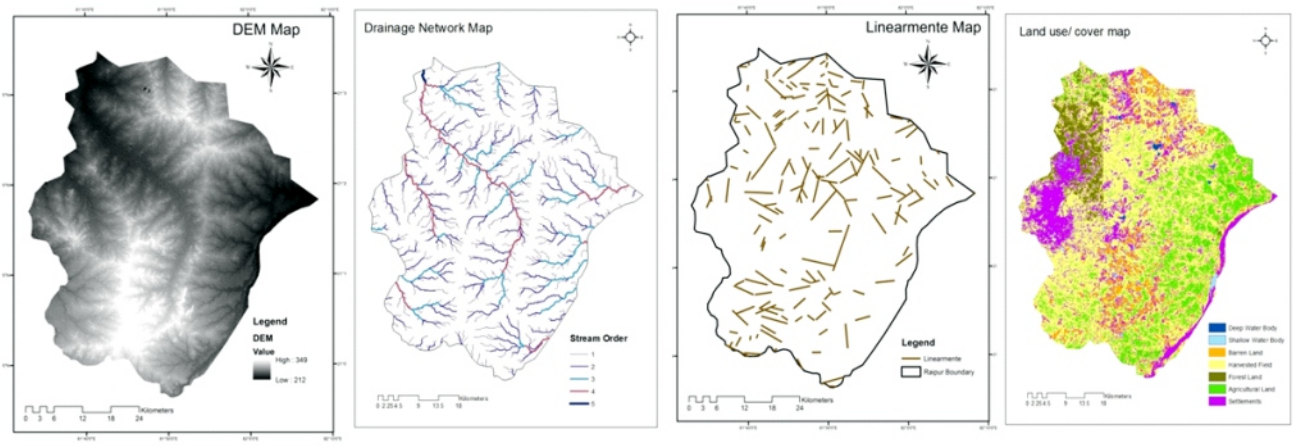
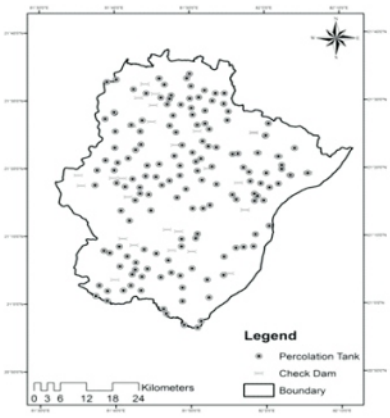


Various Thematic Maps of Raipur



Structure size	Abhanpur		Arang		Dharsiwa		Tilda		Total
	CD	PT	CD	PT	CD	PT	CD	PT	
Small	4	18	3	14	7	17	3	12	78
Medium	2	16	4	11	5	14	4	18	74
Large	3	13	3	9	7	10	2	15	62
Total	9	47	10	34	19	41	9	45	214

Project 04: Surface and Ground water modeling for developing management plan for critical watershed of Seonath Sub basin. (2015 to 2017)

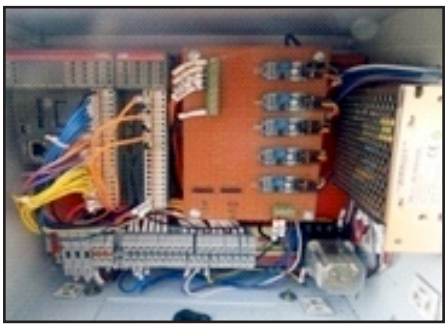
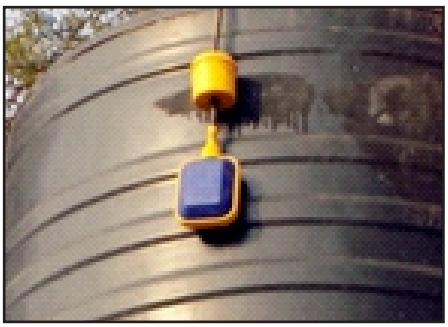
Objectives

1. To characterize various basin parameters using satellite data and GIS techniques.
2. To calibrate and validate the selected distributed parameter model for the study area.
3. To Study the Land cover changes in the basin and their impact on stream flows.
4. To develop the effective management plan for the critical Watershed of the study area

Salient Findings

- SWAT model was simulated for discharge, sediment concentration and water quality of Seonath sub-basin on monthly basis.
- Critical watershed was identified based on the soil erosion and nutrient losses from the Seonath sub-basin.
- Different scenario of BMPs was developed for critical watershed.
- Visual MODFLOW model was also used for groundwater management of critical watershed.
- Groundwater potential zone and groundwater quality index mapping was done to suggest the best location for different recharge structures in critical watershed. Total 120 storage tank, 70 percolation tank, 34 stop dam and 16 check dam were suggested.
- Groundwater quality contamination vulnerability mapping was prepared using the DRASTIC model for critical watershed and suggest the appropriate location for

Parts setup for sensor based irrigation system

AICRP on IWM IGKV, Bilaspur Centre

Experiment. 2.2: Effect of different levels of water on growth and yield of rice–wheat crop sequence under tubewell command at cultivator's field.

Background: In canal command water is made available during rabi season occasionally; as the irrigation project is designed as protective irrigation. This forces the farmers to make use of other sources of water to provide full irrigation to the crop at all growth stages.

Objective:

1. To study the effect of submergence of rice under tube well command.
2. To study the effect of fertilizer and irrigation on rice-wheat crop sequence on farmer's field.
3. To compute WEE.

Location	: Risda village of Masturi Block
Ecology	: Irrigated (Canal + Tube well)
Farming situation	: Crop based, Bunded rice field
Cropping system	: Rice-Wheat
Soil Type	: Dorsa, clay loam
Source of funding	: AICRP on IWM

Rabi: Wheat

- ❑ Grain yield of wheat was affected by irrigation levels. Application of 4 irrigations at CRI, tillering, flowering and milk stages recorded 31% higher yield than irrigation at CRI and flowering (2 irrigations). However, in comparison of 4 irrigations, 2 irrigations recorded higher WEE.
- ❑ Recommended agronomic practices i.e. recommended dose of fertilizer gave 20% higher grain yield of wheat over the farmers practice. Higher WEE was recorded under recommended practice as compared to farmer's practice.

Kharif: Rice

- Irrigation at 3 DADPW recorded 5.75% and 7.17% higher grain yield of rice in comparison to continuous submergence under farmer and recommended practices, respectively. Irrigation at 3 DADPW acquired higher WEE in comparison to continuous submergence.
- Recommended practices with balance dose of fertilizer produced 19.77% and 20.97% higher grain yield of rice under continuous submergence and irrigation at 3DADPW, respectively over to farmer's practices. Higher WEE was recorded under recommended practices of rice cultivation WEE in comparison to farmer's practices.

Measurement to Management (M_2M): Improved Water Use Efficiency and Agricultural Productivity through Experimental Sensor Network

Experiment 1. Water Management Studies on Finger Millet (*Eleusine coracana*) in Mid Land Situation of Chhattisgarh Plains

Objective

1. To assess the water use efficiency of ragi in mid-land situation.
2. To assess the feasibility of growing summer crop (Ragi) in mid-land situation.

Experiment 2. Water Management Studies on Maize (*Zea mays* L.) in Mid Land Situation of Chhattisgarh Plains

Objective

1. To assess the feasibility of growing summer maize in mid-land situation.
2. To assess the water use efficiency of Maize in mid-land situation.

Glimpses of Water Management Technology on Summer Finger Millet

Nursery

Soil Moisture Reading with TDR

Milking Stage

Paddy Straw Mulch Operations

Glimpses of Water Management Technology on Summer Maize

Water management practices

Flowering stage

Performance evaluation of A-frame and U-shaped hydroponic system with different media and nutrient solutions

Objectives

1. Performance of coco-peat as supporting media for hydroponic system
2. Performance of clay pellets as supporting media
3. Study of Hoagland and Cooper solution for hydroponic system
4. Treatments
5. T1= A-frame hydroponic system + Coco-peat media + Standard nutrient solution
6. T2= A-frame hydroponic system + Clay pellets media + Standard nutrient solution
7. T3= U-shaped hydroponic system + Coco-peat media + Standard nutrient solution
8. T4= U-shaped hydroponic system + Clay pellets media + Standard nutrient solution

S.N	Associated Scientists	Position
1.	Dr. M. P. Tripathi/ Er. Rajesh Agrawal	PI
2.	Dr. Dhiraj Khalkho	Co-PI
3.	Dr. G. L. Sharma	Co-PI

SWE-07

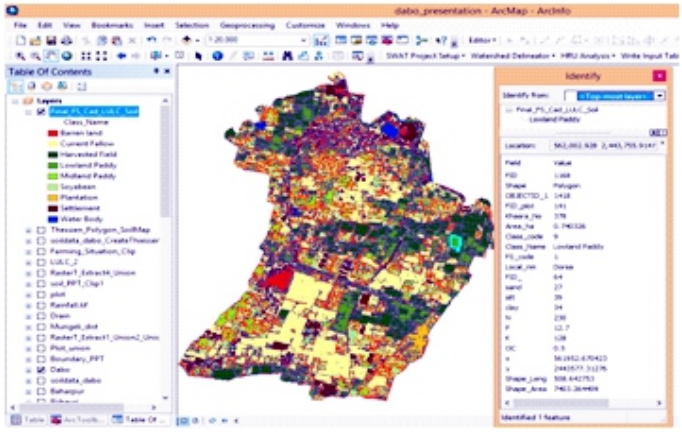
Mega Project: Development of Cadastral Level Land Use Plan for Chhattisgarh State (Mungeli District)

Objectives

1. To develop agricultural resources information system for the Chhattisgarh at cadastral level for better production per unit of land.
2. To disseminate detailed information to the farmer regarding better land use capability.

Salient Findings

- 40 Villages of Lormi Block and 35 Villages of Mungeli block have been accurately georeferenced and individual field boundaries have been digitized with the field number (*khasra* number) as the polygons attribute table.
- All the generated information will be drill-down to the cadastral level for providing scientific information for NRM at micro/ farmers field level.
- Command area from each water harvesting structures and the number of beneficiaries is delineated
- Web Portal for dissemination of Agricultural resource was developed.



SWE-01/2017-18

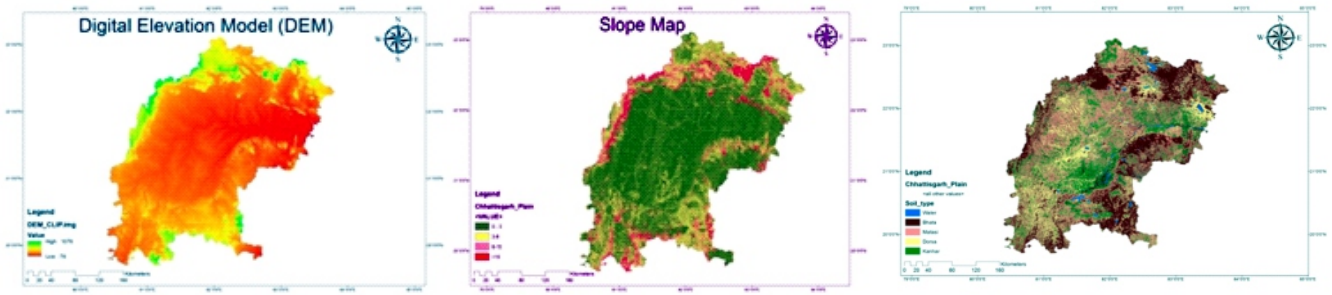
Title: Delineation of farming situations of agro climatic zones of Chhattisgarh State based on digital satellite soil mapping

Objectives

1. To classify satellite digital data based on unsupervised classification method.
2. To analyse the Electromagnetic spectrum behaviour in respect to moisture holding and other physical parameters of soil
3. To study and characterize different farming situations of agro climatic zones of Chhattisgarh State based on digital soil mapping

Salient Findings

- Collection/ sampling of data related to soil physiochemical properties and moisture content of the study area.
- Pixel based classification of digital satellite data (High Resolution data) based on moisture status of soil.
- Accuracy assessment of the reclassified digital data
- Various thematic maps including pH, EC, bulk density, soil texture, soil depth, macro nutrients, micro nutrients and land use/ cover map etc. will be generated in the environment of a GIS package (ArcGIS 10.4) using topographi c map of the study area.
- Characterization of farming situation based on physiochemical properties and water holding capacity of the field of the study area along with integration with the reclassified satellite data.



Unsupervised Classification of Landsat 7 of Chhattisgarh Plain

"Linking Environment and Health in Scaling up of a Pedal Operated Pumping System"

Possible setup of experiment

Objectives:

1. Development of pedal operated rotary pumping system equipped with sensors on human health attributes.
2. Fabrication of 25 units of pumping system for wide spread dissemination of technology.

Observations:

- RPM available at the pump pulley, Suction Head, Delivery head,
- Discharge, Time taken to fill up 1000 litres tank
- Head-discharge relationship

BRSM College of Agricultural Engineering and Technology & Research Station, Mungeli (C.G.)

