Technologies for the Rural Sector

Prepared By

Research Project Planning and Performance Directorate (RPPBDD)

CSIR Headquarters, New Delhi

December 2019

Edited By

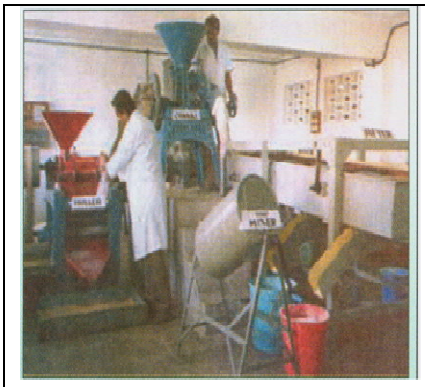
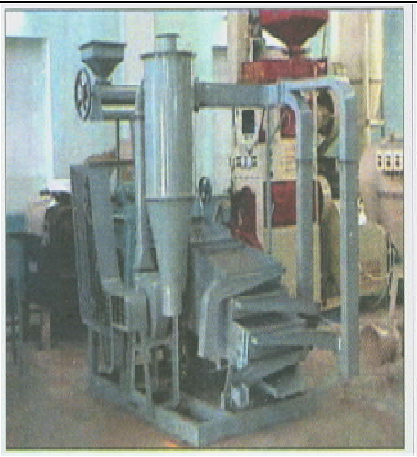
Arvind Kumar Kundalia, Senior Principal Scientist, RPPBDD

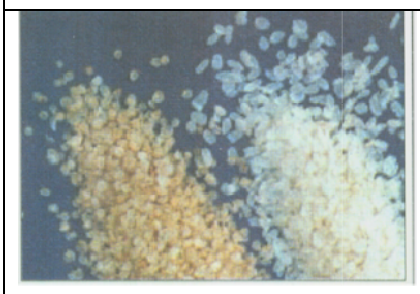
INDEX

		ACHIEVE HIGHER RECOVERY (> 60%)		
190.	**3.2.16**	CASCADED MEMBRANE SYSTEM FOR PRODUCTION OF DEMINERALIZED WATER	**118**	IICT
191.	**3.2.17**	COMPACT MEMBRANE UNIT FOR SURFACE AND GROUND WATER PURIFICATION	**119**	IICT
192.	**3.2.18**	TECHNOLOGY FOR BOTTLING OF PURIFIED DRINKING WATER	**120**	IICT
193.	**3.2.19**	HIGHLY COMPACT REVERSE OSMOSIS	**121**	IICT
194.	**3.2.20**	ONEER- A NOVEL SOLUTION FOR SAFE DRINKING WATER	**121**	IITR
195.	**3.2.21**	TERAFIL WATER FILTRATION TECHNOLOGY	**122**	IMMT
196.	**3.2.22**	WATER PURIFICATION	**123**	NCL
197.	**3.2.23**	FIELD MONITORING OF ARSENIC IN DRINKING WATER	**124**	NCL
198.	**3.2.24**	SLOW SAND WATER FILTER	**124**	NEERI
199.	**3.2.25**	HAND PUMP ATTACHABLE IRON REMOVAL PLANT	**125**	NEERI
200.	**3.2.26**	WATER DEFLUORIDATION: NALGONDA TECHNIQUE	**125**	NEERI
201.	**3.2.27**	ELECTROLYTIC DEFLUORIDATION (EDF) TECHNIQUE	**126**	NEERI
202.	**3.2.28**	ARSENIC REMOVAL FROM GROUNDWATER	**127**	NML
	3.3	**WATER QUALITY ASSESSMENT**	**128**	
203.	**3.3.1**	PORTABLE WATER ANALYSIS KIT	**128**	IITR
204.	**3.3.2**	RAPID CHEMICAL AQUA TESTER	**128**	NEERI
205.	**3.3.3**	FIELD KIT FOR IRON ANALYSIS	**129**	NEERI
206.	**3.3.4**	TITRIMETRIC WATER ANALYSIS KIT	**129**	NEERI
	4.1	**ENVIRONMENT**	**130**	
207.	**4.1.1**	SISAL GEOTEXTILES FOR SOIL CONSERVATION	**130**	AMPRI
208.	**4.1.2**	LOW COST LATRINE	**130**	CBRI
209.	**4.1.3**	DISPOAL OF DOMESTIC WASTE WATER	**131**	CBRI
210.	**4.1.4**	SINGLE STACK DRAINAGE SYSTEM	**131**	CBRI
211.	**4.1.5**	PHOTO ASSISTED ELECTRO CHEMICAL DEGRADATION AND DECOLORIZATION OF DYE BATH EFFLUENT FROM TEXTILE INDUSTRIES	**132**	CECRI
212.	**4.1.6**	RED CLAY SANITARY WARE	**132**	CGCRI
213.	**4.1.7**	STONE SANITARY WARE	**133**	CGCRI
214.	**4.1.8**	ACCELERATED ANAEROBIC COMPOSTING (AAC) OF ORGANIC WASTE	**133**	IICT
215.	**4.1.9**	BIOELECTROCHEMICAL TREATMENT SYSTEM FOR EFFECTIVE TREATMENT OF COMPLEX WASTEWATER	**134**	IICT

