each specific step of the jiggery manufacturing process were identified and preventive measures to control hazards recommended. • Identified Critical Control Points at liquid jaggery manufacturing process have been identified by • applying CCP design tree technique.
5.	Reduction of sugarcane staling losses through post harvest physico-chemical practices	1. To test efficacy of post harvest physico-chemical practices against staling losses of sugarcane	• Experimental work is in progress with requisite chemicals procured

LIVESTOCK CENTRES

	ALIGARH CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1.	Utilization of byproducts from Buffalo Meat	1. To study the existing practices of animal handling and slaughtering in rural areas. 2. To develop cost effectives technologies for utilization of waste and offal's. 3. Shelf life study of edible byproducts and primary processed product under different packaging material and storage conditions. 4. Development of value added products by offals.	• Different levels of blood (10-15%) and bone meal (3-5%) were incorporated with other ingredients such as rice flour, corn flour, fresh heart and fresh fat to formulate 9 compositions of pet food. • Physicochemical qualities (moisture, protein, fat, carbohydrate, ash, pH) and microbiological qualities (total plate count) were studied. The pet foods developed slaughter houses by-products were found to be microbiologically safe and stable even after 80 days of ambient storage.
2.	Utilization of bone marrow (slaughter byproduct) for preparation of Paya, Instant Soup Powder and Bottled products	Not reported.	PC (PHT) convened a meeting on 8-12-2011 with Dr. M. A. Khan (PI) AMU and Dr. A. K. Srivastava (Asstt Professor) of the AMU Aligarh Centre. The meeting was also attended by Dr. Yogesh Kumar and Dr. Tanbir Ahmed, Scientists (LPT), CIPHT Ludhiana and Dr. Anil K. Dixit, Sr. Scientist, PC (PHT) Unit. As an outcome of deliberations, these two research projects were awarded to Aligarh centre.
3.	Development of ready to eat meat slices and instant meat curry mix	Not reported.	
	CHENNAI CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1.	Development of rapid diagnostic method to detect Salmonella spp and Staphylococcus aureus from meat and meat	1. To isolate the food pathogens such as Salmonella spp and Staphylococcus aureus from beef, mutton, chevon, pork and chicken. 2. To characterize Salmonella spp and	• A protocol has been developed for rapid diagnosis (within 24 h) of food borne pathogens namely Salmonella spp. and Staphylococcus aureus, Listeria monocytogenes, Campylobacter jejuni and E. coli O 157 H7 in meat (chicken and mutton), using PCR

	products	Staph.aureus isolates by molecular techniques. 3. To develop a rapid diagnostic method to detect the above organisms in meats.	and m-PCR technique. • The cost for analyzing one sample is worked out as Rs 200/-.
2.	Development of Rural Slaughter House	1. To study the existing practice of animal handling and slaughter techniques at rural areas 2. To prepare a design and layout drawing of a model rural slaughter house 3. To develop a model rural slaughterhouse 4. To work out the cost economics of the newly developed rural slaughterhouse	• Different models of houses suitable for slaughter of various food animals and for rural areas were developed. • The designs of the slaughter house have been sent to National Research Centre on Meat, Hyderabad and National Meat and Poultry Processing Board (Ministry of Food Processing Industries, GoI), New Delhi. • A book entitled "Design and requirements of modern slaughterhouses for India" has been released (QRT meeting at TANUVAS, Chennai in March 2012). • One rural slaughter house with the consultation and design of TANUVAS centre has been constructed near Dindigul exclusively for emus (M/s Emas Processing Centre) with a capacity to slaughter fifty emus per day. • The designs developed have been handed over to the BIS so as to suitably amend the existing BIS standards for "Basic Requirements for an Abattoir" (IS 4393:1979).
3.	Development of an Electrical Stunner	1. To study the existing stunning practices at rural slaughterhouses 2. To develop an electrical stunner for rural slaughterhouses 3. To work out the cost economics of the electrical stunner	• A low cost electrical stunner had been developed and on evaluation found effective for stunning sheep, goats, pigs, emus and ostriches in terms of electroplectic fit and bleeding efficiency. • Field trials with the electrical stunner have been carried out successfully in emu farm. • Eight units have been sold to various stakeholders.
4.	Establishment of Agro-Processing Centre and to	1. To study the existing potential of Tiruvallur and Kancheepuram districts	• A mobile poultry processing unit-cum-retail meat stall has been developed to address the hygiene status of

	study the socio- economic feasibility (demonstration unit for wholesome poultry meat production) with the expected output to establish model poultry meat production unit (livestock APC)	2. To develop an Agro-Processing Centre 3. To study the socio-economic feasibility of the developed Agro-Processing centre	slaughter and dressing of poultry and also to serve as an ideal street meat food vending stall in cities where commercial space is highly prohibitive in cost and availability. • The design of the mobile poultry processing unit was discussed in the Mayors Conference at Kolkatta, and lauded as an innovative product.
5.	Development of extruded meat products	1. To study the physico chemical properties of beef and chicken meat in relation to extrusion 2. To optimize the parameters for extrusion of meat 3 To develop extruded meat products 4. To conduct experiments on the production of extruded based meat products 5. To work out the cost economics	• Chicken and beef based extruded products were developed with rice, maida, tapioca, refined wheat and corn flours. • Chicken meat based extruded products incorporated with 75% rice flour and beef based extruded products incorporated with 85% rice flour or corn flour have been found to be superior in quality, shelf life and sensory characteristics.
6.	Development of pet food from slaughter house byproducts, agricultural by-products, and market waste of plant origin	1. To evolve a pet food utilising offals, agricultural by-products and market waste of plant origin. 2. To conduct acceptability trials by offering the pet food produced to pets 3. To optimize the inclusion of various ingredients 4. To conduct shelf life studies and compute economics of the pet food prepared	• Pet treats were prepared utilising vegetable waste, fruit waste and offals of chicken and pigs including ear lobe, tongue, oesophagus, trachea, diaphragm, lungs, liver, kidney, heart, spleen, stomach, intestine, etc. and suitable plant binder. • Microbial analysis showed that the pet treats were free from Salmonella and anaerobic organisms. • Acceptability by pets was studied. The product was readily accepted by the pets and there were no complaints from the pet owners after consuming the pet treats. • Proximate analysis revealed that 100 g of the pet treat would satisfy the NRC recommendation of a nutritional allowance of a total of 25 g of protein per day. • Similar experiments were conducted for pet foods