Water harvesting based Integrated Farming System model

Farm Machinery and Power Engineering

Project Code : FMP 02 / 2017

Title:- Precision Planting of rice using different machine (Demonstration)

The experiments were conducted with the prototype developed inclined plate planter at 45° of inclination angle for IGKV-R2 variety of rice in 5.02 ha experimental field at IGKV, Raipur. Average seed rate was observed 19.61 kg/ha, 24.58 kg/ha, 29.26 kg/ha and 34.82 kg/ha for different seed spacing 20 cm, 15 cm, 10 cm and 5 cm respectively used for 2 seeds/cell.

Comparative Field Performance of conventional Seed Drill and Inclined Plate Rice Planter

Particulars	Conventional		Inclined Plate Rice Planter			
	broadcasting	Seed drilling	IGKV	Kukera	Auri	Pahanda
Soil Moisture Content, (%) At 6 cm depth	16.4	15.8	15.2	15.8	15.1	15.6
Speed of operation, (km/h)	4.3	4.2	5.5	5.3	5.1	5.2
Effective Field Capacity,(ha/h)	-	0.549	0.778	0.782	0.769	0.745
Field Efficiency, (%)	-	78	84	83	84	85
Seed rate , (kg/ha)	110	83	19.6	24.6	29.3	34.8
Depth of Sowing , (cm)	3.2	3.5	3.4	3.5	3.6	3.5
Width of Sowing, (cm)		7.3	7.2	6.9	7.0	7.1
Row to row distance, (cm)		20	20	20	20	20
Plant to plant distance, (cm)		Drilling	14.7	12.2	8.6	5.8
Multiple index, (%)		Drilling	4	4	5	6
Missing index, (%)		Drilling	1.3	1.1	0.8	0.9
Seed damage (%)	2.7	2.1	0.3	0.2	0	0
Germination, (%)	77	78	87	89	88	89
Plant Population 30 DAS	329	214	102	117	129	138
Grain yield q/ha	0	2.3	5.5	3.4	3.7	3.5

Project Code : FMP 03 / 2016

Title:- Design, development and evaluation of multi-crop planter for intercropping

Objectives:

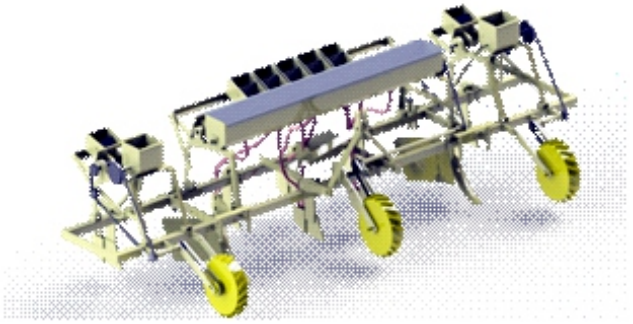
1. To study design parameters for modification of metering unit for inter cropping of soybean-pigeonpea in kharif and chickpea in rabi season.
2. To study the performance of modified design of multicrop planter in lab and field for inter cropping of soybean-pigeonpea in kharif and chick pea in rabi season.
3. Energy analysis and cost economics of intercropping of soybean-pigeonpea in kharif and chickpea in rabi season using modified multicrop planter.

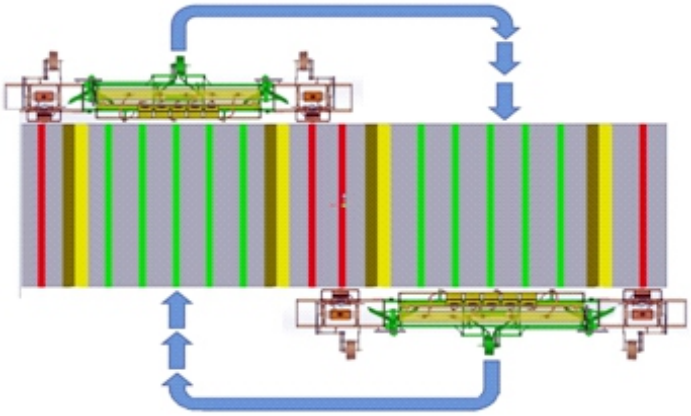
Introduction

- In Chhattisgarh most of the farmers adopt agricultural practices of the soybean and pigeonpea as a intercropping in Kharif season as rainfed condition after that chickpea is taken in same field followed by soybean.
- To overcome this problem there is a need to design a suitable multicrop planter that can be used for sowing of soybean and pigeonpea in *Kharif* and sowing of chickpea on same bed in Rabi on same piece of land.
- Intercropping system has been found productive and remunerative under rainfed condition of Chhattisgarh.
- The present study was aimed to develop such machine for intercropping of soybean and pigeonpea together with 5:2 ratio after harvesting of soybean, chickpea can be sown in place of soybean.

S.N.	Parameter	Specification
1	Total width (mm)	4300
2	Operating/working width, mm	3000
3	Soil condition on which the machine is used	Upland friable soil
4	Required Source of power	Above 45 hp tractor
5	No. of rows	7
6	Furrow opener	Inverted T type
7	Seed hopper, Nos.	7
8	Seed metering mechanism	Inclined plate with edge cells
9	Fertilizer box	3
10	Granular fertilizer metering	Through aluminum fluted roller (5 Nos.)
11	Depth control	By tractor hydraulic
12	Power transmission	chain, and sprockets and set of bevel gear

Specification of Intecrop planter and Broad bed Furrow





Intercropping of soybean and pigeon pea

Intercropping of chick pea on standing pigeon pea

Field performance of intercropping planter for soybean and pigeon pea

S.No	Speed (kmph)	TFC (ha/h)	AFC (ha/h)	FE (%)	Time required to cover 1 ha (h)	Fuel consumption (l/h)
1	2.57	0.77	0.55	71.42	1.81	4.62
2	2.63	0.78	0.61	78.20	1.63	4.89
3	2.45	0.73	0.59	80.82	1.69	4.35
4	2.29	0.68	0.52	76.47	1.92	4.56
5	2.40	0.72	0.57	79.17	1.75	5.10
Avg.	**2.46**	**0.74**	**0.56**	**77.21**	**1.76**	**4.704**

Conclusion : Intercrop planter designed and developed as per requirement. Actual field capacity was 0.56 ha/h and field efficiency was 77.21%. Average fuel consumption was 4.74 l/h. Designed intercropping planter was found suitable for farmer for intercropping Soybean, pigeon pea and chickpea with easy transporting, precise sowing and higher field performance.

Project Code : FMP 04 / 2016-17

Title:- Popularization of agricultural implements and technologies developed by IGKV

Objectives:

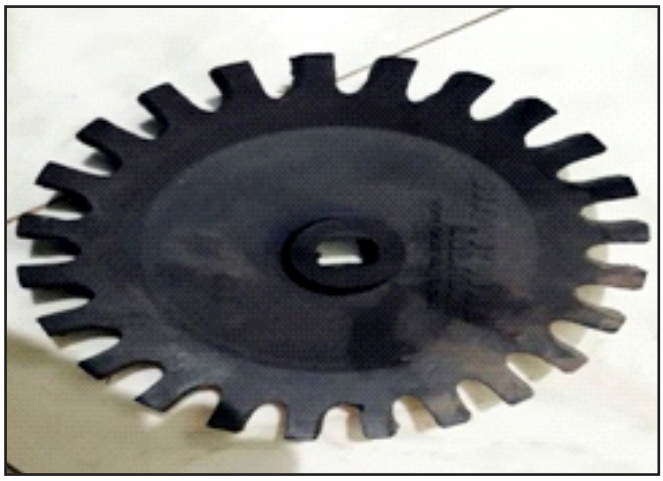
1. Performance evaluation and feasibility trials at KVK's farms and farmers field.
2. Modification and development as per the local needs of the farmers.

Introduction : In Chhattisgarh the adaptability of farm machinery for rice and other crops are very limited and restricted up to certain areas only, because of non-availability of quality implements. All Kharif crops are sown by broadcast method presenting serious problems of weed infestation. Mechanization is needed to get over some of the major constraints of productivity and to make farming less arduous and attractive enough to enable educated youth taking willingly agriculture as vocation. IGKV Raipur has developed many animate and mechanical operated implements operation such as tillage, puddling sowing, weeding, plant protection, harvesting and threshing. These implements are found suitable for soil and crop condition of Chhattisgarh.


Development of Inclined Plate Seed Metering Mechanism for System of Chickpea Intensification

Objectives

1. To develop seed metering mechanism for dropping of two seeds per hill.
2. To evaluate performance of modified device under laboratory and field condition.
3. To workout cost economics of modified system.




Project Code : FMP 06 / 2016

Title:- Studies on conservation machinery system under rice based cropping system

Objectives:

1. To study different wet and dry tillage and their influences on soil physical properties under rice based cropping system.

2. To optimize desired seed bed for seeding and planting of paddy under dry and wet tillage.
3. To study the combined effect of tillage and seeding treatment under rice-chickpea cropping system in terms of machine parameter, energy parameter, soil physical properties, plant biometrics and cost economics.
4. To optimize the conservation machinery system under rice-chickpea cropping system.
5. To develop decision support system.

Experimental Detail

Treatment details : cropping system of 2016-17 and 2017-18 Tillage and sowing practices for rice cultivation: kharif

TILLAGE PRACTICES			
Dry tillage (DT)		**Wet tillage (WT)**	
DT1	Cultivator x 2 + Broadcasting + Biasi	WT1	Cultivator x 1 + Rotavator x 1 + Levelling + Transplanter
DT2	Cultivator x 2 + Rotavator x 1 +Broadcasting + Biasi	WT2	Cultivator x 1 + Rotavator x 2 +Transplanter
DT3	Cultivator x 2 + Leveling x 1 + DSR planter	WT3	Cultivator x 2 + Rotavator x 1 +Transplanter
DT4	Cultivator x 2 + Rotavator x 1+ DSR planter	WT4	Cultivator x 2 + Levelling + Transplanter
DT5	Rotavator x 2 + DSR planter	WT5	Rotavator x 2 + Transplanter

TFor cropping system of 2016-17 and 2017-18

Tillage & sowing practices for chickpea cultivation: RabiTreatments Tillage and Sowing practices for chickpea

Treatments	Tillage and Sowing practices for chickpea
T1	M. B. Plough + Cultivator x 2 + Rotavator x 2 + ridge planter sowing
T2	Cultivator x 2 + Rotavator x 2 + SCFD sowing
T3	No tillage + Zero till inclined plate planter sowing
T4	No tillage + happy seeder sowing

Details of experiment for rice cultivation

Experiment-1: For dry sowing of rice.

1	Design		:	Randomized block design
2	Number of treatments		:	5
3	Number of replications		:	3
4	Length and width of plots, m		:	40 x 6
5	Total number of plots		:	15
6	Gross plot size, m^2		:	3600
7	Total plot area, m^2		:	4160
8	Distance between replication, m		:	2
9	Distance between plots, m		:	0.5
10	Variety		:	IGKV-R1
11	Date of sowing	2016	:	20/06/2016 for dry sowing
		2017	:	19/06/2017 for dry sowing
12	Recommended dose of fertilizer		:	80:60:10
13	Recommended seed rate		:	60 kg/ha for DSR 80 kg/ha for broadcasting
14	Row to row spacing, cm		:	20

Performance results of different machines under the direct seeded rice experiment

Particulars	Treatment T1			Treatment T2				Treatment T3			Treatment T4				Treatment T5		
	Culx1	Cul x2	BD	Culx1	Culx2	Rotx1	BD	Culx1	Cul x 2	ZTIPP	Cul x1	Cul x 2	Rot x 1	ZTIPP	Rot x 1	Rot x 2	ZTIPP
Av. Depth of cut, cm	9.1	9.7	-	9.5	9.0	8.6	-	10.2	9.5	4.6	10.4	9.7	9.3	4.2	9.8	9.2	4.0
Av. Width of operation	1.91	1.93	-	1.92	1.95	2.01	-	1.93	1.96	1.78	1.92	1.96	2.03	1.76	2.01	2.05	1.77
Speed , km / h operation av.	3.5	3.8	-	3.4	3.8	4.1	-	3.1	3.7	3.4	3.3	3.5	4.0	3.2	3.9	4.2	3.1
Draft, kN	6.3	6.0	-	6.8	6.2	5.6	-	6.2	5.8	2.46	6.4	5.7	5.5	2.58	6.2	5.6	2.63
Theoretical field capacity, ha /h	0.79	0.79	-	0.79	0.79	1.01	-	0.79	0.79	0.72	0.79	0.79	1.01	0.72	1.01	1.01	0.72
Field capacity, ha / h	0.67	0.733	-	0.65	0.74	0.82	-	0.59	0.72	0.60	0.633	0.70	0.81	0.56	0.78	0.86	0.54
Time required for 1 ha, (h/ha)	1.49	1.36	-	1.53	1.35	1.21	-	1.69	1.39	1.66	1.57	1.42	1.23	1.78	1.28	1.16	1.85
Total time required	2.85		4.57	4.09			5.85	4.74			6				4.29		
Field efficiency, %	84	92		82.2	93	81		74	91	83	79	91	80	77	77	85	75
Fuel consumption, (lit/h)	3.7	3.5		3.8	3.4	4.1	-	3.7	3.2	4.1	3.9	3.5	4.3	4.3	4.4	4.0	4.22
Fuel consum. lit/ ha	5.51	4.76	-	5.81	4.59	4.96	-	6.25	4.44	6.80	6.12	4.97	5.28	7.65	5.63	4.64	7.80
Total yield, q/ ha	52.33 in Biasi			54.33				53.33			57 in DSR planter				52.66		