1. FOOD AND AGRO-BASED TECHNOLOGIES

1.1 CEREALS AND PULSES:

	**1.1.1 INTEGRATED MINI WHEAT MILL** **Product/Process:** Machine for cottage scale. Milling of wheat. **Application/Use:** Quality bakery flour, Atta, Soji. **By product:** Bran (for animal feed). **Salient Feature of Process! Technology:** The simple wheat mill has the advantage of simultaneously providing bakery flour and Atta for chapatti. The milling system consists of cleaning of grains, bran removal by polishing, grinding and sieving. An unskilled worker can operate this simple mill. It can process 100 kg wheat/hr. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 100 kg/hr. **Indicative Investment**: Rs.1.20 lakh **Equipment and Machinery:**Mini wheat mill available from CSIR licensee. **For Further Information, Please Contact:** The Director,Central Food Technological Research Institute.	**CFTRI**
	**1.1.2 MINI GRAIN MILL** **Product/Process:** Machine for milling of coarse grains e.g. maize, jowar, bajra and also wheat. **By products:** Husk, bran and brokens. **Application Use:** Production of edible flour and soji. **Salient Feature of Process/Technology:** By use of this simple mill, the coarse grains as well as wheat can be refined. In one single step the refined suji and flour can be obtained from wheat/maize/jowar/bajra/ragi and other grains. In this mill, the simple chakki machine has been modified suitably to have arrangements for water mixing, sieving and aspiration. **Status of Commercialization:**In commercial production. **Minimum Economic Unit Size:** 60-80 kg/hour. **Indicative Investment:** Rs.1 lakh. **Equipment and Machinery:** Mini grain mill available from CSIR licensees. **For Further Information, Please Contact:** The Director,Central Food Technological Research Institute.	**CFTRI**

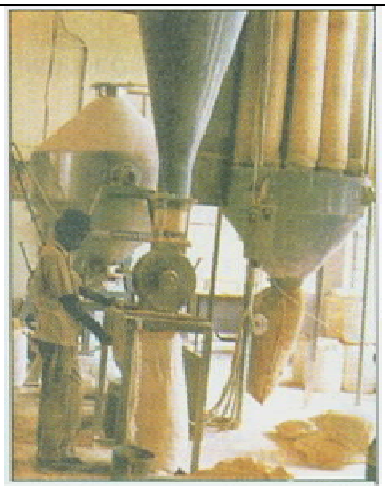
	**1.1.3 DHAL MILL** **Product/process:** Dhal milling in small-scale sectors. **Application/Use:** Production of dhal (Dehusked split pulse). **Salient Feature of Process/Technology:** Thismillis an integrated small-scale pulse processing system, which can process all types of pulses after reconditioning by dry method. It consists of pulse dehusker, cleaner-cum-grader, destoner, elevators, cyclone separators, dhal separator, paddle type mixers and polisher. The pulse dehusker works on the principle of abrasion and has the arrangement of an emery coated cone rotating inside a wire mesh cage. **Capacity:**250 - 300 kg / hr. **Power required:**16 HP **Space Required:**8 x 12 meters **Dehulling:** 98 - 99% **Yield of Dhal:** 75 - 78% Utility: Can process all type of pulses with minimum dust pollution. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 2 tons/day **Indicative Investment:** Rs.6 lakhs. **Equipment and Machinery:** Mini Dal Mill available from CSIR licensee. **Raw Materials:** Whole pulse e.g. tur, Bengal gram, pea etc. **For Further Information, Please Contact:** The Director,Central Food Technological Research Institute.	**CFTRI**
	**1.1.4 JOWAR FLAKES** **Product/Process:** Process for making Jowar (Sorghum) flakes. **Application/Use:** Improved jowar flakes, used similar to rice flakes, e.g. chewda, spiced mixtures, upmav, pongal and other traditional food preparations. **Salient Feature of Process/Technology:** Jowar is a coarse grain normally difficult to pound and convert into flakes. The improved process of flaking includes selection of matured, sound grains (whitish or yellow), cleaning, soaking, roasting, resting, polishing, flaking, grading, and drying up to 10-11 % moisture level. The yield is about 80 kg flakes/100 kg of processed jowar.	**CFTRI**

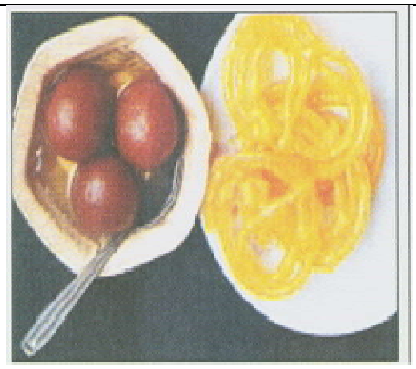
	Status of Commercialization: Ready for commercialization. **Minimum Economic Unit Size:** 250-300 kg/h **Indicative Investment:** Rs.35lakh **Equipment and Machinery:** Hot water boiler, soaking tanks, roaster, polisher, flaker, dryer. **For Further Information, Please Contact:** The Director,Central Food Technological Research Institute.	
	**1.1.5 PAUSHTIK ATTA** **Product/Process:** Production of paushtik atta, a nutritive product obtained by blending wheat flour &soy flour and fortified with vitamins and minerals. **Application/Use:** Used as whole wheat flour for common food preparation e.g. puri and chapatti. **Salient Feature of Process/Technology:** Paushtik atta consists of ablend of 89 parts of whole wheat flour, 10 parts of low fat soy flour and 1 part of common salt together with vitamin-mineral premix. The raw materials are blended using suitable blender. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 0.25 tpd **Indicative Investment:** Rs.5 lakhs **Equipment and Machinery:** Cleaner, destoner,impact pulveriser, mixer, roaster, heat sealer. **Raw Materials:** Wheat, soy flour, common salt, vitamin premix and calcium carbonate. **For Further Information, Please Contact:** The Director,Central Food Technological Research Institute.	**CFTRI**
	**1.1.6 BREAD MANUFACTURE** **Product/Process:** Process for manufacture of bakery bread. **Application/Use:**Food item. **Salient Feature of Process/Technology:** Despite the advent of semi-automatic and automatic bread lines as well as biscuit plants, a fairly sizeable cross section of the population still prefers fresh bread from bakery. With growing population and nutritional standards as well as demand for fresh ready-to-eat foods, the demand for bakery items have also increased considerably. The process involves sifting of flour, preparation of dough, fermentation, dividing,	**CFTRI**