			developed by cold extrusion, with favourable results.
7.	Development of low cost models of meat processing equipment	1. To study existing poultry processing plants 2. To prepare a design and layout drawing of a model poultry processing plant 3. To work out the cost economics of the newly developed poultry processing plant 4. To develop low - cost slaughter equipment for poultry processing	• A sausage stuffer that can be operated mechanically and manually was developed. • Subsequent to initial evaluation, further modification for improved performance is in progress.
8.	Identification of meat species to setup regulations	1. To standardize the technique to extract DNA from the muscle sample. 2. To select and design PCR primers to identify the meat species (cattle, buffalo, sheep, goat, common poultry species, pig) of fresh and processed forms. 3. To standardize PCR technique to identify various meat species. 4. To establish a library of DNA sequences for different meats for species identification particulary food animals/ birds	• PCR technique has been developed identification of beef and pork with selected specific primers having a sensitivity of 0.02 ng/µl and 1.5 pg/µl (detection limit) respectively. • Six samples of beef and pork meat products purchased from retail outlets could be successfully evaluated using this technique in the lab to identify adulteration of meat. • PCR technique has also been developed to identify chicken, duck, emu and quails meat with detection limit 0.025, 0.05, 25 and 0.05 ng respectively. • The results of the sequence analysis with proven software indicated the fool proof accuracy and authenticity of the method developed and standardized in this study for t identification of meats of avian species using PCR technique with species specific primers in fresh, frozen, cooked and processed meat.
9.	Development of suitable facilities for hygienic handling and transport of meat	1. To design the suitable containers to transport carcass, meat cuts and meat packets to short distance and long distance. 2. To identify the cheap cooling agent for transporting the carcass, meat cuts and meat	• Samples of chicken, mutton, beef, and pork were packed/stored in different environments. • Quality characteristic pertaining to meat stored in ice, freezing mixture and food grade gel (pH, ERV, Colour, Odour score and Total Viable Count) are being studied.

		packets. 3. To develop suitable mode of transport of carcass, meat cut and meat packets with appropriate container and cooling agent in summer and winter.	
10.	Standard model design for retail meat shop	1. To study the meat distribution pattern in Chennai (corporation), nearby municipality and panchayat. 2. To develop Standard Operating Procedures for the distribution of meat in corporation, municipality and panchayat level in summer and winter seasons. 3. To develop a suitable cost effective retail meat shop models/ design	• Different models for retail meat stalls suitable for various species were developed. • A private meat store (Batcha Bai Meat Store) designed by TANUVAS centre - AICRP on PHT was opened on 31.07.2011 at Kellys, Chennai. • Following its success, a chain of four Meat Stalls for marketing of chevon and chicken meat have opened at Salem, Tamil Nadu with consultation and design by TANUVAS Centre. • The designs have been handed over to BIS so as to suitably amend the existing BIS standards for "Meat and Meat Products – Basic Requirements for a Stall for Sale of Meat of Small And Large Animals " (IS 7053:1996).
11.	Process refinement for indigenous value added meat products for commercialization	1. To identify the popular indigenous meat products available in Tamil Nadu 2. To develop Standard Operating Procedures for the identified indigenous meat products 3. To develop the identified indigenous meat product as a novel value added meat product 4. To standardize the processing technique for the identified indigenous meat product for commercial exploitation. 5. To assess the shelf life of the developed indigenous meat product	• Preparation of several shelf stable meat products were standardized. • Analysis of physico-chemical characteristics, proximate composition, microbial qualities and sensory evaluation has been carried out for all products developed. • Retort processed indigenous chicken meat products (viz. Chettinad Chicken, Chicken Curry and Pepper Chicken) can be safely stored up to 90 days at room temperature without changes in its nutritive and sensory quality. • Beef, chicken and emu cutlets developed can be safely stored up to 5 days at refrigerated temperature (4±1 °C) without changes in its nutritive and sensory

			quality. • Beef, chicken and emu tikka developed can be safely stored up to 7 days at refrigerated temperature (4±1 ℃) without changes in its nutritive and sensory quality • Among enrobed chicken meat products, products coated with corn flour batter found to be superior as per analysis of parameters stated above.
	KHANAPARA CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1.	Characterization of Different Biogenic Amines in Meat and Meat Products and Development of Mitigation Measures	1. To characterize the different biogenic amines, if any, in the smoke treated traditional meat products of the North Eastern region of India. 2. To suggest suitable mitigation measures to reduce the level of biogenic amines for public health welfare of the meat consumers.	• A total of 231 samples of smoke dried meat samples collected from the states of Assam, Meghalaya, Nagaland and Sikkim have been analyzed. • None of the samples contained biogenic amines beyond the MRL significant to produce clinical symptoms.
2.	Development of Dietary Fibre Enriched Pork Nuggets and Sausage	1. To study the effect of incorporation of different levels of dietary fibre of cereal origin on physico-chemical, proximate, microbiological and sensory quality of pork nuggets and sausage. 2. To study the shelf-life of dietary fibre enriched pork nuggets and sausage under chilled/ frozen condition.	• Pork nuggets were prepared with the inclusion of 5% and 10% of ground rajma, corn four, oat and green pea to the basic recipe and their effect of the physico-chemical, microbiological and sensory attributes were studied. • The nuggets thus prepared were stored under refrigerated condition for 10 days and at -20 ^{0}C for up to 1½ months and storage behaviour of the product was studied. • Pork nuggets prepared with 5% corn flour and green pea powder were found to be better in terms of the physico-chemical properties and sensory quality attributes. • Inclusion of dietary fibres at higher levels of 10% tended to affect the sensory attributes of the product.