Total energy use (MJ/ha) & cost of production for rice (Rs/ha)*

Particulars	Direct seeded rice				Transplanted	
	Broadcasting traditional		Row improved by planter		4 row Mahindra Transplanter	
	Energy MJ/ha	Cost Rs/ha	Energy MJ/ha	Cost Rs/ha	Energy MJ/ha	Cost Rs/ha
Farm operation (Direct energy)						
Land preparation	2712	3910	2490	3678	3205	4670
Sowing /Nursery	516	1616	664	2035	56	1092
Transplnating	-	-	-	-	945.7	4500
Interculture	1789	4876	1045	4560	245	2150
Plant protection fertilizer application water management	- 23.9 49.0	- 430 4200	11.0 23.0 49.0	200 430 4200	15.8 30.0 54.8	150 416 2000
Harvesting	425	3800	458	3700	460	3500
Transportation	200	1120	245	1280	268	1314
Threshing	635	3015	674	3250	628	3055
Sub Total (I)	6350	22967	5659	23333	5908	22847

Total energy use (MJ/ha) & cost of production for rice (Rs/ha)*

Particulars	Direct seeded rice				Transplanted	
	Broadcasting traditional		Row improved by planter		4 row Mahindra Transplanter	
	Energy MJ/ha	Cost Rs/ha	Energy MJ/ha	Cost Rs/ha	Energy MJ/ha	Cost Rs/ha
(Indirect energy)						
Seed fertilizer Chemical	1528 5604 47	1740 2520 2000	1293 5604 47	1020 2520 2000	740 5604 60	570 2520 1450
Sub total (II)	7179	6260	6944	5540	6404	4440
Total (I) + (II)	13529	29227	12603	28873	12312	27387
Av. Yield (q/ha)	44.8		57		52.0	
B:C ratio	2.2		2.9		2.8	
Specific Energy MJ/kg	3.01		2.2		2.36	
Energy productivity kg/MJ	0.33		0.45		0.42	

Results:

- The performance of inclined plate planter for direct seeding of rice under field prepared by Cultivator + rotavator one pass each was found better in terms of energy efficiency, economics and crop yield compared to other direct seeding treatments including Biasi. The lowest specific energy, higher energy ratio and higher cost benefit ratio was observed.
- Under transplanted condition the self propelled rice planter performed better where field was puddled twice by rotavator and yields were on higher side compared to other transplanted treatments.
- The performance of raised bed planter was found superior for chickpea cultivation in terms of yield. However the Zero till drill was proved to be energy efficient and cost effective.
- The detailed analysis is under process looking to Ph.D. work.


Cultivator with leveller


Rotavator with planker

Fuel consumption measurement set up

Inclined plate planter sowing of rice

Mechanical rice transplanter (4 row)

Mat Nursery

Self-propelled Biasi plough
Project Code : FMP 07 / 2016

Draft measured by load cell

Title:- Design, development, fabrication and testing of tractor drawn FYM applicator

Introduction : Organic manure is considered as the eco-friendly bio-fertilizer for the highly polluted modern era. Farmyard manure available in the country is 1200 million ton including the availability of 268 MT dung from livestock and 5 MT poultry droppings for bio-methanation to produce biogas and manure of high quality. 50% FYM used to improve soil fertility and remaining quantity is used for fuel (Singh and Singh, 2014).The application rates for solid manure are 5 to 30 tons/acre according to manure density and spreader type, respectively.

Conceptual design of FYM applicator

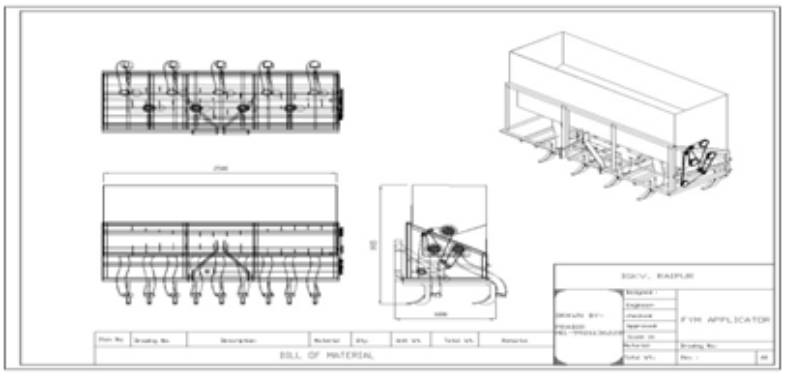
Design of components

- Design of hopper
- Design of slider plates
- Agitating mechanism

Delivery attachment

Power transmission

Mounting attachment

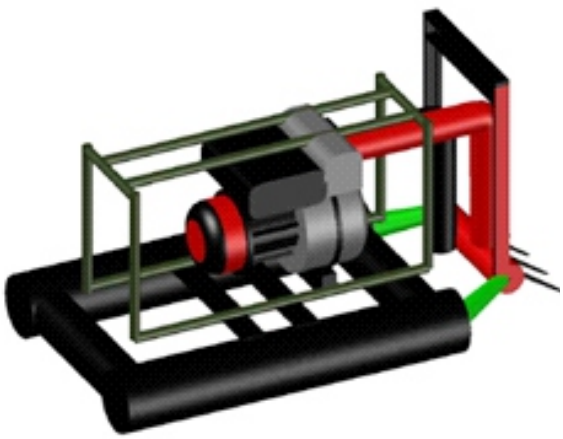


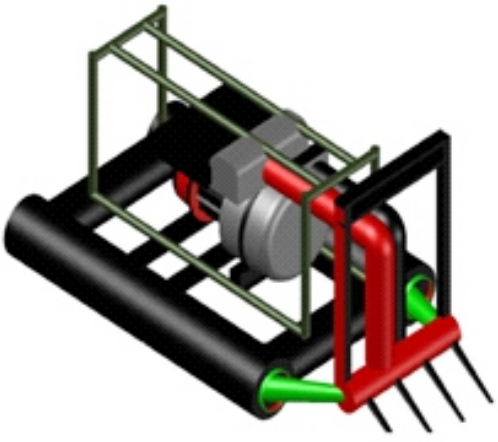
Procurement process after conceptual design have been completed.

Project Code : FMP 08 / 2017

Design, Development and Performance Evaluation of Lotus Rhizome Harvester Studies on the Conventional harvesting of lotus rhizome

Concept : The machine will adopts a boat-shape structure that makes it possible to float on the water. And the streamlined structure helps to reduce water resistance.





Conceptual Auto CAD design of lotus rhizome harvesting machine.
Project Code : FMP 09 / 2017

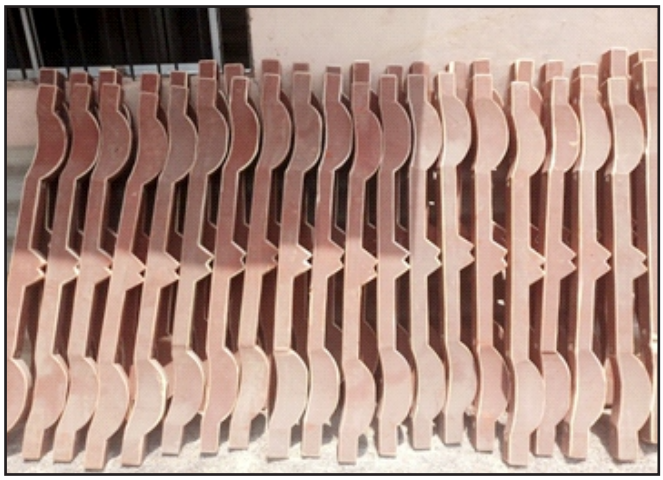
Title: Popularization of improved Indira yoke to enhance efficiency of draught animals in Chhattisgarh.

Objectives:

1. To promote DAP based technology among small and marginal farmers of Chhattisgarh.
2. To popularize the improved yoke through field demonstrations in farmers' fields.
3. To conduct training programmes for farmers and village artisans (carpenters) on fabrication of improved Indira yoke.

Duration: Two Year

Progress: Under this project 50 numbers of improved yoke has been procured. In order to promote DAP based technology the distribution of the yokes to the selected farmers under animal farming system is in progress.



Yoke procured for distribution under RPF project

Yoke distributed to the beneficiaries

AICRP on FIM

S No	Performance parameters	Happy Seed Drill	Zero Tillage Seed Drill	Conventional Seed Drill
01	Effective working width , cm	180	180	180
02	Operating speed , km/h	4.1	4.3	4.7
03	Effective field capacity, ha/h	0.49	0.67	0.50
04	Field efficiency, %	78	65*	76
05	Time of field preparation, h/ha	0	0	10
06	Time of sowing, h/ha	1.74	1.99	1.56
07	Total Time required upto sowing	1.74	1.99	11.56
08	Fuel consumption, l/ha	10.42	9.94	25#
09	Fuel saving, %	58.32	60.72	-
10	Labour requirement man days/ha	06	05	20
11	Labour saving, %	70	75	-
12	Germination percentage	85	84	86
13	Yield, q/ha	38.2	34.1	33.02

*due to clogging of straw

two cultivator + 1 patela

FIM/PFT/05: Feasibility testing of vertical conveyer reaper (commercial) for harvesting of crops

Objectives :

- To conduct feasibility testing of vertical conveyer reaper
- To work out the cost economics of reaper as compared to traditional method

S No	Parameters	Specifications
1	Manufacturer	Kerala Agro Machinery Corporation Ltd., (A Govt. of Kerala undertaking), Athani- 683 585, Ernakulam Dist.
2	Model	KR 120
3	Dimension, LxWxH (cm)	239 x 147 x 90
4	Weight (kg)	116
5	Power unit	3.5 HP single cylinder 4 stroke, air cooled, petrol start, kerosene run engine
6	Working capacity (ha/h)	0.25 to 0.3
7	Crop release	Right side of the machine(Viewed from rear)
8	Travel speed (km/h)	Forward: 3.5 Reverse: 3.0
9	Cutting device	Reciprocating knife
10	Cutting height, cm	10-30 from ground level
11	Cutting width, m	1.2

Front Line Demonstration of Rice Weeder (Single row)

S. No.	Farmer's Name/Father name	Village	Area (ha)	Weeding efficiency, %
1	Lalu Ram Sahu/ Sia Ram Sahu	Bendri, Raipur	1.0	78.80
2	Nikhil Chandrakar/Pintu Chandrakar	Khudmuda	0.5	80.25
3	Diwan Kashyap/Raja	Taresar	0.5	81.50
	Total		2 ha	80.18

Farmers feed back:

1. The performance of rice weeder was found satisfactory in wet condition. The average field capacity of machine was 0.05 ha/h. Depth of cut varies from 3.84 to 6 cm as per soil condition.
2. Weeding efficiency was found to be 81.5 %, operating cost was Rs 980/ha as compared to traditional hand weeding (Rs 2300/ha)
3. Saving of cost of weeding was 60% and saving in time was 65%.
4. Plant damage during operation was found to be 1.32% (15DAS), 1.85% (25 DAS) and 2.03% (35 DAS) with four blades, it was also increased with increase in number of blades (6/8).

S No	Particulars	Specification details
01	Make	Vijay Villers
02	Model	Vijay1WPW
03	Power kW(hP)	1.4 kW (2 hp)
04	Speed of the engine (rpm)	6500 rpm±100 rpm
05	Intermediary transmission	Dry clutch (centrifugal type)
06	Power transmission	Light weight aluminium gear box
07	Fuel	Petrol mixed with lubrication oil (1 lit petrol + 40 ml oil)
08	Fuel tank	1.1 lits
09	Rotor and blades	2 rotor blade with 4 blades per rotor
10	Average weeding depth	3 cm
11	Weight of the machine	14.5 kg
12	Fuel consumption	6.25 lit /ha

Front Line Demonstration on axial flow paddy thresher

S. No.	Farmer's Name/ Father's name	Village	Category	Variety	Threshing capacity, t/h	Threshing efficiency, %	Seed damage, %
1	Lekh Ram Verma	Sekari, Arang	OBC	Swarna	16.50	98.00	0.05
2	Kissan Yadav	-do-	-do-	Masoori	17.25	96.20	0.07
3	Rekh Ram Sahu	-do-	-do-	Mahamaya	16.50	96.50	0.05
4	Nilambar Verma	-do-	-do-	Swarna	18.50	96.00	0.02
				Average	17.18		

AICRP on UAE

INVESTIGATION NO. 1

Title :- Feasibility testing of animal drawn inclined plate planter for hybrid rice.

OBJECTIVES:

1. To test the inclined plate planter for correct seed rate and uniform seed placement in Laboratory condition.
2. To study the field performance of the machine for hybrid rice seeding.
3. Comparative performance evaluation of the inclined plate planter and other sowing practices for direct seeded rice.
4. Economic evaluation of machine.