	baking, slicing and cooling. Women entrepreneurs can easily manufacture this at cottage/tiny scale. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 500 bread loaves/day **Indicative Investment:** Rs.10 lakhs. **Equipment and Machinery:** Dough kneader, flour sifter, hand divider, moulding machine, country type oven, bread slicer, balance, and miscellaneous vessels. **Raw Materials:** Wheat flour, yeast, Vanaspati, sugar and milk powder. **For Further Information, Please Contact:** The Director,Central Food Technological Research Institute.	
	**1.1.7 HIGH – PROTEIN BUN** **Product Process:** Production of the high protein bakery buns. **Application/Use:** Ready-to-eat snack. **Salient Feature of Process/Technology:** Protein malnutrition is a major health problem amongst Indian children. There exists a good scope for introduction of protein-rich baked goods. The high protein buns contain 4% more proteins than ordinary buns. They could be prepared in large scale and utilised in various school feeding programs for the children. **Status of Commercialization:** Ready for commercialization. **Minimum Economic Unit Size:** 50 kg/day **Indicative Investment:** Rs.10 lakhs. **Equipment and Machinery:** Weighing scale, mixer and oven. **Raw Materials:**Wheat flour, yeast, sugar, salt, fat etc. **For Further Information, Please Contact:** The Director,Central Food Technological Research Institute.	**CFTRI**
	**1.1.8 NUTRITIOUS RUSK** **Product/Process:** Process for making composite ragi rusk and high protein rusk. **Application/Use:** Ready-to-eat snack. Ragi is a rich source of calcium and hence it is good for growing children, pregnant women and lactating mothers. Ragi is also rich in dietary fibre and it is specially	**CFTRI**

	advised for patients suffering from diabetes. Rusk in general is liked by children and has a long shelf life. High protein rusks have great potential in rural areas in view of the increased protein content of about 6 % than ordinary rusks and long shelf life. **Salient Feature of Process/Technology:** **Ragi Rusk:** Rusk prepared from suitably processed ragi flour incorporated in wheat flour gives touch of the local taste, contributes to the variety and adds to nutrition. **High Protein Rusk:** High protein rusks prepared using defatted soya flour has improved taste, texture and nutritional quality. **Status of Commercialization:** Commercialized. **Indicative Investment:** Rs.10 lakhs **Equipment and Machinery:** Weighing scale, dough kneader, baking trays, baking oven, cooling rack, slicer. The above equipment's/machines can be utilized for the manufacture of variety bakery products like bread, rusks, cakes, cookies, pastries. **Raw Materials:** Wheat flour, ragi flour, defatted soya flour, sugar, salt, Vanaspati, yeast, skimmed milk powder, water, permitted additives. **For Further Information, Please Contact:** The Director,Central Food Technological Research Institute.	
	**1.1.9 SUGAR-FREE CUP CAKE** **Product/Process:** Production of sugar-free cupcakes. **Application/Use:** Ready-to-eat snack item intended for diabetic patients. **Salient Feature of Process/Technology:** Sugar-free cake is a therapeutic bakery product intended for the use of diabetic subjects. The portion size of the cupcake being small makes it very convenient for consumption. It is a novel product with good market potential. **Status of Commercialization:** Ready for commercialization. **Minimum Economic Unit Size:** 25 kg/day. **Indicative Investment:** Rs.10 lakhs. **Equipment and Machinery:** Weighing scale, mixer, and oven. **Raw Materials:**Wheat flour, sugar substitute, eggs, margarine/butter, flavors, permitted preservatives.	**CFTRI**

	For Further Information, Please Contact: The Director,Central Food Technological Research Institute.	
	**1.1.10 JOWAR FLAKES** **Product/Process:** Process for making jowar flakes. **Application/Use:** A new product used similar to rice flakes e.g. chiwda, spiced mixtures, upmav, pan gal and other traditional food preparations. **Salient Feature of Process/Technology:** Jowar is a coarse grain normally difficult to pound and turn into flakes. The improved process of flaking includes selection of matured sound yellowish/whitish grains, cleaning, soaking, roasting, resting, polishing, flaking, sifting and drying up to 1 0~11 % moisture level. The yield is about 80 kg flakes/100 kg of processed jowar. **Status of Commercialization:**Know-how available. **Minimum Economic Unit Size:** 3 tpd **Indicative Investment:** Rs.18 lakh **Equipment and Machinery:** Hot water boiler, soaking tanks, roaster, cone polisher, flaker, edge runner, drier. **Raw Materials:**Jowar. **For Further Information, Please Contact:** The Director,Central Food Technological Research Institute.	**CFTRI**
	**1.1.11 PAPADS** **Product/Process:** Production of papad using Papad Press. **Application/Use:** As food adjunct. **Salient Feature of Process/Technology:** 'Papad' is a thin wafer like product, circular in shape, rolled from dough made out of pulse flour. The papad dough is made from pulse flour (preferably urd dal), salt, carbonates, farinaceous material and water. The contents are kneaded into semi tough dough. The dough is made into balls of 5-6 g and pressed into 1 mm thick circular discs using papad press. The pressed circular shaped papad is dried to 14·15% moisture level. The thickness of the papad can be varied and the machine can also be used for shaping Chapattis, Puris, etc. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** Leg operated	**CFTRI**