			• The work on pork sausage is continuing.
3.	Development of intermediate moisture pork	1. To study the effect of application of the paste of fenugreek and colocasia corm on physico-chemical, proximate, microbiological and sensory quality of pork. 2. To study the shelf-life of the intermediate moisture pork at room temperature.	• Cured and uncured samples of fresh Longissimus dorsi pork were enrobed with (1) fenugreek paste and (2) paste of colocasia corm powder. • Physico-chemical, microbiological and sensory properties the samples hung at room temperature were analysed at regular interval up to 1 month. • Cured meat samples enrobed with the paste of fenugreek were found to be better in terms of the shelf-life at room temperature than other treatments.
4.	Ham Production with Improved Sensory Properties and Safety Indices	1. Study the effect of application of mixed starter cultures of Lactobacillus acidophilus and Micrococcus varians M483 on the physico-chemical-, keeping-, sensory- and microbiological quality as well as amino acid profile of brine cured ham. 2. Study the effect of vacuum and modified atmosphere packaging on quality indicating parameters of refrigerated ham.	• Technology for production of ham with the inoculation of mixed starter culture for improved sensory properties and safety indices has been developed. • Application of starter culture did not affect the total protein and non-protein nitrogen content of ham nor the textural property of ham. • Treated hams liberated higher concentration of free amino acids confirming the proteolytic nature of the inoculated cultures. • Starter cultures improved the physico-chemical properties (ERV, WHC and water activity, FFA, pH) of the ham and also the sensory attributes (appearance, colour, taste, tenderness, flavour, juiciness and overall acceptability). • Microbiological analysis evaluation at 60th day of storage in terms of total viable count (TVC), lactic acid bacteria (LAB) count, Micrococcaceae count, Enterobacteriaceae and coliform count has been carried out to establish product food safety • MAP is found to be a better packaging system for refrigeration storage of ham samples up to 60 days as compared to vacuum packaging.

	KOLKATA CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1.	Manufacture and preservation of ready-to-cook and ready-to-eat fishery products: peeled and deveined shrimp/ fish in vacuum pack	1. To develop fish meat / shrimp products under vacuum packed condition using suitable packaging materials and using different treatments to increase shelf life of the product. 2. To make available hygienic ready-to-cook and ready-to-eat fishery products to the consumers.	• The effect of packaging and sodium acetate treatment on the shelf life of Silver Pomfret (Pampus argenteus) fillets was investigated during refrigerated storage (4±1oC), to present the product in a ready-to-cook form in urban markets • The samples were tested for sensory attributes, bacteriological counts and biochemical (TVBN, TMAN and FFA) quality at periodical intervals. • The vacuum packaging (in polyester pouch laminated with LDPE 42 µ thick film) is effective in inhibiting microbial spoilage to a great extent as compared to 100% air packed samples by increasing the lag phase and generation time. • Sodium acetate treated vacuum packed (SATVP) samples were found to be acceptable up to 21 days, followed by 15 days for control vacuum packed (CVP) and 9 days for control air packed (CAP) samples.
2.	Efficacy of solar drier for salted dried fish meal	1. Procurement of solar drier from Raichur Centre 2. Evaluation of overall performance in terms under agro-climatic conditions of West Bengal 3. Analysis of nutritional parameters of dried fish products	• A 50kg capacity solar drier is under fabrication as per specification received from AICRP on PHT Raichur centre.
3.	Development and demonstration of model retail outlet for live fishes and seafood	1. Establishment of a model retail outlet at AICRP on PHT Kolkata Centre for distribution of hygienic and good quality raw and processed fish products to consumers	• Model retail outlet for fish has been developed by AICRP on PHT Mangalore centre. Request has been placed with PI, Mangalore centre for one unit for adaption and demonstration of the technology.

4.	Extension of shelf-life of extruded fish products using multilayer packaging material under nitrogen flushing	1. Selection and evaluation of multilayer packaging materials. 2. To study the physic-chemical, microbiological and sensory properties of extruded fish products.	• Multilayer packaging material (LDPE + metalized polyester + LDPE) was evaluated in comparison to LDPE film (control) on the basis of the pouch to withstand the nitrogen pressure under nitrogen infused packaging state containing the fishery extruded product. The thickness of the selected multilayer packaging material was 65µ. • Shelf-life of the extruded fishery product was found to be 3 Months.
5.	Pilot scale production of feed using Shrimp Processing waste	1. Optimization of fermentation period for shrimp waste in Biofermenter using three bacterial species. 2. Quantification of amino acid composition of fermented shrimp waste 3. Estimation of Drying rate of fermented fish product. 4. To establish a small scale production unit (as per availability of space and sustenance) unit for fish feed preparation	• Shrimp waste material taken from local processing industry was analysed for proximate composition (protein 40.37%, fat 9.86%, moisture 9.74%, ash 19.82%, crude fibre 15.78% and nitrogen free extract 4.43% db). • Fermentation period was optimized using three different bacteria, viz. Lactobacillus brevis, Bacillus amyloliquefaciens and B. subtilis (14 days in conventional method and 6 days in Biofermenter). • Quantification of amino acids of fermented shrimp head waste is awaited (trend of increased protein is noticed).
6.	Development of biopreservation strategies for seafood and safety	1. Quality assessment of fermented fish products. 2. Microbiological and biochemical analyses of fermented fish products. 3. Proximate principle analysis of fermented fish products.	• High total volatile base nitrogen (TVB-N), peroxide values, moisture content and microbial load in the retailer's samples reflected poor quality, whereas those obtained in producer's samples were within the acceptable limit. • Bacillus sp. present in shidal fish was identified as one of the predominant microbiological populations. • The nucleotide sequences of isolated two Bacillus species were directly submitted to the GenBank and after analysis of the sequences the following accession numbers were generated respectively, viz. GenBank accession number: "KF319057" and

			GenBank accession number: "KF319058" • Lactobacillus plantarum was selectively isolated from shidal. The isolate was found to be bacteriocin positive possessing promising antibacterial property and utilization as a biopreservative.
	MANGALORE CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1.	Shelf-life enhancement of fish sausage in natural casing by using identified natural preservatives	1. Standardization of recipe for smoked fish sausage by using natural casings 2. To study the effect of smoking and natural preservative on the quality of fish sausages	• The smoked sausage in casing of animal origin was observed to have a shelf life of 27 days in refrigerated condition. • Considering the difficulties in procurement and processing animal casing, cellulose casing of plant origin was identified as a better alternative. • Fish sausages in cellulose casing remained acceptable for 10 days without any preservatives. • Cost of cellulose casing was found to be 20 times cheaper than animal/synthetic casing, besides saving processing time. • Smoke treatment enhanced the shelf life of fish sausage in cellulose casing up to 40 days, which could be attributed to its good barrier properties such as prevention of weight loss and oxygen transmission.
2.	Development of women friendly fish vending and display unit	1. Improvement of cost effective, durable, contamination less, women friendly, fish vending and display unit by using alternate materials such as plastic/stainless, steel/fibre for fabricating and replacing the galvanized iron used earlier. 2. To make it more user friendly by fining wheels, covering display portion etc. 3. To test its suitability and ergonomics in market	• A prototype of fish vending and display unit has been developed, evaluated and refined. • The unit has been demonstrated at Ankola, Bangalore, Hebbal, Mangalore (Karnataka) and Ranchi (Jhrkhand) • Patent application for the Fish VDU has been filed through NRDC, Bangalore Regional Office • The Fish VDU has been proposed to be brought