Table : Specifications of 3 –row Inclined Plate Planter

S. No.	Particulars	Details
1.	Material Overall Dimension Length, mm Breath, mm Height, mm	Mild steel 950 1480 850
2.	No. of rows	Three
3.	Seed metering unit	Inclined plate
4	Row to row spacing, mm	Adjustable (200 to 500 mm)
5.	Type of furrow opener	Inverted 'T' type (Shoe type)
6.	Placement seed before fertilizer, mm	50
7.	Cost of the machine, Rs.	16,800

Modification of Furrow

Opener Blockage of seeds

Inclination of seed tube

Modified shoe

Field Testing of the Incline Plate Planter

Field test results of inclined plate planter for planting hybrid rice

S. N.	Particulars	Results	
1.	Depth of seed placement, mm	48.40	
2.	Seed to seed spacing, mm	120	
3.	Speed of operation, km/h	2.30	
4.	Draught requirement, N	509.60	
5.	Power requirement, hp	0.44	
6.	Theoretical field capacity, ha/h	0.16 (20 cm row)	0.18 (25 cm row)
7.	Actual field capacity, ha/h	0.12 (20 cm row)	0.13 (25 cm row)
8.	Field efficiency, %	75	72
9.	Cost of operation, Rs/h (Rs/ha)	82 (683)	82 (630)
12.	Multiple index, %	12	

Conclusions

- 30 kg/ha seed rate was obtained at 25 x 15 cm row to row and plant to plant distance which was 33% higher than recommended seed rate of 15-20 kg/ha for hybrid rice.
- Draught requirement to pull the 3 row incline plate planter was within the pulling capacity of local bullocks.
- 3 row inclined plate planter was found cost effective implement for planting of rice seeds from operational **point of view.**

Investigation No. 2

Title :- Adaptive trials on animal drawn plastic mulch laying machine for vegetable growers of Chhattisgarh.

Objectives:

1. Identification and selection of suitable animal drawn plastic mulch laying machine.
2. Testing and performance evaluation of the mulch laying machine.
3. Economic analysis of the machine

Specifications of Plastic Mulch Laying Machine

S. N.	Particulars	Specifications
1.	Overall Dimension L x W x H, mm	4780 x 1700 x 500
2.	No. of press wheels	2
3.	Diameter of press wheel, mm	360
4.	No. of earthing unit	2
5.	Thickness of plastic mulch, micron	25
6.	Length of plastic mulch, m	400
7.	Width of plastic mulch, m	1.2
8.	Weight of the machine, Kg	75
9.	Cost of machine, Rs.	11,500/-

View of Field Testing of Plastic Mulch Laying Machine

Field performance of Plastic Mulch Laying Machine

S. N.	Particular	Result
1.	Speed of operation, km/h	1.9
2.	Draught requirement, N	336
3.	Power output, kW	0.17
4.	Actual field capacity, ha/h	0.11
5.	Cost of operation, Rs./h (Rs/ha)	135 (1227)
6.	Operational Energy, MJ/ha	215.65
7.	Cost of manual laying, Rs./ha	9615
8.	Savings, Rs./ha	8388

Conclusions

- Draught requirement to pull the machine was found quite low
- The field capacity of the machine may be increased, if the trial may be conducted on long bed for more than 100 m length.
- Mulch laying machine is proven as cost effective technology for laying of plastic mulch in vegetable farms.
- It saves cost of operation in laying plastic mulch compared to manual practice.

Investigation No. 3

Title : Effect of urea treated rice straw and Urea Molasses Block supplementation on feed intake and draught performance of working bullocks.

Objectives:

1. To investigate the effect of feeding urea treated rice straw and urea molasses mineral block on body weight of working bullocks.
2. To evaluate the effect of UMMB supplementation on intake of untreated and treated rice straw.
3. To study the effect of feeding urea treated and untreated rice straw supplemented with UMMB on draughtability of working bullocks.

METHODOLOGY

- Place of experiment –Village -Rasni , Arang block,Raipur district in Chhattisgarh
- Experimental Animals- Nine pairs of working bullocks of approx. similar body weight
- Experimental groups- 3 (T1, T2 and T3)
- No. of animals in each group- 3 pairs
- Period of experiment- 90 days

Feeding schedule

Experimental Groups	**Feed Ingredients**		
T1	Concentrate Mixture 1 kg	Concentrate Mixture 1 kg	Concentrate Mixture 1 kg
T2	Untreated Rice Straw	Untreated Rice Straw	Untreated Rice Straw
T3	-	UMMB 500 g	UMMB 500 g

Preparation of Urea Molasses Mineral Block

Urea Molasses Mineral blocks were prepared with following ingredients as mentioned in the Table given below:

S. No.	**Ingredients**	**Quantity**
1.	Molasses	40 kg
2.	Wheat bran	28 kg
3.	Cotton Seed Cake	08 kg
4.	Urea	10 kg
5.	Cement	05 kg
6.	Limestone powder	05 kg
7.	Mineral mixture	02 kg
8.	Common salt	02 kg
9.	Total	100 kg

Preparation of Urea Molasses Mineral Block

Urea treatment of rice straws

- **Urea treatment**

Paddy straw- 100 kg chaffed rice straw

3% Urea Solution - 3 kg urea dissolved in 50 lit of water

Incubation for 21 days in air tight polyethylene bag

Ready to feed after 1 to 1½ exposure in air

Weighing and Feeding of Experimental bullocks

Urea treatment of paddy straw

Conclusions

- All the bullocks remained healthy throughout the experimental period.
- All the haematobiochemical parameters were within the normal range.
- More increase in haematobiochemical parameters was observed in bullocks fed with of urea treated rice straw and UMMB but were within the normal range..
- The treated paddy straw improves the voluntary feed intake, nutrient digestibility and rumen fermentation, thus increase in body weight. The highest body weight gain was observed in T3 group.
- Bullocks of T2 and T3 group could be operated for 4 hours at 8% and 10 % loads, however, bullocks of T3 could be operated at 12 % load for 3 hours.
- It can be concluded that feeding of urea treated rice straw in supplementation with urea molasses mineral block has positive effect on the body weight and working ability of bullocks.

Recommendation

The farmers can be recommended to feed their bullocks urea treated rice straw on *ad libitum* basis along with UMMB @ 500 grams per animal per day and 1 kg balanced concentrate mixture prior to field work for 90 days to maintain the health and body weight at the start of working season.

Investigation No. 4

Title : Comparative evaluation and development of bullock cart for non-descript bullocks in Chhattisgarh plains.

Objectives:

1. To study the features of different types of bullock carts available in Chhattisgarh plains.
2. To evaluate the performance of different bullock carts available in Chhattisgarh plains.
3. To find out the limitations and shortcomings of the existing bullock carts.
4. To develop a bullock cart considering the draughtability of non-descript bullocks of the region in order to increase its performance.

Methodology

i. Selection of study area for survey of bullock carts in CG plains.

ii. Collection of information through pretested proforma.

iii. Selection of respondents.

Chhattisgarh plains consist of 16 districts

Zone 8 districts 3 blocks 1 villages 4 farmers

Total 96 nos. of farmers were interviewed to collect primary data.

iv. Identification of limitations and shortfalls of existing bullock carts.

v. Selection of commonly used existing bullock carts for their performance evaluation.

vi. Modification of existing bullock cart in order to overcome the limitations.

vii. Study on pneumatic wheeled bullock cart.

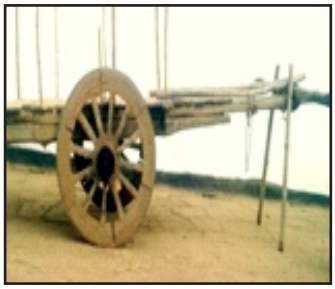
Selection of Existing bullock carts

- Bullock carts are selected on the basis of its design which is mostly preferred by the farmers in the region and its material of construction.

S. N.	Type of cart	Constructional Materials of the cart
1	Wooden frame with wooden wheels	Wood (except iron axle)
2	Iron frame with iron wheels	Iron
3	Wooden frame with iron wheels	Wood and iron
4	Iron frame with wooden wheels	Wood and iron

Existing Bullock Carts selected for performance evaluation



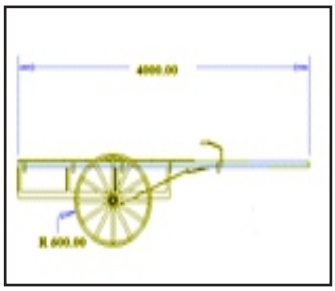



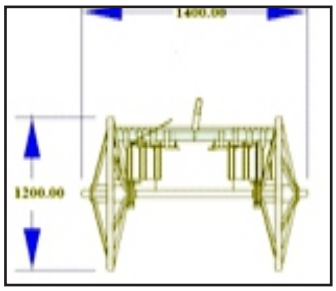
Iron frame with iron wheels Iron frame with wooden wheels Wooden frame with iron wheels Wooden frame with wooden wheels

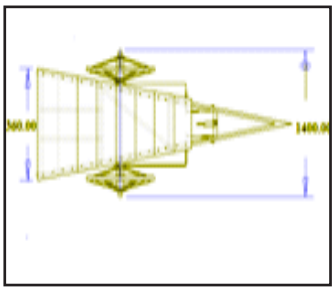
Specifications of selected bullock carts

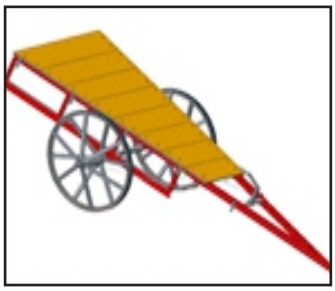
Contents	Iron Frame+ Iron wheels	Iron frame + Wooden wheel	Wooden frame + Iron wheel	Wooden Frame + Wooden Wheel
Frame	Channel iron (100×50×50)mm and 0.4 mm thickness	Channel iron (100×50×50)mm and 0.4 mm thickness	Wooden planks	Wooden planks
Axle diameter	48 mm	48 mm	48 mm	48 mm
No. of spokes	14 L shaped spokes	12 wooden spokes	9 hollow iron spokes	12 wooden spokes
Wheel diameter	1200 mm	1200 mm	1200 mm	1200 mm
Overall length	4500 mm	4600 mm	4830 mm	4300 mm
Overall width-	1670 mm	1630 mm	1460 mm	1790 mm
Height	1550 mm	1550 mm	1650 mm	1400 mm
Weight, kg	310	350	320	350

All dimensions are in mm









Side view **Front view** **Top view** **3 D view**

Isometric view of modified bullock cart

View of modified bullock cart

Specifications of Modified Bullock Cart

S. N.	Part	Designed value
1	Wheel diameter	1200 mm
2	Hub diameter	100 mm
3	No. of spokes	12
4	Axle diameter	55 mm
5	Platform trapezoidal size	Length of parallel sides=1360 mm,800 mm Perpendicular distance=1800mm
6	Overall dimensions of bullock cart	Overall length =4000 mm Overall width =1400 mm
7	Channel section size	MCP 75
8	Weight	330 kg
9	Cost of fabrication, Rs	22250/-

Study on Pneumatic Wheeled Bullock Cart

View of Pneumatic wheeled bullock cart

Specifications of Pneumatic Wheeled Bullock Cart

S.N.	Particulars	Observed value
1	L x W x H, mm	4200 x 1550 x 1350
2	Frame (chassis)	MS channel of 70 x 35 x 5 mm
3	Wheel Type	Pneumatic (Rubber tyre)
4	Wheel diameter	740 mm
5	Rim size	6.00 – 16 “
6	Axle frame	MS Channel 70 x 35 x 5 mm
7	Hitch system	MS pipe of 50 OD & 10 gauge
8	Platform shape	Rectangular
9	Platform size (LxWxH, mm)	2150 x 1550 x 330
10	Ground clearance from axle, mm	440
11	Height of yoke from ground, mm	1080
12	Carrying capacity, kg (aaprox.)	1500

Findings

- Highest number (58157) of cart used by the farmers in Rajnandgaon district and lowest (7261) in Mungeli district in CG plains region.
- Bullock carts were utilized 75 days per hectare land holding and largely used in Rabi season i.e. 30 days per hectare land holding.
- The average draught at 1100 kg load was highest in the wooden frame with wooden wheels type cart (447.27 N) and lowest draft (345.15 N) was found in iron frame and iron wheel type cart.
- The average speed at 1100 kg load was found highest in iron frame with iron wheel type cart 0.83 m/s and lowest 0.76 m/s in wooden frame with wooden wheels cart.
- Average wheel slippage was found lowest in iron frame with iron wheel type cart 0.88 % and highest in wooden frame with wooden wheels type 1.63 % as compared to other types of cart
- The draught of the existing carts was lower than the draughtability of the local bullocks, thus it is imperative to increase their efficiency by increasing carrying capacity of the existing bullock carts.

Investigation No. 5

Title :- FLD on package of improved animal drawn implements for maize, rice and pulse crops.

Objectives:

1. To acquaint the farmers about the improved animal drawn package of implements and to demonstrate the technology in the farmers' fields for cultivation of maize.
2. To obtain feedback from the farmers regarding performance of the improved implements.