	press: 300 - 400 papad per hour Hand operated press: 1 00 ~ 120 papad per hour **Indicative Investment:** leg operated press: Approx. 'cost! machine: Rs.9000/- Hand operated press: Approx. cost! machine: Rs.2000/- **Equipment and Machinery:** Papad press (available from CSIR licensee). **Raw Materials:** Black gram dal, pulse flour, salt, farinaceous material, spice mix. **For Further Information, Please Contact:** The Director,Central Food Technological Research Institute.	
	**1.1.12 MULTIPURPOSE FOOD** **Product/Process:** Manufacture of Multipurpose Food: a blend of edible quality groundnut meal and bengalgram flour with added vitamins and minerals. **Application/Use:** To supplement the diet of children, expectant and nursing mothers; can also be used as general diet supplement. **Salient Feature of Process/Technology:** Edible quality groundnut cake is ground to a fine powder and roasted for 6 min at 7°C. Bengal gram dal is cleaned and roasted till it develops a characteristic aroma, cooled and powdered to fine grits. Three parts of groundnut flour is mixed with one part of Bengal gram flour. The vitamins and minerals are added. The blend is mixed. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 0.25 tpd. **Indicative Investment:** Rs.6lakh **Equipment and Machinery:** Grader, sieves, roaster, plate mill, aspirator, sorting belt conveyer, expeller, mixer. **Raw Materials:** Groundnut cake, Bengal gram dal, vitamin premix and minerals. **For Further Information, Please Contact:** The Director,Central Food Technological Research Institute.	**CFTRI**

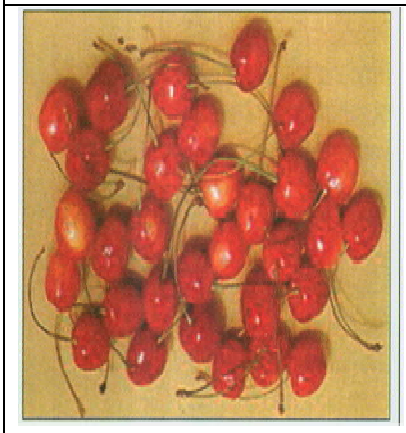
	**1.1.13 ENERGY FOOD** **Product/Process:** Production of energy food: Ready-to-eat; rich in protein, vitamins and minerals. **Application/Use:** Supplementary food to combat protein calorie malnutrition among children in developing countries. **Salient Feature of Process/Technology**: The process consists of pre-cleaning of the raw materials, roasting under optimal condition, powdering to the required mesh size and ultimate mixing of all the powders. The mix has a pleasant flavor and good acceptability. It can be consumed as such and requires no elaborate cooking. It could be mixed with water or milk to make a porridge or paste. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 1 tpd. **Indicative Investment:** Rs.6 lakhs. **Equipment and Machinery:** Elevators, grain grader-cum-cleaner, continuous roaster, grain cooler, destoner, gram roaster, ribbon mixer, soy flour roaster, impact pulveriser, pneumatic conveyer, form-fill-seal machine and storage bins **Raw Materials:**Edible quality groundnut, soybean, wheat, Bengal gram dal and jaggery. **For Further Information, Please Contact:** The Director,Central Food Technological Research Institute.	**CFTRI**
	**1.1.14 READY MIXES FOR SWEETMEATS** **Product/Process:** Production of ready mixes for traditional sweetmeats like Gulab jamun, Jalebi, Cake. **Application/Use:** Convenience foods, ready-to-prepare. **Salient Feature of Process/ Technology:** **Gulab Jamun:** Maida, skim milk powder, sodium bicarbonate, and citric/tartaric acid are thoroughly mixed and melted Vanaspati is added. **Jalebi mix:** Maida, black gram flour, sodium bicarbonate, edible yellow color and citric acid are mixed thoroughly and melted Vanaspati is added and mixed again. **Cake mix:** The premix is obtained by mixing bakery chemicals, flavors and small quantity of Maida. **For chocolate cake:**Mix cocoa powder has to be mixed with the Maida. Starch, sugar and skim	**CFTRI**