		condition.	under subsidy scheme of the state government through financial support of National Fisheries Development Board (NFDB), Hyderabad • Technology transfer to Department of Fisheries, Jharkhand Govt. and Kenya Marine and Fisheries Research Institute, Mombasa (Kenya) is in process.
3.	Development of Fish Ham and Patty using Natural Antioxidant Extracts	1. To standardize recipe for the preparation of fish ham and patty using low value fishery resource 2. To study the physio-chemical, microbiological and sensory quality changes of the product stored at refrigerated (0-5 °C) and frozen conditions (-18±2°C).	• A fish ham has developed using shrimp chunks, which is not only nutritious and healthy but also maintains the integrity of shape of the product even after slicing. • The fish ham was prepared using fibrous casing, an economical and environment friendly alternative to synthetic casing. • Fish patties were prepared using button mushrooms which acts as preservative and enhancer of flavour and texture of the product. • The product has a shelf life of 20 days under refrigerated storage (without any synthetic preservatives). • The technology of fish patties has been transferred to a local female entrepreneur following a training programme.
4.	Development of fish chikuwa from low cost marine and fresh water fish and their shelf life study	1. Process development for the preparation of marine and fresh water fish chikuwa 2. To pack the prepared products in Bio-active packaging material 3. To estimate the shelf life of the product 4. Development of electrical kiln to heat process the product. 5. To popularize and commercialize the product entrepreneur groups and industry	• Process for preparation of fish chikuwa (popular snack in Japan as a low-fat source of protein) was optimized using fish, starch (10 %) and other spices mixture microwave oven cooking time (20 min). • A training programme has been conducted on the technology and its transfer to one woman entrepreneur is in process.

	MUMBAI CENTRE		
S. No.	Research Project Title	Objectives	Specific Output
1.	Establishment and demonstration of model retail outlet for chicken	1. To study the existing status and slaughtering practices from chicken outlets in and around Mumbai city. 2. Surveillance of chicken meat samples from different retail shops in and around Mumbai for the microbial profile and molecular characterization of these food borne pathogens. 3. To prepare a design and layout drawing of a model retail shop. 4. To develop and establish model retail chicken shop. 5. To evaluate performance of newly developed retail chicken shop for hygienic meat production and economic viability.	• A model retail chicken outlet has been developed and found suitable for production of hygienic and wholesome chicken meat. • One unit has been established in Mumbai Veterinary College Campus and in regular use since December 2012 • A local retail chicken shop owner in Navi Mumbai has adopted the technology and is getting one unit fabricated under technical guidance of Mumbai centre .
2.	Development of techniques for preparation of bile concentrate and separation of acids and salts from bile and tissue	1. To collect bile from freshly slaughtered buffaloes at slaughter houses in and around Mumbai City 2. To standardize the protocol for manufacturing of bile concentrate, bile acids and bile salts. 3. To standardize the protocol for preparation of chondroitin sulphate from tissue.	Process protocols were standardized for production of bile concentrate (using hot air oven and open fire drying method), bile acid, bile salt and chondroitin sulphate (extracted from the tracheal tissues).
3.	Development of pet treats from buffalo slaughter house waste	1. To collect different buffalo byproducts from the slaughter houses located in and around Mumbai City. 2. To standardize the protocol for manufacturing of pet treats. 3. To study the physical and microbiological	• Process protocols were standardized for manufacturing of following pet treats: Buffalo Trachea Treat, Buffalo Ear Treat, Buffalo Tendon Treat.

		quality of these products	
4.	Development of emu meat emulsion and preparation of sausage and patties	1. To standardize and develop the emu meat emulsion 2. To evaluate the sensory and keeping quality / shelf-life of emu meat sausages and patties at chilling temperature. 3. To study the physico-chemical, microbiological and nutritional qualities of these products.	• Protocols were standardized for manufacturing of emu meat sausages and patties. • The products developed were nutritionally adequate, microbiologically safe and organoleptically acceptable up to 7 days of storage at chilling temperature.
5.	Quality evaluation of shelf stable fermented pork sausages	1. To evaluate the sensory and keeping quality/shelf-life of fermented pork sausages. 2. To study the physico-chemical qualities of these sausages. 3. To carry out the nutritional/proximate analysis of these fermented sausages. 4. To assess the microbiological qualities of these sausages	• Protocol was standardized for preparation of fermented pork sausages. • *Pediococcus pentosaceus* @ 180mg/kg and Glucono delta Lactone @ 1% in meat emulsion are recommended as an acidulent during the preparation of fermented pork sausages having shelf-life of 75 days with acceptable microbial, physic-chemical, nutritional and sensory attributes of the products at ambient storage temperature.
6.	Preservation and handling techniques for porcine skin for production of biological bandages	1. To collect porcine skin from freshly slaughtered pigs at Deonar abattoir. 2. To standardize shape and size of porcine skin xenografts. 3. To standardize the preservation techniques for porcine skin xenografts.	• Trials were undertaken to standardize the shape and size of the skin grafts. • Graft removal was very difficult using surgical scalpel (thicker and uneven grafts). • Hamby's knife was used for removal of thin skin grafts under the guidance of Head, Division of Cosmetic Surgery, K.E.M. Hospital, Parel, Mumbai and Head, Department of Surgery, Sion Hospital, Mumbai. • To achieve uniform size thickness skin flap equipment "Dermatome" is needed (proposed in the XII Plan, Approx. cost Rs 6.50 lakh).

7.	Design and development of poultry processing plant (in collaboration with Chennai and Khanapara centres)	1. To design and develop a low cost chicken processing plant 2. To evaluate the performance of the processing plant 3. To conduct the poultry processing trials 4. To evaluate performance of newly developed processing plant for hygienic meat production and economic viability.	• Model poultry processing plant has now been developed by AICRP on PHT Chennai centre. The PI (Chennai centre) has been communicated for giving one unit for adaption and demonstration of this technology.