Package of Improved Animal Drawn Implements

During kharif season packages for 2 different rice growing practices viz. biasi system and transplanting system were selected for demonstration.

Biasi System : The package selected for this practice consists of Improved Yoke, Tendua plough, biasi plough and pedal operated loop type paddy thresher.


Tendua Plough


Biasi Plough


Improved Yoke

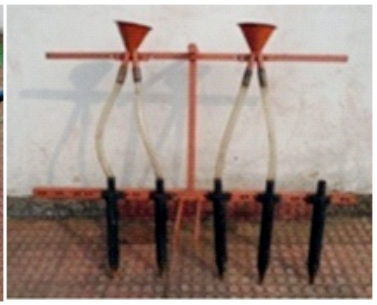

Tendua Plough

Transplanting Practice: **Package selected for this practice consists of Improved Yoke, Tendua plough, puddler cum clod breaker and Ambika paddy weeder**


Puddler


Ambika Weeder


Tendua Plough


Bhoramdev Seed Drill

During Rabi season packages of improved animal drawn implements for wheat and chickpea cultivation was selected for demonstration.

Chickpea cultivation : The package of implements selected for these cultivations consists of Improved yoke, Tendua plough for field preparation, Indira seed drill and Bhoramdev seed drill for seeding of wheat and chickpea respectively.

Investigation No. 6

Title :- Status of draught animal power and its utilization in Chhattisgarh state.

Objectives:

1. To conduct survey of draught animal population and their utilization for agricultural production in Chhattisgarh.
2. To collect data on type of work done by draught animals in Chhattisgarh.

Total 360 nos. of farmers were interviewed to collect primary data.

RESULTS

1. Draught Animal Power Availability in State – 0.27 kW/ha
2. Trend of draught animal population in state
   a. Types of draught animals – Bullocks and he-buffaloes
   b. Draught animal numbers - 36,32282
      Total population - 36,32,282
      Bullocks - 27,46,719

He buffaloes - 8,85,563

c. Breed name - Non - descript breeds are available in state

d. Dominant breed in region - None

e. Size (GxL) - 1700 x 1300 mm

f. Average body weight - 320 kg (single animal)

- Hiring rate of bullock pair per day - Rs. 500/-
- Average price of a bullock pair: Rs. 70,000/-

Annual use of Draft Animals, hrs

In Agriculture	For transportation	Any other work
194	130	-

Innovation by farmers

3-tyne cultivator for tillage

For ridge making and earthing operation

Status of farm implements in Chhattisgarh

Wooden Plough	Iron Plough	Bullock Cart
2025115	54522	433181

Subsidy available on Improved Animal Drawn Implements

50% subsidy is granted by the Government which include 25% share of State Govt. and 25% share of Central Govt.

Suggestions to improve animal drawn technologies

Target should be given to the Rural Agriculture/Horticulture Extension Officers

Krishi Vigyan Kendra Progress

Activities Carried Out during 2017 -18 by different KVKs

Name of KVK	Activity	Farm machines	Crop
Bhatapara	OFT	Broad bed planter Zero till seed cum ferti drill	Soybean Mustard
	FLD	TD Seed cum Fertilizer Drill axial flow multi-crop thresher Zero till seed cum ferti drill TD Seed cum Fertilizer Drill	Paddy Paddy Wheat Chickpea
Mahasamund	OFT	8 row paddy drum seeder TD Seed cum Fertilizer Drill Broad bed planter Rotavator TD Inclined plate planter	Rice Rice Blackgram Wheat Chickpea
	FLD	Animal drawn biasi plough TD Seed cum Fertilizer Drill	Rice Chickpea
Durg	OFT	TD Seed cum Fertilizer Drill Inclined plate planter	Chickpea Maize
	FLD	TD Seed cum Fertilizer Drill	Rice
	Activity	Farm machines	Crop
	OFT	Raised bed planter Weeder Self Propelled Reaper Broad bed Planter	Soybean Syean Rice & Wheat Chickpea
	FLD	TD Seed cum Fertilizer Drill	Paddy, Soybean, Wheat & Chickpea
	OFT	Axial Flow Htresher Self Propelled Reaper	Rice wheat
	FLD	Self Propelled Reaper	Rice

Agricultural Processing & Food Engineering

Technology Developed

1. Developed *chironji* decortications machine.
2. Developed hydraulic assisted tamarind briquetting machine.
3. Mechanization of process technology for the starch extraction from *tikhur* rhizomes.
4. Process technology for the extraction of *sindoor* powder from annatto seeds.
5. Process technology for the extraction of patchouli oil with enhanced quality of patchouli alcohol

External funded Projects in the Department

S. No.	Title of Project	Funding agency
1	AICRP on Post Harvest Engineering & Technology	ICAR
2	Study for determining on storage losses of food grains	ICAR-FCI
3	Network project on Harvesting Processing and Value Addition of Natural Resins and Gums	IINRG (ICAR)
4	ICAR Platform Project – Secondary Agriculture Establishment of APC for value addition of small millets	ICAR
5	Extramural Development of pilot scale value chain of *chironji* seeds	ICAR-Extramural

AICRP on PHET

Project Detail (Year – 2017)

S. No.	Title of Project
1	Development of process technology for optimum recovery of essential oil from patchouli (*Pogostemon cablin* Benth.)
2	Design and development of *Chironji* (*Buchanania lanzan*) decorticator
3	Evaluation and improvement of existing farm level grain storage structures of different parts of Chhattisgarh
4	Value chain on kodo rice and ragi
5	Performance evaluation and popularization of prototypes developed at other PHET centres and other R & D institutions
6	Establishment of Agro Processing Center, training and demonstration of technologies
7	Study for determining storage losses of food grains in FCI and CWC warehouses and to recommend norms for storage losses in efficient warehouse management

Investigation No. 1

Development of Process Technology for Optimum Recovery of Essential Oil from Patchouli (*Pogostemon cablin* Benth.)

OBJECTIVES

1. To study the effect of pectinase producing microbial incubation on oil recovery.
2. To study the dehydrogenase producing microbial incubation on active ingredients of patchouli oil.
3. Analysis of physico-chemical properties of patchouli oil along with active ingredients.

Patchouli is a fragrant, bushy herb with soft oval leaves and square stems. Leaves are harvested 3-4 times in a year. It gives one of the important essential oil which provides long lasting characteristics along with the fixative ability to fragrance.






Physico-chemical quality of patchouli oil extracted at different intervals of processing time with 15% moisture level of shade drying samples

S. No.	Processing time (h)	Density (g/ml)	Refractive Index	Acid Value	Ester Value
1	4	0.955	1.5124	1.68	7.85
2	5	0.978	1.5098	2.81	7.3
3	6	0.981	1.5090	3.37	6.73
4	7	0.987	1.5055	3.93	6.73
5	8	1.0	1.5021	5.05	5.61

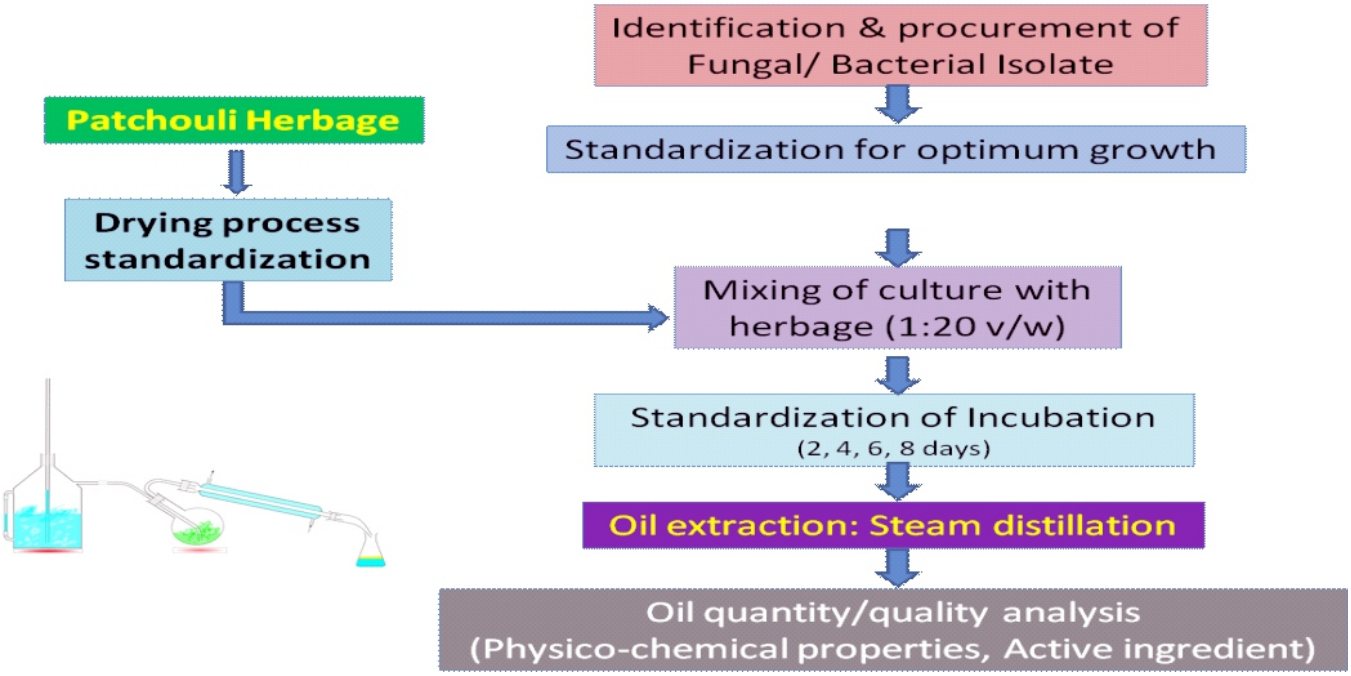
- ❑ Acid values increased with the increase in processing time.
- ❑ Acid value beyond 4.0 is considered to be poor quality of the oil.
- ❑ Therefore, 7.0 hours of processing time (distillation period) is optimum from the recovery point of view as well as the oil quality.

Process improvement with microbial culture

Screening of pactinase and dehydrogenase producing microbial cultures (based on the literature)

PACTINASE		
Aspergillus foetidus	*Penicillium citrinum*	*Tricosporon asteroids*
DEHYDROGENASE		
Candida boidinii	*Pseudomonas fluorescence*	*Penicillium citrinum*

Microbial culture



Chemical composition (%) of extracted patchouli oil from different treatments

PECTINASE

S. No.	Retention Time (min)	Compound	Fresh	Control	*Aspergillus foetidus*	*Penicillium citrinum*	*Tricosporon asteroids*
1	9.13	, ,	1.83	3.64	3.34	2.81	3.34
2	21.47	Copaene	1.56	1.55	1.99	2.33	1.99
3	21.89	Caryophylliene	5.81	2.64	1.66	1.66	1.66
4	22.49	Anzulene	*	6.68	9.53	*	*
5	23.32	Benzene	7.05	*	*	4.44	5.64
6	23.4	Aromadendrene	7.82	1.76	18.97	10.97	
7	24.02	Naphthalene		9.53	1.53	1.53	1.53
8	25.91	Caryophyllene oxide	2.56	1.73	3.64	3.64	3.64
9	27.28	Anzulene	3.36	2.63	3.58	2.53	3.58
10	27.54	Epiglobulol	*	3.69	2.39	2.39	2.39
11	27.75	Patchouli alcohol#	25.2	26.23	28.26	31.36	33.63
12	28.13	Thujopsene	3.66	7.31	1.76	1.76	1.76
13	29.91	Patchoulene	2.63	4.49	1.49	4.52	*
14	30.23	Caryophylliene	2.94	1.86	*	1.58	1.58
15	31.7	β –Guaniene	11.87	*	2.05	2.05	2.05

Chemical composition (%) of patchouli oil obtained after different treatments

DEHYDROGENASE

S. No	Retention Time (min)	Compound	Fresh	Control	*Candida boidinii*	*Pseudomonas fluorescence*	*Penicilliumcitrinum*
1	25.91	Caryophyllene oxide	2.23	2.18	4.52	4.23	4.02
2	27.28	Anzulene	3.36	2.63	3.58	3.58	2.53
3	27.54	Epiglobulol	2.65	3.69	2.39	2.39	2.39
4	23.4	Aromadendrene	7.82	1.76	18.97		10.97
5	24.02	Naphthalene		9.53	1.53	1.53	1.53
6	27.75	Patchouli alcohol	28.0	28.03	30.26	29.48	30.92
7	28.13	Thujopsene	3.66	7.31	1.76	1.76	1.76
8	29.91	Patchoulene	2.63	4.49	1.49	*	4.52
9	30.23	Caryophylliene	2.94	1.86	*	1.58	1.58
10	31.7	β –Guaniene	9.87	8.95	5.65	5.79	5.55
11	9.13	β –pinene	1.51	3.64	3.34	3.34	2.81
12	21.47	Copaene	1.32	1.55	1.99	1.99	2.33
13	21.89	Caryophylliene	4.98	2.64	1.66	1.66	1.66
14	22.49	Anzulene	5.15	6.68	9.53	8.25	7.65

Salient Achievements

- Process technology for optimum recovery of oil is standardised.
- Potential cultures for *pectinase* (*Penicillium citrinum, Aspergillus foetidus and Tricosporon asteriodes) a*nd *dehydrogenase* (*Bacillus subtilis, Candida boidinii and Pseudomonas fluorescence) were identified.*
- With the use of pectinase and dehydrogenase producing microbes - increased oil recovery with enhanced patchouli alcohol content (active component of oil) was obtained.
- The performance of pectinase was better than dehydrogenase producing microbes.