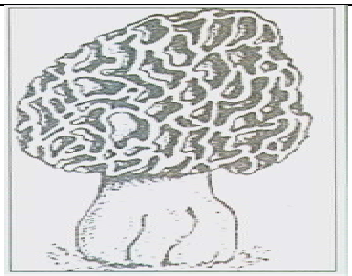
	milk powder are blended. GMS is mixed with starch and glycerol. All these mixes are blended. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 100 kg/day **Indicative Investment:** Rs.6 lakh **Equipment and Machinery:** Blender, sifter, heat-sealing machine, vessels, handling gadgets. **Raw Materials:** As mentioned above for each product. **For Further Information, Please Contact:** The Director,Central Food Technological Research Institute.	
	**1.1.15 READY MIXES FOR SAVOUARIES:** **Product/Process:** Ready mixes for making Vada, Chakli, Pakoda, and Maddur Vada. **Application/Use:** For supply to housewives/shops as convenience food, ready-to-prepare. **Salient Feature of Process/Technology:** Convenience foods provide the housewife novelty, convenience in real sense, reducing the drudgery and satisfaction of preparing at home. **Vada mix:** Black gram flour, Maida, salt, asafoetida, leavening chemicals and Vanaspati are mixed in a blender. The contents are mixed with water, made into dough, shaped and fried. **Chakli mix:** Black gram flour, Maida, cumin seed, sesame seed, salt and Vanaspati are mixed in a blender and packed. **Pakoda mix:** Rice flour, suji, Bengal gram flour, dehydrated onion, chilli, curry leaves, common salt and Vanaspati are rnixed in blender and packed. **Maddur Vada mix:** Processed rice flour, Maida, suji, dehydrated onion, green chiili, salt & Vanaspati are mixed in blender & packed. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 100 kg/day **Indicative Investment:** Rs.6 lakh **Equipment and Machinery:** Lender, sifter, heat-sealing machine, mixing vessels, handling equipment. **Raw Materials:** As mentioned above for each product. **For Further Information, Please Contact:** The Director,Central Food Technological Research Institute.	**CFTRI**

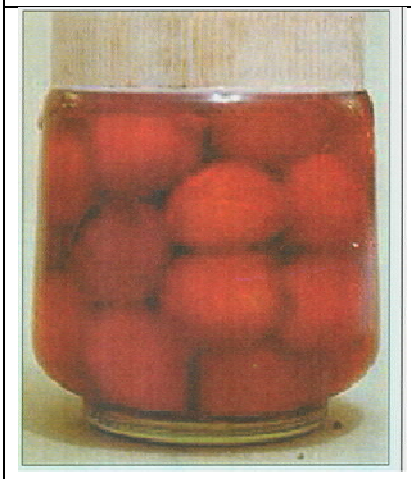
	**1.1.16 READY MIX FOR PAYASAM** **Product/Process:** Process for making ready-mix for payasam. **Application/Use:** For making payasam, a traditional Indian delicacy. **Salient Feature of Process/Technology:** Vermicelli, sugar, skimmed milk powder and fat are mixed in specific proportion and blended to get the premix of desired taste. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 1 tpd **Indicative Investment:** Rs.24 lakhs **Equipment and Machinery:** Roaster, mixer or blender, packing machines. **Raw Materials:** Vermicelli, sugar, skimmed milk powder and fat. **For Further Information, Please Contact:** The Director, Central Food Technological Research Institute.	**CFTRI**
WITHOUT PICTURE	**1.1.17 POPPED GRAINS** **Product/Process:** Popping Machine. **Application/Use:** Production of popped cereals like Maize, Paddy, Rice, and Jowar etc. **Salient Feature of Process/Technology:** The maize of any of the specified grains to be popped is fed in to the inverted U type hood/popping chamber mounted on the combustion chamber through a motorized screw feeder. The maize is fed on to a perforated sieve kept at the intersection between the combustion chamber and the popping chamber at a feed rate ranging between 15-20 Kg/h. The air temperature is maintained 230-300° C. The popped maize is discharged through the outlet chute of the popping machine and collected on a wide circular tray. **Status of Commercialization:** Ready for commercialization. **Indicative Investment:** Rs.50,000/Unit. **Equipment and Machinery:** Continuous hot air popping machine - Design drawing available from CFTRI. **For Further Information, Please Contact:** The Director,Central Food Technological Research Institute.	**CFTRI**

	**1.1.18 FERMENTED & DEHYDRATED READY MIXES FOR DOSA & IDLI BATTER** **Product/Process** **Application/Use:** The product is in the form of a dehydrated ready mix, which are convenience products meant for easy preparation of dosa & idli. The mixes are reconstituted with required amount of water and kept aside for 5 to 10 minutes. The mixed batter is used for the product either dosa or idli. **Salient Feature of Process/Technology:** A ready mix had been developed earlier at this Institute, which contained chemical leavening additives for achieving appropriate taste and texture of finished products. To derive the nutritional advantages of fermentation and avoid/minimize the addition of leavening agents and other chemical additives, a new process has now been developed wherein dehydrated ready mixes have been prepared from the fermented batters (both for dosa & idli) for their easyand quick preparation at home. **Status ofCommercialization:** Commercialized **Minimum Equipment Size**: **Indicative Investment:** **Equipment and Machinery:**Soaking tank, Tray/Truck drier, wet grinder, planetary ribbon blender, Disintegrator, Handling vessels, Packing machines & Miscellaneous etc. **Raw Materials:** Raw rice, Parboiled rice, Black gram dhal etc. **For Further Information, Please Contact**: The Director,Central Food Technological Research Institute.	**CFTRI**
	**1.1.19 RICE FLAKES** **Product/Process:** Process for production of rice flakes. **Application/Use:** In various food products, e.g. ‘Chiwda’ (deep fried product), poha, seasoned mixture, etc. By products: husk (22%), bran (5%) and broken flakes (2%). **Salient Feature of Process/Technology:** Rice flake or ‘Chiwra’ is a traditional food in India. Improvements have been made in the traditional method of making poha, resulting in more yield and less breakage. The unit operations involve cleaning, soaking, roasting, shelling, polishing,	**CFTRI**