NATIONAL LEVEL STUDIES UNDERTAKEN BY MULTIPLE CENTRES OF AICRP ON PHT

1. Survey to Identify the Practices for Ripening of Fruits (ICAR-ICMR project)

The study was carried out under the ICMR - ICAR Joint Committee for Research on Food Safety with the following objectives.

(i) To identify the traditional practices of ripening of fruits and their extent of use.
(ii) To identify the chemical methods of ripening of fruits and their extent of use.
(iii) To assess the knowledge, practice, attitude and perceptions about the use of different ripening methods adopted by stakeholders.

A investigative survey was conducted by **16 centres** listed below in 16 states of India.

1. Akola
2. Bangalore
3. Bapatla
4. Bhopal
5. Bhubaneswar
6. Coimbatore
7. Jorhat
8. Junagadh
9. Kharagpur
10. Ludhiana
11. Pusa
12. Raipur
13. Ranchi
14. Solan
15. Srinagar
16 Trivandrum

Salient findings of the study undertaken to identify the ripening practices for three fruits (Mango, Banana, Papaya) assigned by Indian Council of Medical Research

S. No	State selected (Name of centre)	Producing Districts selected	Trading Districts selected	Salient Findings
2	Assam (Jorhat)	Morigaon	Kamrup	**Mango** – No ripening practice adapted. **Banana** - For commercial ripening of fruits, Ca Carbide is used @ 50 to 100 gm per 10 kg of banana fruits. Needs about 24 hours for colour development. Cost of ripening by Ca Carbide is Rs.10-15 per 10 kg banana. **Papaya** - Paper wrapping of individual fruits for ripening and transportation of fruits in containers made up of wood, bamboo or CFB boxes
4	Chhattisgarh (Raipur)	Durg	Raipur	Ethrel use in banana, mango **Mango** – Ethylene gas and

				Carbide(solid @ 1-2kg/MT) in 2.5% and 97.5% **Banana** - Ethylene gas @ 170-220 ppm one wholesaler, Dipping in Ethrel liquid @ 1 ml per litre of water by retailers **Papaya** – Traditional ripening by wrapping in newspaper.
5	Gujarat (Junagadh)	Junagadh (M, B) Sabarkantha (P)	Navsari (M) Kutchh (P) Vadodara (B)	**Mango** – No ripening practice adapted by farmers and traders. 55% of retailers are using traditional practices. 45% of retailers are using traditional and chemical method (calcium carbide in powder and stone form). **Banana** - Farmers and retailers were not following any methods of ripening of banana fruit. All traders use chemical methods (mostly Ethrel solution, followed by Ca carbide) for ripening of banana fruit. **Papaya** – Farmers (100%), Traders (95%) and Retailers (93%) are using traditional method (newspaper covering, packing in paddy straw) for ripening.
7	H.P. (Solan)	Kangra	Una	**Mango** – Traditional ripening adopted by 40% and chemical practice by 60% of farmers. Retailers make it 100%. About 10-15 gram Ca carbide (masala, in the form of stone in small packets kept inside the heap) is used por kg of mango fruits. Cost of masala Rs 40-50 per kg and cost of ripening Rs 1 -3 per kg of mango. Health problem (excessive coughing and sneezing) of workers reported. 10% use gloves, 90% do not take any precaution. **Banana** – Use of ethylene gas reported @ one litre (from generator) for 10 tonne of banana fruit, released in a closed room to achieve ripening in 18 hours.
8	Jharkhand (Ranchi)	Hazaribag	Ranchi	Chemical method of ripening is prevalent among farmers, traders and retailers (more than 90%). Treatment periods with Ca carbide was reported to be 24, 24 and 48 h for **banana, mango and papaya** respectively. Products were stored for 1-3 days depending upon the need of final colour and

				market demand. The most common way of disposal of used chemicals is in surface soil. About 70 % surveyed traders, retailers and farmers had gained the experience to use the chemicals through their friends, 20 % through ancestors and 10 % through other means (newspaper, TV and magazines). None of surveyed traders, retailers and farmers were aware of the ban of the chemical.
9	J & K (Srinagar)	Jammu	Srinagar	For ripening of **Banana and Mango** fruits, ethrel is used @ 300 g in summer and 600 grams in winter per chamber (15 tonnes). Ripening takes place in 1-2 days in summer and 3-4 days in winter. Cost of ethrel is Rs 1000 per litre. Use of Ca carbide reported by all surveyed wholesalers (stone form @ 100 kg/3 tonne of mango fruits, Rs 0.07 per kg of mango) **Papaya** comes in fully ripened form.
10	Karnataka (Bangalore)	Ramanagara	Bangalore Rural	**Mango** – Traditional ripening practices by farmers (spreading fruits in alternate layers of straw, on floor or in bamboo basket). Chemical method of ripening by retailers and wholesalers (dipping in ethrel, Ca carbide, Acetylene gas for 3-5 days). **Banana** – Traditional ripening practices by farmers (wrapping with dried banana leaves, applying lime to the tip of banana stem and exposing it to sunlight). Chemical method of ripening by retailers and wholesalers (spraying Calcium Carbide solution (@ 3g/litre concentration and keeping the bunches in an air-tight chamber for 3-5 days). **Papaya** – Only traditional ripening practice (Wrapping with newspaper)
11	Kerala (Trivandrum)	Palakkad	Malappuram	No ripening practice is followed for **Mango** and **Papaya**. Traditional ripening practice (covering with straw, smoking provided by

				agarbathis) is followed for **Banana**.
13	M.P. (Bhopal)	Burahanpur (B) Badwani (M) Bhopal (P)	Burahanpur (B) Badwani (M) Bhopal (P)	Traditional (1. Burying the mangoes in the ground, separating the layers by paddy straw, 2. Charcoal ash and turmeric 3. Ice) and chemical (Ca Carbide in powder form) ripening practices reported for **Mango**. Use gloves and mask reported for protection, while handling the chemicals. Traditional practices reported for **Papaya**. No ripening practice reported for **Banana**.
14	Orissa (Bhubaneswar)	Khurda	Dhenkanal	Traditional, chemical or both methods of ripening is reported to the extent of 10, 70 and 20% respectively. Farmers use only traditional methods for ripening (wrapping individual fruits with paper for papya, covering with straw, smoking for mango). Use of chemical (Ca carbide for **Papaya and Mango** and Ethophen for **Banana**) has been reported in case of wholesalers and retailers.
15	Punjab (Ludhiana)	Hoshiarpur	Ludhiana	Chemical ripening practice by farmers/ wholesalers/ retailers has been reported up to 80, 57.5 and 70 % for Banana, Mango and papaya respectively.
16	Tamil Nadu (Coimbatore)	Theni	Coimbatore	**Banana** - Retailers adopt traditional method of ripening (Smoking with kerosene and dried banana leaves in dark closed room for 2-3 hours). Ripening (gradual colour change) occurs within a day. Cost incurred for ripening is Rs.150/tonne.