Investigation No.2

Design and development of *Chironji* (*Buchanania lanzan*) decorticator

Objectives

1. To study and document the traditional/conventional method of *Chironji* processing in the area.
2. To study physico-chemical properties of *Chironji* seed (nut) and kerne
3. To develop a decorticator for processing of *Chironji* seed/nut.

Design and development of machine

The experimental unit of *chironji* decortications machine (prototype) is designed and developed.

The machine comprises of:

- Hopper
- Cylindrical housing
- Emery black stones
- Lower frame
- Electric motor
- Driving systems
- Sieves
- Grader

Optimum condition for decortications

The optimum condition of machine, material and operational for processing or decortication of *chironji* nuts is given in the Table.

S. No.	Parameters		Values
1	Speed	:	197 rpm
2	Disk Clearance	:	7 mm
3	Treatment	:	24 hour soaking in water
4	Total Kernel recovery	:	18.88 %
5	Whole kernel	:	16.00 %
6	Broken kernel	:	2.88 %
7	Shell	:	64.32%
8	Dust	:	4.00%
9	Efficiency	:	87.20 %
10	Capacity	:	22.09 kg/h
11	Electricity consumption	:	0.17 kWh

Cost analysis of chironji nut processing

- The average cost of processing of *chironji* nuts into kernels was Rs/kg 5.06.

Salient Achievements

- Documentation of the traditional methods of processing practices of chironji nuts in different parts of the state is done.
- Studies on physico-chemical properties at different level of moisture of chironji seed (nut), kernel and hull is done.
- The machine, material and operational conditions were optimised for processing or decortication of chironji nuts.

Investigation No.4

Evaluation and improvement of existing farm level grain storage structures of different parts of Chhattisgarh

OBJECTIVES

1. To identify and collect information on existing storage practices used in different parts of Chhattisgarh for major cereals.
2. To evaluate the existing storage practices/structures used for the storage of paddy/millets in Chhattisgarh.

Bamboo bin

- Construction materials – bamboo strips plastered with mud /cow dung and mud.
- Average life – 3 years
- Capacity – 250 to 2500 kg

Dhan kothi /Mud kothi **Dhan kothi /Mud kothi**

- Construction materials – mud, paddy straw, cow dung, neem leaves
- Average life – 10 years
- Shape – circular, square/varies according to the space availability

MUD DHAN KOTHI

CEMENTED DHAN KOTHI (MODIFIED)

Paddy straw rope bin

- Construction materials – rope prepared from freshly threshed paddy straw
- Capacity – varies up to 1 tonne
- Local name – *dhussi* or *puri*

Construction details, shape, size, and capacity of different types of farm level storage structures.

S No	Type of Structure	Material of construction	Size (L × B × H)	Shape	Capacity (Tonnes)
1.	*Kuchha kothi*	Unbaked bricks & mud	1×1×0.6 – 6×4×3	Square/ Rectangular/ Round	0.2 to 5
2.	Bamboo and wood	Bamboo strip & wood	2×1.5×3.5 – 2.5×3.5×2.5	Round	2-2.5
3.	*Pucca Kothi*	Brick and cement	1.8 X 0.6 X 1.8 – 3.5 X 3.5X 3.5	Square/ Rectangular	1-10
4.	Bamboo *Kothi* (*Pal*)	Bamboo mat & cow dung	0.9 X 1.8 – 1.8 X 2.0	Round	0.4 -0.7
5.	Bamboo *kothi* (Tuti)	Bamboo strip & cow dung	0.8 X 1 – 1.5 X 1.8	Round	0.2 -0.5
6.	Paddy rope (*Gola / Puri / Dhussi*)	Rope made up of paddy straw	0.45 X 0.6 – 1.5 X 1.8	Round	0.05 - 1
7.	Gunny bags	Plastics/jute	-	-	-
8.	Metal bin	GI sheet	D – 0.9 m H – 1.5 m	Round	2-3
9.	Wooden planks	Wooden planks & mud	0.9 X 0.7 X 0.6 – 2.4 X 1.5X 1.2	Square/ Rectangular	10 - 30

Evaluation of some existing modern storage structures used for the storage of paddy

Plastic drum

Metal drum

Bamboo storage with mud plaster

Polythene bag

Gunny bag

Salient Achievements

- ❖ A survey of Chhattisgarh plains for the storage practices and structures have been conducted.
- ❖ Sensitization of farmers for the safe storage of grains is continuously being done through different training programmes and Kisan Melas.
- ❖ Storage study in the existing and modern storage structures used for the storage of paddy is in progress

Investigation No. 6

Performance evaluation and popularization of prototypes developed at other PHET centers and other R&D institutions (Maize dehusker- cum-sheller (MPUAT, Udaipur), Custard apple pulper (PDKV, Akola), Hand operated double screen grain cleaner (CIAE, Bhopal), Dal mill (IIPR, Kanpur)

Objectives:

1. To identify the equipments and processes suitable for post harvest loss reduction and value addition in the selected crops of the region.
2. To procure the selected equipment, their installation, testing and adoptive modifications (if any).
3. To assess financial viability of these in comparison to the existing practices.
4. To make available suitable equipment/machine for processing and value addition of agricultural commodities.
5. Installation and testing of selected equipments.

Specification & performance results -power operated maize sheller, MPUAT, Udaipur

S. No.	Particulars	Values
1	Capacity	1000 kg cobs/ h
2	Size	1500 × 850 × 1900 mm (L×W×H)
3	Weight	570 kg
4	Motor	5 HP
5	Shelling efficiency	93 %
6	Unit cost, Rs.	91,000.00

Specification & performance results - Custard apple pulper, PDKV-Akola

S. No.	Particulars	Values
1	Capacity, kg/h	80
2	Size	1000 X 750 X 800 mm
3	Material	Stainless steel
4	Power requirement	0.5 HP
5	Efficiency: • Coarse/Intact Pulp recovery • Fine Pulp recovery	70-72% 28-30%
6	Unit cost, Rs.	86,260.00

Specification & performance results of hand operated double screen grain cleaner, CIAE-Bhopal

S. No.	Particulars	Values
1	Capacity	150-225 kg/h
2	Size	950 × 630 × 140 mm (L×W×H)
3	Weight	20 kg
4	Top screen size	620 × 930 mm
5	Bottom screen size	620 × 920 mm
6	Cleaning Efficiency	99.0 -99.8 %
7	Labour Requirement	1 man h/q
8	Operating cost	5.30 Rs./q
9	Unit cost, Rs.	7000.00

Specification & performance results - Dal Mill, IIPR-Kanpur

S. No.	Particulars	Values
1	Capacity	75-100 kg/hr
2	Size	900 × 600 × 140 mm (L×W×H)
3	Power requirement	1.5 hp
4	Suitable for	Chickpea, Pegion pea (*Arhar*), Green gram (*Mung*), Lytharus
5	Screen (sieves)	Changeable (for different *dals)*
6	Dehusking efficiency	84 - 93 %
	Dal recovery	70 -75 %
7	Unit cost, Rs.	1,46,769.00



Training And Extension Activities

Trainings and demonstrations

Training program on processing and value addition conducted at KVKs

1	**Number of individuals benefited during the year**				**261 Nos**
2	**Date and period of training/demonstration**				
	i.	Gariyaband	5 & 6 January 2017	2 days	54
	ii.	Dhamtari	12 & 13 January 2017	2 days	59
	Iii	Raipur	3 & 4 February, 2017	2 days	39
	iv.	Kanker	21 & 22 March, 2017	2 days	55
	v.	Raipur	26 & 27 March, 2018	2 days	54

List of demonstrations conducted by the centre

S. No	Event/ Mela	No of participants
1.	National level Kisan Mela 2018, 24-28 January, 2018 at IGKV, Raipur.	10000
2.	Technology Demonstration Mela 2018, 16 February, 2018.	1000
3.	Post-harvest technology and machines demonstration to *Panchyat Rajya* representative of state under *Hamar* Chhattisgarh programme	1500

PROGRESS ICAR- FCI

Study for determining storage losses of food grains in FCI and CWC warehouses and to recommend norms for storage losses in efficient warehouse management.

Objectives

1. Assessment of storage losses in warehouse and CAP structures.



Achievements

- Study is completed and the data obtained for the storage period was recorded and submitted to the PC Unit.

Details of storage loss study

Commodity & Storage type	Location	Observation
Paddy – CAP	FCI, Arjuni, Dhamtari	Study has completed on 14.05.2015 and data entered on software and sent to PC Unit.
Rice – Warehouse	CWC – 4, Raipur	Study has completed on May, 2017 and data entered on software and sent to PC Unit
Wheat – Warehouse	CWC- 4, Raipur	Study discontinued on Jan 2016 due to degradation in wheat quality. (liquidated only four stakes)
As per the guidelines the environmental, operational and biotic factors are recorded regularly as per scheduled.		

PROGRESS

Network Project on HPVA on NRG

Network Project on Harvesting Processing and Value Addition of Natural Resins and Gums

Objectives

- To study production, processing, marketing and utilization of region specific resins (except lac), gums and gum-resins
- To develop and standardize protocols for harvesting and collection
- To improve/refine the primary processing technique for enhanced recovery and quality
- To improve the process and machinery for making value added products in collaboration with IINRG, Ranchi.
- To transfer the resin, gum and gum-resin specific technologies in the region.

Network Project

HPVA of NRG (Year – 2017)

S. No.	Title of project
1	Scientific approaches of biopolymers extraction in Karaya, babool, dhawara and drumstics, and development of protocol for mass propagation in karaya
2	Sustainable utilization of gum and resin by establishing improved tapping technique in Sal (Shorea robusta) and Salai (*Boswellia serrata*)
3	Development of tapping techniques for sustainable extraction of biopolymer in Rohini (*Soymida fembrifuing* Roxb), Chironji (*Buchanania lanzan* Spreng), Saja (*Terminalia tomentosa* Roxb) and Dhawara (*Anogiessus latifolia*)
4	Drying characteristics of babul gum (*Acacia nilotica*)

Investigation No.1

Scientific approaches of biopolymers extraction in Karaya, babool, dhawara and drumstics, and development of protocol for mass propagation in karaya






KARAYA

BABOOL




Dhawda tree
(ATR, forest area of Mungeli) Dhawara tree (*Anogeissus lattifolia*)






INFERENCES

- ❖ Elevation of the tree plays a significant role in gum production. High elevation have negative impact on quantity of gum production per plant in *Karaya*.
- ❖ DBH (diameter at breast height), have significant impact on gum production.
  - **Karaya – should > 90 cm tree circumference**
  - **Dhawara – should > 150 cm tree circumference**
  - **Babool – should > 75 cm tree circumference**
  - **Drunstick – should > 60 cm tree circumference**
- ❖ In *Karaya* 4 ml of 3.9% ethephon is significantly effective when applied in two concomitant doses since March – May in 30-45 days intervals at RH below 40% and temp more than 38-40°C for potential production of gum – technology developed and transferred to KVKs for OFT
- ❖ Various concentrations of ethaphon with constant dose of 4 ml was found significantly effective for biopolymers exudation:

Babool - @2.56% , Dhawara - 3.12 – 3.9% and Drum sticks - 0.39% applied in two concomitant doses in 30-45 days intervals in Mar-May, when RH is less than 40% and temp more than 38-40°C.

Investigation No. 2

Sustainable utilization of gum and resin by establishing improved tapping technique in Sal (*Shorea robusta*) and Salai (*Boswellia serrata*)

Objectives:

1. Survey of availability of tree species in Chhattisgarh.
2. To develop and standardize protocols for safe harvesting and collection of gum/resin
3. To study production, processing, marketing and utilization of gum/resin
4. To transfer gum/resin specific technologies in the region.

Inferences:

1. The summer time were found best and combined effect of ethephon and H_2SO_4 were most effective for production of biopolymer in sal.
2. Mechanical method (semi arc cut) was found best for maximum production of biopolymer in month of February to June in Salai.

Investigation No. 3

Development of tapping techniques for sustainable extraction of biopolymer in Rohini (*Soymida fembrifuing* Roxb), Chironji (*Buchanania lanzan Spreng*), Saja (*Terminalia tomentosa* Roxb) and Dhawara (*Anogiessus latifolia*)

Objectives:

1. Survey of area for abundant availability of true species for experimentation.
2. Assessment of efficacy of gum enhancer for potential production of gums
3. To transfer gum/resin specific technologies in the region.

Saja ***Terminalia tomentosa*** **Roxb**

MECHANICAL TAPPING METHOD (SEMI ARC) Rohina *Soymida febrifuga Roxb.*


Chironji ***Buchanania lanzan Spreng.***

Mechanical Tapping Method (SEMI ARC)

Chemical method of gum tapping in Rohina (*Soymida febrifuga* Roxb.)