	flaking, sieving and drying. The by-products are economically utilized. The husk is utilized as a fuel for heating the soak water and also in grain roaster. The bran is rich in oil (18-25%), stabilized and used for oil extraction. The broken flakes are used in making traditional food items. **Status of Commercialization:** Commercialized **Minimum Equipment Size**: 2 tpd **Indicative Investment:** Rs.19 lakh **Equipment and Machinery:** Roaster, polisher, flaker, grader, drier, soaking tanks, edge runner, fumigation equipment. **Raw Materials**: Paddy. **For Further Information, Please Contact** : The Director Central Food Technological Research Institute.	
	**1.1.20 PROCESS FOR MAKING JOWAR (SORGHUM) FLAKES** **Product/Process:** Process for production of jowar flakes. **Application/Use:** Improved jowar flakes, used similar to rice flakes, e.g. Chewda, spiced mixtures, upmav, pongal and other traditional food preparations. **Salient Feature of Process/Technology:** Jowar is a coarse grain normally difficult to pound and convert into flakes. The improved process of flaking includes selection of matured, sound grains (whitish or yellow), cleaning, soaking, roasting, resting, polishing, flaking, grading, and drying up to 10-11% moisture level. The yield is about 80 kg flakes/ 100 kg of processed jowar. **Status of Commercialization:** Commercialized **Minimum Equipment Size:** 250-300 Kg/hr. **Indicative Investment:** Rs.20,000/- **Equipment and Machinery:**Boiler, soaking tanks, roaster, cone polisher, flaker and dryer. **Raw Materials:**Jowar. **For Further Information, Please Contact**: The Director,Central Food Technological Research Institute.	**CFTRI**
	**1.1.21 VALUE ADDED BUCKWHEAT PRODUCTS:** **Product/Process:** **Varieties/Use:** • More vitamins and minerals. Especially zinc, copper, and manganese. • Healthier fat profile. Monounsaturated fatty	**IHBT**

	acids—the type that makes olive oil so heart-healthful. • Healthier starch and fiber profile. High in "resistant starch," which also enhances colon health, and serves to reduce blood sugar levels. • Reduces blood glucose levels. Due to the presence of rare carbohydrate compounds called fagopyritols (especially D-chiro-inositol), of which buckwheat is by far the richest food source yet discovered. • Contains flavonoids for heart and circulatory health. buckwheat has been traditionally prized as a "blood-building" food. buckwheat's high levels of antioxidant polyphenols—especially rutin (a bioflavonoid), which supports the circulatory system and helps preventing recurrent bleeding caused by weakened blood vessels, as in hemorrhoids and varicose veins. **Suitable Region in India:** **Soil & Climate:** **Propagation**: **Agripractices**: **Yield:** **For Further Information, Please Contact:** The Director,Institute of Himalayan Bioresource Technology.	
	**1.1.22 BULK STORAGE OF CHERRY** **Product/Process:** Process for storage of cherries in brine. **Application/Use:** Year round availability for canning and processing into preserve, candy, maraschino cherry, fruit cocktail. **Salient Feature of Process/Technology:** Cherries are mainly grown in Kashmir and to some extent in Himachal Pradesh. The fruit is highly perishable which cannot be stored beyond 3 days in the ambient. Requirements of processing industry demand its use at leisure time or matching with the harvest season of other fruits. In this process, the freshly harvested cherries are stored in HOPE barrels/tanks containing a chemical brine consisting of Sulphur dioxide, calcium and citric acid. The cherries are taken out when required, washed, dyed and processed into various products. **Status of Commercialization:** Know-how released. **Minimum Economic Unit Size:** 0.5 tpd during season.	**IIIM**

	Indicative Investment: Rs.10 lakh **Equipment and Machinery:** Storage tanks/barrels. **Raw Materials:** Cherry varieties viz. Mishri, Makhmali, Siah and Double galas. **For Further Information, Please Contact:** The Director, Indian Institute of Integrative Medicine, Jammu.	
	**1.1.23 BRINE STORED MOREL** **Product/Process:** Process for bulk preservation of morel mushrooms in brine solution. **Application/Use:** Edible mushroom variety. **Salient Feature of Process/Technology:** Morel (Morcella esculenta) also known as 'Honey combed mushroom' or 'Guchhi' is a highly prized mushroom variety, which is collected from the wild in western Himalayan region. It grows naturally on decaying vegetable matter during May-August. The commodity is perishable and preserved by sun drying in the field while the international market demands fresh morels. Canning is not feasible there due to sporadic small collections. This process facilitates storage of the harvest in wide mouth HDPE barrels along with a brine formulation. The mushrooms can be kept preserved therein for subsequent transport, repacking. **Status of Commercialization:** Know-how released to an export house. **Minimum Economic Unit Size:** Tiny scale. **Equipment and Machinery:** Storage vessels. **Raw Materials:** Morel, chemicals, water. **For Further Information, Please Contact:** The Director,Indian Institute of Integrative Medicine, Jammu.	**IIIM**