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2. Assessment of Harvest and Post Harvest Losses of Major Crops and Commodities in India (MoFPI Sponsored Project)

MoU for the MoFPI Sponsored Project on "Assessment of Harvest and Post Harvest Losses of Major Crops and Commodities in India" was signed on 29 February 2012.

The study has been undertaken with the following objectives:

1. To carry out a systematic quantitative assessment of the extent of harvest and post harvest losses of all major crops representing cereals, millets, pulses, oilseeds, fruits, vegetables, plantation crops, and spices & condiments as well as livestock produce comprising meat, fish, egg and milk at the national level covering all the agro-climatic zones.
2. To estimate the losses, starting from harvesting, at all post harvest on-farm operations, transportation, storage and distribution in various marketing channels.
3. To identify the specific crop / commodity as well as the specific unit operation inducing significant losses in order to prioritize the points of remedial intervention.

Brief Progress of Work

The study is being carried out by **all centres** under AICRP on PHT.

Group Meeting of the Research Engineers (RE) / Principal Investigators (PI) from all 37 cooperating centres of AICRP on PHT and Scientists from Indian Agricultural Statistics Research Institute, New Delhi was organized at CIPHET Ludhiana for appraisal on MoFPI Sponsored Project on "Assessment of Harvest and Post Harvest Losses of Major Crops and Commodities in India" during 30 May - 01 June 2012. Altogether 120 districts and corresponding block, villages and respondents were selected and finalized.

Orientation Training on PH Loss Assessment Methodology was organized at Jaipur centre during 03-04 September 2012 to familiarize RE/PIs under AICRP on PHT to with methodology for Enumeration, Data collection and Data Entry previously and to train in turn the contractual Field Investigators recruited by the centre.

Training on Data Entry Software for the RE/PI of all the 37 centres undertaking the survey work was conducted during 16-17 November 2012 at CIPHET, Ludhiana. Data Entry Software was provided to all centres on CD (in March 2013, after troubleshooting) for installation at the centre.

Complete enumeration of all the farming households in each of the selected villages undertaken from September 2012 and selection of farmers completed (with the help of the village enumeration data). Field Investigators were recruited in 36 centres and collection of harvest and post harvest loss data in the prescribed schedules for different crops from farmers and from storage channels is in progress.

3. **Study on determining storage losses in food grains in FCI and CWC warehouses and to recommend norms for storage losses in efficient warehouse management (FCI Sponsored Project)**

MoU for the above FCI Sponsored Project was signed on 04 March 2013.

The study is proposed with the following objectives:

1. To identify the extent of losses commodity wise i.e. separately in Wheat, Rice, Paddy and Maize.
2. To identify the factors responsible for losses in storage.
3. To arrive at storage loss norms in different Agro-climatic regions/State with respect to various factors.
4. To suggest ways and means to reduce the extent of storage losses in different unit operations.

The study has been commenced by the following **20 centres**.

1.	Akola	6.	Bhubaneswar	11.	Kolkata	16.	Raipur
2.	Almora	7.	Coimbatore	12.	Lucknow	17.	Ranchi
3.	Bangalore	8.	Hisar	13.	Ludhiana	18.	Srinagar
4.	Bapatla	9.	Jorhat	14.	Pusa	19.	Trivandrum
5.	Bhopal	10.	Junagadh	15.	Raichur	20.	Udaipur

A training on storage loss parameters and present methods of their computation by Food Corporation of Indial was organized at UAS, Bangalore on behalf of FCI Regional Office, Bangalore during 16-17 July 2013 for the Research Engineers / PIs of centres located in southern India.

A Training Manual on Determination of Storage Losses in Food Grains in FCI and CWC Warehouses was prepared for the occasion.

The training on the same theme was oalso rganise at FCI Mayapuri Depot, New Delhi during 23 - 24 July 2013 for the Research Engineers / PIs of AICRP on PHT centres located in norhern India.

Guidelines for selection of compartments and preparation of stacks was prepared and circulated. Field Investigators have been contractually engaged by the relevant centres. Presently selection of compartments and stacks with regard to rice and wheat is in progress, depending on availability of stock. The study of paddy in CAP storage is scheduled to commence from October 2013 with procurement of fresh stock.

4. Central Sector Scheme on Post Harvest Technology and Management (CSS-PHTM)

Department of Agriculture and Cooperation had taken up a new scheme (CSS-PHTM) to promote Post Harvest Technology during the XI Five Year Plan. The Central Sector Scheme aims to focus on lower end of the spectrum of Post Harvest Management. The centres under AICRP on PHT took up CSS-PHTM for the benefit of the farmers and primary processors in respect of (i) Demonstration of Technologies (Component-3), and (iii) Training of Farmers, Entrepreneurs and Scientists (Component-4).

Demonstrations of various manual operated and power operated machines as well as trainings of different stakeholders were undertaken during 2008-09 under Component 3 (Demonstration) and 4 (Training) and Component 3 (Demonstration) also continued during 2012-13. Altogether demonstrations on 56 post harvest technologies of AICRP on PHT were given to more than 16500 farmers/entrepreneurs till date. Besides, 294 trainings on various aspects of post harvest management were imparted to 839 participants (823 farmers and entrepreneurs and 16 Agril. Engg./ ADO). On an average, 33 percent women, 16 percent SC and 13 percent ST population were benefited.

During 2012-13, 118 demonstrations were given to 4612 farmers, which consist of 22.34 percent women, 18.86 percent SC and 28.32 percent ST population.

Following processing equipment have been fabricated/procured by some of our centres for giving to KVKs in different states of India.