Ethephon @3.9 + H_2SO_4@ **1% *Ethephon* @** ***3.9 % H_2SO_4 @ 1%***

Chemical method of gum tapping in Chirounji (Buchanania lanzan Spreng.)



Ethephon @3.9 + H_2SO_4@ **1% Ethephon @** **3.9 % H_2SO_4 @ 1%**

INFERENCES

- The rate of gum exudation was more by using gum enhancer (ethephon/H_2SO_4) as compare to mechanical and traditional method of gum tapping in Chironji (Buchanania lanzan Spreng.) and Rohina (Soymida febrifuga Roxb.). But in case of Saja (Terminalia tomentosa Roxb.) the gum yield was higher in mechanical method as compare to chemical.
- Temperature and relative humidity plays significant role on quantity of exudation. The maximum exudation was obtained in summer season (1st week of April – 1st week of June) in all the three trees.
- The combined effect of H_2SO_4 and Ethephon was found better as compare to individual.

Investigation No. 4

Drying characteristics of babul gum (Acacia nilotica)

Objectives

To study the drying kinetics of babul gum at different drying air temperatures.

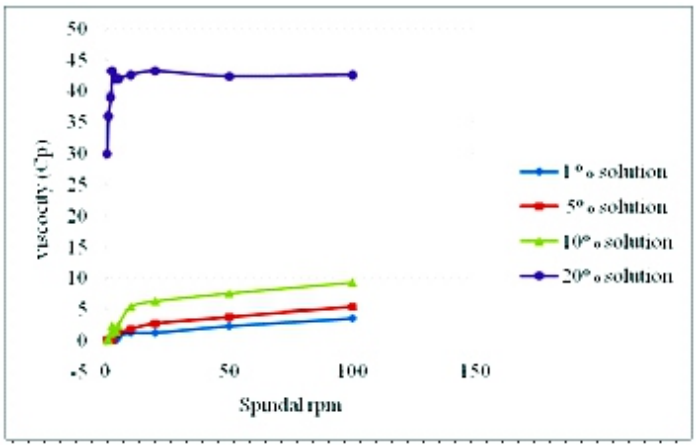
Physico-chemical properties of babool gum grits

Physical parameters	**Obtained results**
Moisture Content (%wb)	15.91±0.42
Bulk density (g/ml)	0.78±0.06
Tapped density (g/ml)	0.90±0.06
True density (g/ml)	1.72±0.13
Bulkiness (ml/g)	1.29±0.09
Porosity (%)	54.82±3.55
Hausner's Ratio	1.15±0.02
Carr's Compressibility Index (%)	13.12±2.00
Angle of repose (°)	22.34±2.64
Coefficient of friction (N)	
Glass	0.33±0.02
Mild Steel	0.44±0.02
Plywood	0.35±0.02
Rubber	0.45±0.24

Physico-chemical properties of babool gum grits

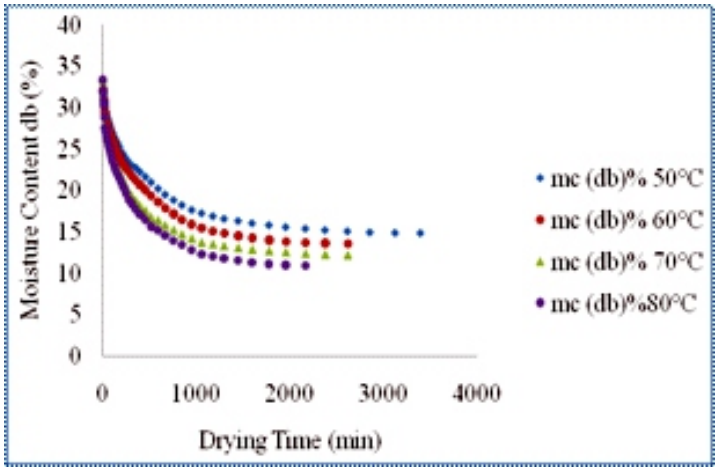
Physiochemical parameters	Obtained results
pH Content (%)	4.52±0.03
Ash Content (%)	1.96±0.04
Solubility (per 100 ml)	
Hot Water	0.79±0.16
Cold Water	0.51±0.10
Acetone	0.00
Chloroform	0.00
Ethanol	0.00
Water Holding Capacity (per 10 ml)	0.29±0.1
Nitrogen (%)	0.37±0.06
Protein (%)	2.42±0.43

Rheological properties of babool gum



- Brookfield viscometer, Spindle (No. 63) and at room temperature (approximately 32°C), Concentration of solution 1 – 20% (w/v).
- It acts as a pseudo-plastic material, exhibiting a decrease in viscosity with increasing rates of shear. The viscosity of babool gum solution increases with the increased in concentration and decreased in temperature.

Drying graphs of babool gum grits



- Final moisture content of 14.43, 13.83, 10.92 and 7.27 % (db) for 50, 60, 70 and 80°C respectively.
- The moisture-time relationship is non linear and decreases in moisture being larger initially.
- Drying temperature exhibited a significant effect on drying time

Inferences

- The viscosity of babul gum was determined by viscometer and it was found that with the increased in concentration the viscosity is increase. At 20% (w/v) concentration viscosity was found to be 43 cps which confirms it use as a viscosity enhancing agent (as thickner).
- The curve for moisture content versus drying time shows that drying time was reduced with increased in drying temperature from 56-32 h for 50 to 80°C and to reduce the moisture content from 25%(wb) to 10% (wb).
- The complete drying take place in falling rate period and constant rate period was totally absent in all drying air temperature.
- The proper drying of gum can prevent microbial contamination.

Progress

ICAR Platform Project– Secondary Agriculture

Establishment of APC for value addition of small millets

OBJECTIVES

1. To establish pilot plant for high value and low volume products.
2. To promote entrepreneurship development and processing of millets through training and capacity building.
3. To act as nodal centre for project preparation for setting up of new plants and extend technical support.

PROGRESS

1. The process technologies for multi grain flour & ragi malt have been validated and demonstrated.
2. Set of equipments/machineries have been purchased and the process line is established for the processing of small millet.
3. Five training programmes to sensitize the producers, small processors, entrepreneurs and other stake holders have been organized as per the details given below.

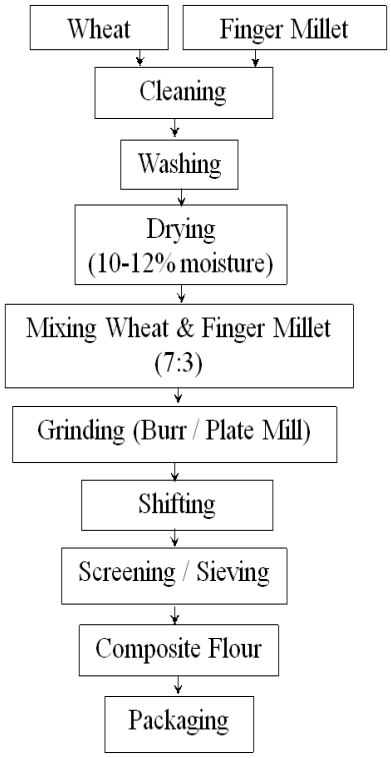
Training Programme

S. No.	Date	Place	No. of participants
1	Dec 29-30, 2016	Krishi Vigyan Kendra, Kanker	48
2	Jan 05-06, 2017	Krishi Vigyan Kendra, Gariyaband	54
3	Jan 12-13, 2017	Krishi Vigyan Kendra, Dhamtari	60
4	March 21-22, 2017	Krishi Vigyan Kendra, Kanker	55
5	March 26-27, 2018	Krishi Vigyan Kendra, Raipur	54

Topic covered during trainings

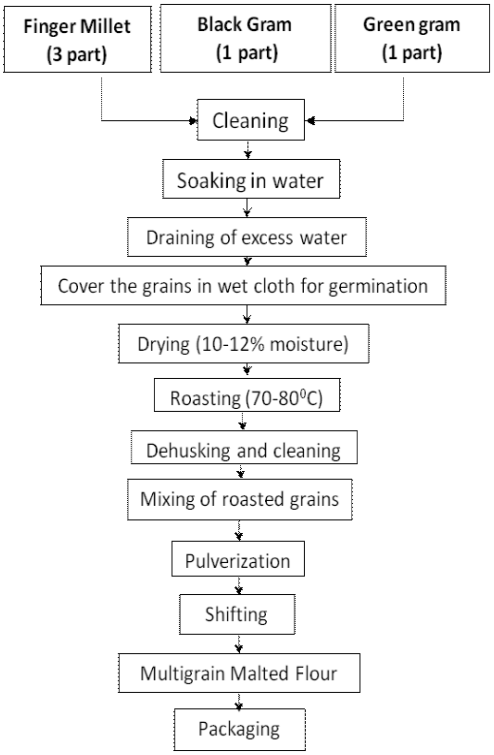
1	Importance and availability of millets in the district.
2	Major post harvest operations essential in millet processing.
3	Importance of primary processing and value addition of produce.
4	Value addition/product development of millets.
5	Processing and Safety Measures in Food Processing Industry.
6	Machines and Equipments used in millet processing.
7	Protection and safety measures in storage of millets.
8	Marketing and Entrepreneurship development through millet processing.
9	Food and medicinal values of different millets.
10	Hands on training & demonstration of millet processing.

Process technology for composite flour



Nutritive values (per 100 g at 12 % moisture)		
Carbohydrate (g)	:	61.94
Protein (g)	:	11.27
Fat (g)	:	00.93
Total diatry fibre (g)	:	12.99
Glycemic index (GI)	:	57.00
Calcium (mg)	:	85.80
Phosphorus (mg)	:	245.73
Energy (kcal)	:	301.00

Process technology for ragi malt

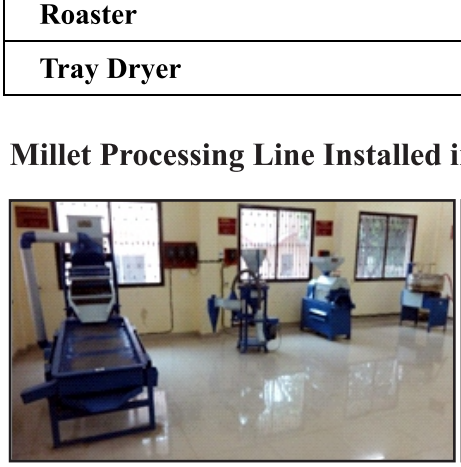


Nutritive values (per 100 g at 12 % moisture)		
Carbohydrate (g)	:	56.39
Protein (g)	:	12.37
Fat (g)	:	1.64
Total dietary fibre (g)	:	14.64
Calcium (mg)	:	280.92
Phosphorus (mg)	:	321.95
Energy (kcal)	:	290.00
Thiamine (mg)	:	1.37
Niacin (mg)	:	3.51
Riboflavin (mg)	:	0.06

Equipment purchased for the establishment of small millet processing line

Equipment/Machines Name
Plant growth chamber with humidity controller
Grain polisher
Kodo dehusker/Kodo mill
De-stoner-cum-Grader-cum-Aspirator
Pulveriser
Flour sifter
Roaster
Tray Dryer

Millet Processing Line Installed in The Department



Testing of Kodo dehusker/Kodo mill

Visit of Hon'ble Chief Minister

PROGRESS

Extramural Project - ICAR

Development of pilot scale value chain of chironji seeds

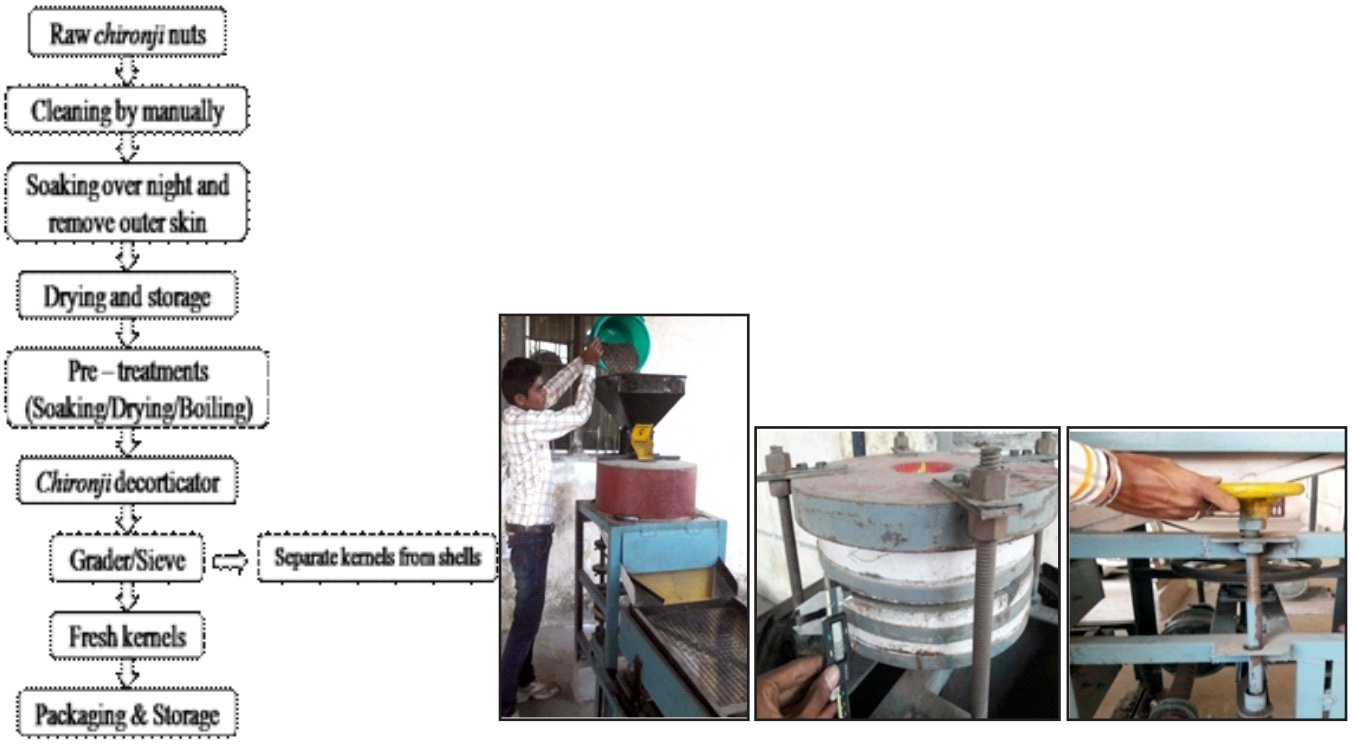
Investigation

Development of pilot scale value chain of chironji seeds – Extramural (ICAR)

Objectives:

1. To develop compatibility amongst the developed machines/ equipment for chironji seeds and carryout modifications, if required any.
2. To develop value added products and their production systems from chironji seeds and its by-products.
3. To demonstrate and train the local processors and enhance the acceptability of the developed pilot plant.