	**1.1.24 DRY APRICOTS** **Product/Process:** Process for production of dry apricots. **Application/Use:** As confection. **Salient Feature of Process/Technology:** The fully ripe fruits are harvested and placed overnight in a wooden sulphuring chamber wherein yellow Sulphur is burnt at the rate of 4 g/kg fruit. The fruits absorb sulphur dioxide gas. Sulphured fruits are dried in a solar drier for 5-7 days or in drying yard for 15 days till the moisture content is about 17%. The dry fruits are packed in polythene bags for storage and marketing. **Status of Commercialization:** Process adopted by most of apricot growers in Ladakh. **Minimum Economic Unit Size:** 200 kg/day. **Indicative Investment:** Rs.1.0 lakh **Equipment and Machinery:** Sulphuring chamber, drying yard/solar drier. **Raw Materials:** Fresh apricot fruit, sulphur. **For Further Information, Please Contact:** The Director,Indian Institute of Integrative Medicine, Jammu.	**IIIM**
	**1.1.25 MARASCHINO; CHERRY** **Product/Process:** Process for making canned maraschino cherries is syrup. **Application/Use:** Fruit cocktail, ice creams. **Salient Feature of Process/Technology:** Cherry fruit already stored in chemical brine is thoroughly washed in running water to remove excess Sulphur dioxide. It is subjected to secondary bleaching with chlorite solution to make it brilliant white. The fruit is dyed with erythrosine and color fixed through pH control. Syrup treatment is provided by gradually increasing the sugar concentration to 65° brix while maintaining the pH. The product is canned and sterilized. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 0.2 tpd. **Indicative Investment:** Rs.15 lakh **Equipment and Machinery:**Syruping tanks, steam jacketed kettle, boiler, canning unit.	**IIIM**

	Raw Materials: Brine stored cherry. **For Further Information, Please Contact:** The Director,Indian Institute of Integrative Medicine, Jammu.	
	**1.1.26 APRICOT LEATHER** **Product/Process:** Production of fruit slab from apricot. **Application/Use:** Confection. **Salient Feature of Process/Technology:** Drying varieties (total solids> 18%) e.g. Halman, Nari, Shakarpara, Sufaidi, Khochuli as available in Ladakh are used. Pits are removed by hand and the halves pressed through SS soup strainer to extract pulp and remove large fibres. Sugar and KMS are mixed with the pulp, which is spread in 3 mm thick layer onto aluminium trays, pre smeared with edible oil. The material is sun-dried. Subsequently more layers of pulp are added in similar way till the sheet is 20-25 mm thick. It is cut into slabs and wrapped with flexible film. **Status of Commercialization:** Widely adopted by tiny units in Kargil, Ladakh. **Minimum Economic Unit Size:** 50 kg fruit/day. **Indicative Investment:** Rs.0.50 lakh **Equipment and Machinery:** Aluminium trays, pulp strainer. **Raw Materials:** Apricot, sugar, potassium metabisulphite, smearing oil. **For Further Information, Please Contact:** The Director,Indian Institute of Integrative Medicine, Jammu.	**IIIM**

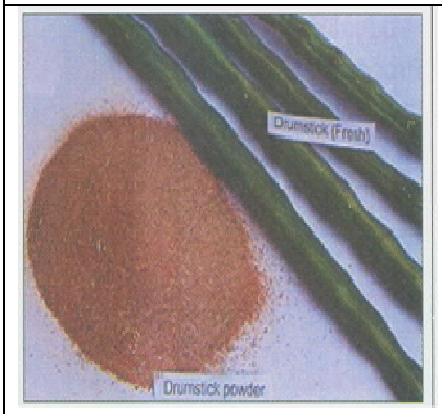
	**1.1.27 UPGRADED TART APPLE JUICE** **Product/Process:** Process for removal of excessive acid from tart apple juice using ion exchange resins. **Application/Use:** Production of palatable apple juice from tart cooking apple varieties. **Salient Feature of Process/Technology:** A major portion of apple production consists of tart varieties e.g. 'Maharaji' in Kashmir, which has >0.7% acidity while other characteristics like sugars, tannins, and aroma are acceptable. The juice quality can be upgraded by bringing down the acidity to an acceptable level of 0.35% without affecting the flavor. The clarified apple juice is treated with a weakly basic anion exchange resin, which selectively removes the malic acid during 10 min/treatment. The resin is regenerated with NaOH solution for reuse. **Status of Commercialization:**Know-how released to a party. **Raw Materials:** Weakly basic anion exchange resin, viz. Amberlite IR-48, sodium hydroxide for regeneration, clarified apple juice. **For Further Information, Please Contact:** The Director, Indian Institute of Integrative Medicine, Jammu.	**IIIM**
	**1.1.28 APPLE CIDER** **Product/Process:** Production of bottled apple cider. **Application/Use:** Fruit based fermented alcoholic beverage (7-8% alcohol). **Salient Feature of Process/Technology:** Tannin-rich tart apple fruit, which is not much valued for table purpose, is utilized. The fruits are washed, crushed and the juice pressed out. Sugar is added to raise the brix to 18°- 20°C. Sulphur dioxide and ammonium hydrogen phosphate is included and the juice is inoculated with yeast culture medium (Saccharomyces cerevisiae), multiplied in steps (1: 20). Alcoholic fermentation proceeds under aseptic conditions at 16-20°C for 20-22 days. The cider is racked, filtered, bottled, sealed and pasteurized at 68°C for 30 min. **Status of Commercialization:** Know-how released to a party. **Minimum Economic Unit Size:** 10 lakh bottles/	**IIIM**