S. No.	Name of Equipment (Centre)	No. of Equipment Fabricated	No. of units sent to KVKs	No. of units remaining to transport to KVKs	Rs, Anticipated cost of packaging, transport, loading and unloading/unit
1	Mini Dhal Mill (PKV Akola)	50	28	22	8000
2	Fruit Grader (PKV Akola)	40	28	12	8000
3	Turmeric Boiler (TNAU Coimbatore)	60	0	60	4000
4	Motorised-cum-Pedal operated Cleaner-Grader (CIAE Bhopal)	100	0	100	6000
6	Cassava Chipping Machine hand operated (CTCRI)	34	0	34	5000
7	Pedal-operated Potato Peeler (CIAE Bhopal)	62	24	38	4000
8	Pedal-operated Potato Slicer (CIAE Bhopal)	62	24	38	4000
9	Vegetable Washer (PAU Ludhiana)	39	0	39	6000
10	Hand-operated Groundnut Decorticator (CIAE Bhopal)	100	24	76	3000
13	Arecanut Dehusker (UAS, Bangalore)	100	0	100	3000
14	Insect Trap (Coimbatore)	1000	0	1000	50
15	Honey Filtration Plant PAU Ludhiana)	20	0	20	5000
16	Carrot Washer (Hisar)	8	8	0	0

An amount of Rs 24,98,000 may be required under Plan RC in 2013-14 for this purpose.

5. Impact Assessment of Post Harvest Technology Developed under AICRP on PHT

An assessment of economic and other social benefits of technologies from AICRP on PHT centres have been made based on the feedback of beneficiaries/users (Schedule-I) as well as response of Research Engineer (RE)/ Principal Investigator (PI).

The monitory gain from the selected 39 commercialized technologies of AICRP on PHT, known and found to be in use by the end users/farmers/entrepreneurs, was worked out to be Rs. 1819 million per annum.

Further, the monetary output from 45 selected technologies transferred to farmers/users and from 15 selected technologies in ready for commercialization stage has also been estimated on per unit and per year basis.

Not surprisingly, the study gives very clear message that benefits to the society/consumers/end-users were much stronger than the direct benefits to farmers/entrepreneurs in several cases. Further, it is evident from the analysis that technology has impacted well on various aspects such as reduction in post harvest losses, reduction in labour drudgery, timely operation, value addition and employment generation.

The entrepreneurs of selected commercialized technologies were found satisfied on economic, social and sustainability aspects, as examined from feedback. Intangible benefits to the entrepreneurs as well as to the society were most prominently noticed in case of Agro Processing Centres. For instance, high level of satisfaction with the present work/ profession, quality of their life, motivation towards group approach, and enhancement of animal husbandry.

The fact that AICRP on PHT has brought economic benefit to users and to the society as well as micro-and macro levels, should be inspiring to enhance our efforts in developing new technologies and dissemination of potential technologies.

ANNEXURE

ALL INDIA COORDINATED RESEARCH PROJECT ON POST HARVEST TECHNOLOGY (ICAR) CIPHET, Ludhiana - 141 004

PROGRAMME FOR THE 29th WORKSHOP

Venue : Conference Hall, College of Technology and Agricultural Engineering, Maharana Pratap University of Agriculture and Technology, Udaipur

Dates : 23 - 26 September 2013

23-09-2013 Monday

09:00-10:00	:	**Registration**
10:00-10:45	:	**INAUGURAL SESSION**
10:00 - 10:05	:	Welcome Address – Dr. P.L. Maliwal, Dir. (Res), MPUAT
10:05 - 10:10	:	Opening Address – Dr. K.K. Singh, ADG (Process Engg)
10:10 - 10:20	:	Coordinator's Report – Dr. S.K. Nanda, PC (PHT)
10:20 - 10:25	:	Address by Director, CIPHET – Dr. S.N. Jha
10:25 - 10:30	:	Presidential Address – Dr. N.S. Rathore, DDG (Engg)
10:30 - 10:35	:	Address of the Chief Guest - Dr. O.P. Gill, VC, MPUAT
10:35 - 10:40	:	Release of new publications *(by Chief Guest and President)*
10:40 - 10:45	:	Vote of thanks - Dr. N.K. Jain, Research Engineer (PHT)
Rapporteurs	:	Dr. U.K. Nidoni, Research Engineer, UAS, Raichur Dr. B.M. Pandey, PI, VPKAS, Almora
10:45-11:00	:	**Tea**
TECHNICAL SESSION – I 11:00-13:30	:	**Presentation of Biennial Progress Reports (Horticultural Crops Sector)**
Chairman	:	Dr. N.S. Rathore, DDG (Engg), ICAR, New Delhi
Co-chairman	:	Dr. K.K. Singh, ADG (PE), ICAR, New Delhi
Expert Invitee	:	Dr. C. K. Narayana, Principal Scientist & Head, IIHR, Bangalore
Coordinator	:	Dr. S. K. Nanda, PC (PHT)
Sectoral PI (Food Grains):		Dr. P.A. Borkar, Head, PDKV, Akola
Rapporteurs	:	Dr. M.N. Dabhi, Research Engineer, JAU, Junagadh Dr. Ravi Gupta, Research Engineer, CAU, Gangtok

(The session will commence with a presentation by the Sectoral PI on the present scenario and significant achievements in the sector, limited to 20 minutes. Research Engineers/PI of the cooperating centres to present the salient Progress Report of the projects under the sector for 2011-2012 and till date. Presentations will be arranged in alphabetical order to the name of the Centres and will be limited to 15 minutes for each centre including discussion).

13:30-14:30	:	Lunch
14:30-17:30	:	Technical Session – I continued (Horticultural Crops Sector)
Rapporteurs	:	Dr. Nachiket Kotwaliwale, Research Engineer, CIAE Bhopal Dr. M.S. Alam, Research Engineer, PAU Ludhiana