Testing of developed machine



Clearance adjustment : 6, 7 & 8 mm

Speed : 197, 246 & 286 rpm

Pre-treatments	Temperature (°C)	Moisture content % (wb)
30 min. drying	60°C	7.83 - 7.90
20 min. boiling	90-100°C	8.34 - 8.52
24 h soaking	Room temperature	8.57 – 8.66
30 h soaking	Room temperature	8.68 – 8.75

Whole Kernel, Rs. 900-1200Broken Kernel, Rs. 300-600 **Half spilited shell, Rs. 3 – 5 Mili dust, Rs. 3 - 5**

Utilization of chironji nut shell as fuel - briquettes
Different combination for production of briquettes

Sample name	Symbolic name	Chironji shell (%)	Rice husk (%)	Cow dung (%)	Soil (%)
Grind chironji shell (Machine made)	B_1	42	10	42	6
Ungrind chironji shell (Machine made)	B_2	28	11	57	4
Grind chironji shell (Handmade)	B_3	20	15	59	6
Ungrind chironji shell (Handmade)	B_4	25	19	49	7

B1 *B2* *B3* *B4*

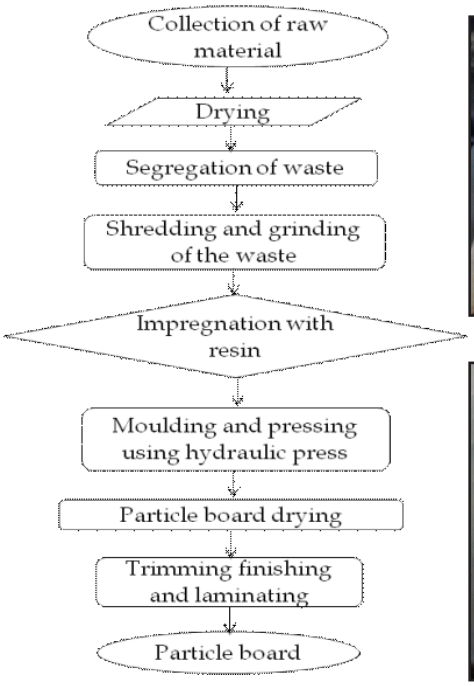
Sample name	Water absorption, (%) C = (B-A)*100/B	Ave. density of briquette, (g/cm^3)
B_1	3.59	0.68
B_2	6.91	0.62
B_3	8.06	0.49
B_4	6.76	0.41

Water boiling test

S. No.	Parameters	Briquettes			
		B_1	B_2	B_3	B_4
1.	Fuel taken, (g)	500	500	500	500
2.	Time taken to burn briquette, (min)	9.42	8.21	6.47	7.12
3.	Water boiling time, (min)	11.48	12.2	15.55	14.94
4.	Ratio of water evaporated to fuel used, (ml/g)	0.28	0.29	0.31	0.32

- ❑ The grind chironji shell (machine made) briquettes was found having high density, minimum water absorption value and lowest water evaporation to fuel used ratio.
- ❑ The developed chironji shell briquettes are environmental friendly and will help reduce the health hazard associated with the use of fuel wood and reduce deforestation.

Utilization of chironji hull for manufacturing of particle board



Training at KVK, Kanker during 21 & 22 March 2017

Salient Achievements

- Testing and evaluation of the chironji decortication machine is completed.
- Material, machine and operational parameters are optimised.
- Training on processing and value addition of chironji.
- Utilization of chironji hull in production of hardboard and briquettes.

Investigation No.1 RPF - II

Evaluation of important paddy varieties for the production of value added product: puffed and flaked rice

Objectives:

1. To study and document the variety used for producing puffed and flaked rice and also to know the different processing methods used for producing puffed and flaked rice in Chhattisgarh state.
2. Comparative study on puffing and flaking characteristic of selected variety with the well-established variety.
3. Screening of variety suitable for producing puffed and flaked rice and standardization of product and processing parameter for it, to obtain quality product.

Progress:

Status of Experiment	:	Study on flaking characteristics of three paddy varieties is conducted namely Makdo, Urai Butta and Roti.
Findings	:	All the three varieties (Makdo, Urai Butta and Roti) were found suitable for the preparation of thick flaked rice (mota poha) and only one varieties (i.e. Urai Butta) was found suitable for thin flaked rice (patala poha)

Flaking yield and Broken percentage of different varieties of paddy

S. No.	Verities	Sample	Total Flacking Yield %	Head Flacked Yield %	Broken %
1.	Makdo	Thick	70.84	94.66	5.34
2.	Urai Butta	Thick	70.06	94.18	5.82
3.	Roti	Thick	72.72	93.37	6.63

S. No.	Verities	sample	Total Flacking Yield, %	Head Flacked Yield %	Broken %
1.	Makdo	Thin	67.38	70.79	29.21
2.	Urai Butta	Thin	71.74	91.22	8.78
3.	Roti	Thin	72.92	69.03	30.97

Investigation No.2 RPF - II

Seed grading manual sieves for different crops

Objectives:

1. To create awareness on primary processing among farmers.
2. To design and develop sieves for different crops.

Progress:

1. One prototype unit of manual seed grader was fabricated and tested.
2. Order to fabrication 40 units of manual seed grader has been placed to FMP.
3. Fabrication work is under progress.

Investigation No. 3

Title: Developing of process technology for the production of Bixin (sindoor powder) from annatto sindori fruit (Bixa orellana) and enhancement of storability of extracted sindoor

Objective

1. To study physico-chemical properties of annatto seed and extract (sindoor powder).
2. To develop process technology for processing/extraction of Bixin powder.
3. To study the storage behavior of Bixin extract on different packaging materials over a period of time.

Physical and engineering properties of annatto seeds

Physical Property	No. of Obser-vations	Sample 1 BTP	Sample 2 JDP	Sample 3 BSP-G/17	Sample 4 BSP-G/31	Sample 5 SUR-R	Average
Moisture Content, % (wb)	5	7	9.6	8.1	7.8	9.4	8.4
Length, mm	100	4.7	4.6	4.76	4.47	4.45	4.60
Width, mm	100	4.04	3.8	3.71	3.42	3.79	3.75
Thickness, mm	100	3.22	3.28	3.15	2.8	3.17	3.12
Mass, g	100	0.038	0.029	0.035	0.029	0.025	0.03
Volume, mm^3	100	32.00	30.01	29.11	22.40	27.98	28.30
GMD, mm	100	3.94	3.86	3.82	3.50	3.77	3.78
Aspect ratio, %	100	85.96	82.61	77.94	76.51	85.17	81.64
Sphericity	100	0.84	0.84	0.80	0.78	0.85	0.82
True density, kgm^{-3}	3	1377.93	1393.40	1270.10	1311.90	1202.70	1311.21
Bulk density, kgm^{-3}	3	757.86	766.37	698.555	721.545	661.485	721.16
Porosity, %	30	45	45	45	45	45	45
Angle of repose, degrees	4	57.57	49.72	50.66	45.65	47.78	50.28

Traditional Method: Sindoor Extraction

Extraction of colour pigment using organic solvent – soxhlet method

S. No.	Solvent system	Pigment recovery# (%)	Colour	Bixin content# (%)
1	Acetone	13.79	Orange-red	16.02
2	Chloroform	12.02	Dark-red	15.10
3	Hexane	9.13	Red	15.21
4	Methanol	13.85	Dark red	14.52
5	Ethanol	13.09	Dark red	14.75

Optimization of the soxhlet extraction method

Recovery of crude pigment at different extraction temperature

S. No.	Extraction temperature (°C)	Crude pigment# (%)	Bixin content# (%)
1	35	13.79	15.23
2	45	14.02	14.02
3	55	14.25	13.51
4	65	14.12	13.43

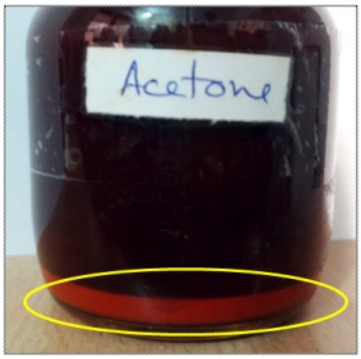
Recovery of crude pigment at different number of refluxing cycles

S. No.	No. of Extraction	Crude pigment# (%)	Bixin content# (%)
1	04	13.79	14.02
2	06	14.50	14.23
3	08	14.50	13.51
4	10	14.52	13.43

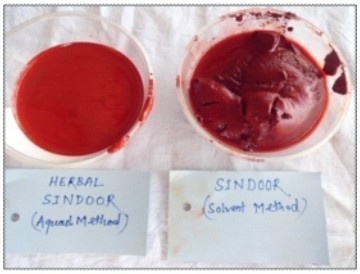
(A)

(B)

(C)



(D)



(E)

(A) Annatto pod;
(B) Extracted pigment using various solvent;
(C) Fungal growth in aqueous extract;
(D) Settled pigment in acetone extract;
(E) Concentrated pigment extracted using water and solvent.

Salient Achievements:

- ❖ Documentation of the traditional methods of sindoor powder extraction is completed.
- ❖ Studies on physical properties of seeds of some varieties collected from different regions are done.
- ❖ Experimental trials for extraction of sindoor powder using water extraction and solvent extraction methods have been completed.
- ❖ Optimization of the acetone extraction method for pigment recovery and bixin recovery is completed.

Investigation No. 4

Title : Design and development of a cottage level rice puffing machine

Objective

1. Design and development of rice puffing machine (50-100 kg capacity).
2. Testing and evaluation of the developed machine.
3. Standardization of product and processing parameters for quality product.
4. To work out the cost economics, feasibility, and compare with the existing traditional methods.

Present practice used for rice puffing

1. Rice puffing by hot sand roasting – traditional method or the domestic (manually)
2. Rice puffing by hot sand roasting – semi mechanized method
3. Rice puffing by hot sand roasting – commercial method

Rice samples exposed to hot sand and separation of puffed rice by sieve

Rice puffing by hot sand roasting method (semi mechanized)

Rice puffing by hot sand roasting - commercial method

Design consideration

1. The unit should be of small capacity in the range of 50-100 kg/hr.
2. Machine is required for the preparation of puffed rice (murra) from different varieties of parboiled rice.
3. It should follow the puffing of grains through heating over sand or any other heating media for heat transfer.
4. The major parts of machine should be made up of mild steel of suitable thickness.
5. The machine should be of continuous type with sand/salt heating medium used for puffing options.
6. The system should be pollution free; hence it should be compatible with LPG for heating the material for puffing.
7. The desired temperature of 180-300°C for puffing should be attained for heating of the grains.
8. The unit should be capable of producing uniform quality of the product.
9. The cost of the machine should be low.
10. Its operation and maintenance should be easy and can be operated by a semi-skilled personals.
11. There should be enough safety for operator.
12. The provision of recycling of heated sand/salt should be there to reduce the operational energy.

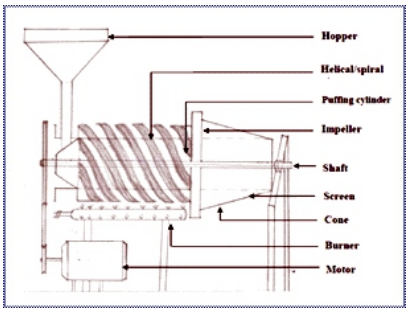


Diagram of rice puffing machine Fabrication of machine parts