24-09-2013 Tuesday

TECHNICAL SESSION – II 9:30-13:30	:	Presentation of Biennial Progress Reports (Food Grains Sector)
Chairman	:	Dr. N.S. Rathore, DDG (Engg), ICAR, New Delhi
Co-chairman	:	Dr. K.K. Singh, ADG (PE), ICAR, New Delhi
Expert Invitee	:	Dr. R. Kachru, Ex-ADG & QRT Chairman, Bhopal
Coordinator	:	Dr. S. K. Nanda, PC (PHT)
Sectoral PI (Food Grains):		Dr. R. Viswanathan, Prof. & Head, TNAU, Coimbatore
Rapporteurs	:	Dr. V. Palanimuthu, Research Engineer, UAS Bangalore Dr. S. L. Srivastava Co-Investigator, IIT Khargpur
13:30-14:30	:	Lunch
TECHNICAL SESSION – III 14:30-16:00	:	Presentation of Biennial Progress Reports – Livestock Produce (Centres: Aligarh, Bangalore, Chennai, Khanapara, Kolkata, Mangalore, Mumbai, Pantnagar, Raichur)
Chairman	:	Dr. N.S. Rathore, DDG (Engg), ICAR, New Delhi
Co-chairman	:	Dr. K.K. Singh, ADG (PE), ICAR, New Delhi
Expert Invitee	:	Dr. B. S. Prakash, ADG (AN&P)
Coordinator	:	Dr. S. K. Nanda, PC (PHT)
Sectoral PI	:	Dr. Dr. Robinson J.J.Abraham, Head, TANUVAS,Chennai
Rapporteurs	:	Dr. R. N. Borpuzari, PI, AAU, Khanapara Dr. C.V. Raju, PI, KVA&FSU, Mangalore
TECHNICAL SESSION - IV 16:00-17:30	:	Presentation of Biennial Progress Reports - Jaggery Sector (Centres: Anakapalle, Bangalore, Buralikson, Coimbatore, Kolhapur, Lucknow, Pantnagar)
Chairman	:	Dr. N.S. Rathore, DDG (Engg), ICAR, New Delhi
Co-chairman	:	Dr. K.K. Singh, ADG (PE), ICAR, New Delhi
Coordinator	:	Dr. S. K. Nanda, PC (PHT)
Sectoral PI	:	Dr. Jaswant Singh, RE, Lucknow
Rapporteurs	:	Dr. P.K. Omre, Research Engineer, GBPUA&T, Pantnagar Dr. B.G. Gaikwad, PI, RS&JRS, Kolhapur

25-09-2013 Wednesday

TECHNICAL SESSION – IV	:	**Presentation of Technical Programme for 2013 – 2014**
09:30-13:30	:	by **Sectoral PI** (Food Grains): Dr. R. Viswanathan and **Sectoral PI** (Horticultural Crops): Dr. P.A. Borkar
Chairman	:	Dr. N.S. Rathore, DDG (Engg), ICAR, New Delhi
Co-chairman	:	Dr. K.K. Singh, ADG (PE), ICAR, New Delhi
Expert Invitee	:	Dr. S.M. Ilyas, NIRD, Hyderabad
Coordinator	:	Dr. S. K. Nanda, PC (PHT)
Rapporteurs	:	Dr. M.S. Sajeev, Research Engineer, CTCRI, Trivandrum Dr. M.K. Panda, Research Engineer, OUAT, Bhubaneswar

(The Sectoral PIs of AICRP on PHT to present the research projects and technical programme proposed to be undertaken during the years 2013-2014).

13:30-14:30	:	**Lunch**
14:30-17:00	:	**Technical Session – IV continued** by **Sectoral PI** (Livestock Produce): Dr. Robinson J.J.Abraham and **Sectoral PI** (Jaggery): Dr. Jaswant Singh
Rapporteurs	:	Dr. R.J. Zende, Research Engineer, MAFSU, Mumbai Dr. K. Veerbhadra Rao, PI, RARS, Anakapalle

26-09-2013 Thursday

TECHNICAL SESSION - V : MoFPI sponsored project on "Assessment of Harvest and Post Harvest Losses of Major Crops and Commodities in India" (Discussion on progress and constraints)

09:30-11:30

Chairman	:	Dr. N.S. Rathore, DDG (Engg), ICAR, New Delhi
Co-chairman	:	Dr. K.K. Singh, ADG (PE), ICAR, New Delhi
Invitee Sponsor	:	Shri U. Venkateswarlu, Joint Secretary, MoFPI, New Delhi
Coordinator	:	Dr. S. K. Nanda, PC (PHT)
Rapporteurs	:	Dr. Jaswant Singh, Research Engineer, IISR, Lucknow Dr. A. Borah, Research Engineer, AAU, Jorhat

TECHNICAL SESSION - VI : FCI sponsored project on Study on determining storage losses in food grains in FCI and CWC warehouses and to recommend norms for storage losses in efficient warehouse management (Discussion on progress and constraints)

11:30-13:30

Chairman	:	Dr. N.S. Rathore, DDG (Engg), ICAR, New Delhi
Co-chairman	:	Dr. K.K. Singh, ADG (PE), ICAR, New Delhi
Invitee Sponsor	:	Shri M.L. Sehgal, Consultant, FCI, New Delhi
Coordinator	:	Dr. S. K. Nanda, PC (PHT)
Rapporteurs	:	Dr. D.K. Sharma, Research Engineer, HAU, Hisar Dr. Devina Vaidya, PI, YSPUH&F, Solan

13:30-14:30 : Lunch

TECHNICAL SESSION - VII : BUSINESS SESSION
14:30-15:30

Chairman	:	Dr. N.S. Rathore, DDG (Engg), ICAR, New Delhi
Co-chairman	:	Dr. K.K. Singh, ADG (PE), ICAR, New Delhi
Coordinator	:	Dr. S. K. Nanda, PC (PHT)
Sectoral PIs	:	All four Sectoral PIs
Rapporteurs	:	Dr. S. Patel, Research Engineer, IGKVV, Raipur Dr. A.K. Dutta, Research Engineer, IIT, Kharagpur

(In this Session, Research Engineers/PI of the centres will discuss the salient features of the functioning of their centres, and also administrative / technical problems, if any).

TECHNICAL SESSION - VIII : PLENARY SESSION
15:30-16:30

Chairman	:	Dr. N.S. Rathore, DDG (Engg), ICAR, New Delhi
Co-chairman	:	Dr. K.K. Singh, ADG (PE), ICAR, New Delhi Dr. S. N. Jha, Director, CIPHET, Ludhiana
Coordinator	:	Dr. S. K. Nanda, PC (PHT)
Rapporteurs	:	Dr. V.Thirupathi, Prof. and Head, PI, TNAU Coimbatore Dr. H.R. Naik, Prof. and Head, PI, SKUAST, Srinagar

(In this Session, recommendations of different sessions will be read out by the Rapporteurs and comments invited. This will be followed by concluding remarks of chairpersons).

Vote of thanks : by Host Institute

(S. K. NANDA)
Project Coordinator
AICRP on PHT