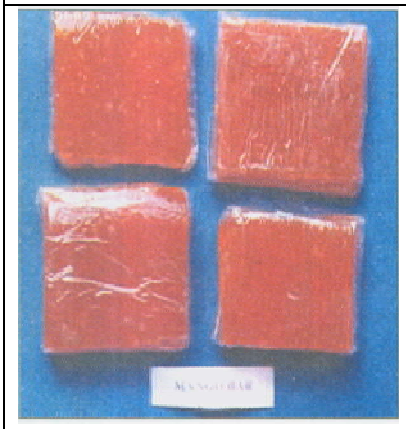
	season. **Indicative Investment:** Rs.25 lakh **Equipment and Machinery:** Fruit mill, juice press, filtration unit, fermentation tanks and bottling unit. **Raw Materials:** Apple, bottles, culture media, chemicals etc. **For Further Information, Please Contact:** The Director Indian Institute of Integrative Medicine, Jammu	
  	**1.1.29 LOW GRAIN ARSENIC RICE VARIETY FOR ARSENIC AFFECTED RURAL AREAS** **Product/Process:** low arsenic rice variety. **Application/Use:** The cultivar has been developed using popular cultivar as parents through conventional breeding method, hence there is no eco-hazard issue. **Salient Feature of Process/Technology:** Having low arsenic content, the variety is safe for human consumption. This is the only variety presently available for arsenic rich areas. **Status of Commercialization:** Seed companies would be interested in procuring the technology /cultivar considering the potential for competition-less market for the product as more and more people would become aware of the arsenic problem. **Minimum Economic Unit Size:** **Indicative investment:** **Equipment:** **Raw Materials:** Plant material, fertilizers, irrigation etc. **For Further Information, Please Contact:** The Director, National Botanical Research Institute.	**NBRI**

1.2FRUITS AND VEGETABLES:

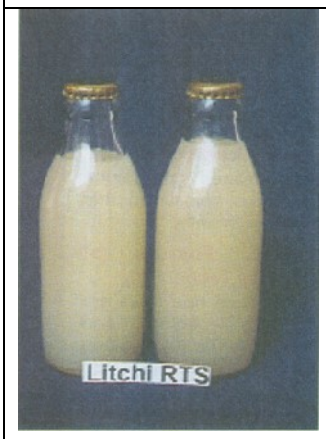
	**1.2.1 MODIFIED ATMOSPHERE PACKAGING OF VEGETABLES** **Product/Process:** Process for packaging of minimally processed vegetables in modified atmosphere. **Application/Use:** Vegetables maintaining freshness & quality are available in ready-to-cook form with shelf life extended by 3-5 folds (10-60 days), reduction in bulk for easy packaging & storage. **Salient Feature of Process/Technology:** The process involves washing, grading, peeling, trimming, slicing, pre-treatment, surface drying, modified atmosphere packaging and storage at optimum temp. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 200 Kg/day **Indicative Investment:** Rs.9lakh. **Equipment and Machinery:** Dicing machine, Walk-in cooler, display cooling cabinets, drier, sealer and balance. **Raw Materials:** Beet root, beans, carrot, cabbage, cauliflower, mint, coriander, fenugreek, spinach, gourds, okra, onion, tomato, turnip. **For Further Information, Please Contact:** The Director,Central Food Technological Research Institute.	**CFTRI**
	**1.2.2 DEHYDRATED FRUITS AND VEGETABLES** **Product/Process:** Dehydration of grapes, banana, onion, potato and peas. **Application/Use:** Year round availability of fruits and vegetables in hygienic condition at reasonable cost. **Salient Feature of Process/Technology:** The process consists of washing, peeling, shelling, slicing, blanching, chemical treatment (for peas), dehydration under controlled conditions and packaging of finished product in suitable containers. **Status of Commercialization:** Commercialized **Minimum Economic Unit Size:** 0.1 tpd. **Indicative Investment:** Rs.6lakh. **Equipment and Machinery:** Slicer, drier, washing, sulphiting and blanching tanks, boiler etc. **Raw Materialss:** Fruits, vegetables, salt,	**CFTRI**

	potassium metabisulphite. **For Further Information, Please Contact:** The Director, Central Food Technological Research Institute	
	**1.2.3 OSMO-AIR DRIED FRUITS** **Product/Process:** A novel process for fruit drying wherein the dry fruit is comparable to fresh fruit in color, flavor and texture. **Application/Use:** As confection, in ice cream, fruit salad, cakes and bakery products. **SalientFeature of Process/Technology:** Fruits like apricots, ber, pineapple, jackfruit, mango etc. are used. The process involves operations like selection of fruits, cleaning, washing, peeling, curing and slicing/ dicing. The prepared fruit slices are steeped in sugar solution to remove about half of water by osmosis. The slices are then drained, dried in a hot air drier and packed in flexible pouches. **Status of Commercialization:** Demonstrated at various fruit production sites including remote areas. **Minimum Economic Unit Size:** 100 kg/day. **Indicative Investment:** Rs.8 lakh **Equipment and Machinery:** Syruping tank, heating vessels, plastic vats, nylon net. **Raw Materials:** Fruits, sugar syrup, citric acid etc. **For Further Information, Please Contact:** The Director, Central Food Technological Research Institute,Indian Institute of Integrative Medicine, Jammu.	**CFTRI IIIM**
	**1.2.4 GRAPE RAISIN** **Product/Process:** Process for manufacture of raisins from grapes. **Application/Use:** Confection, sweetmeats and other culinary preparations. **Salient Feature of Process/Technology:** Fully ripe seedless grapes with high sugar content (about 22° brix) are used. Sound bunches are selected and dipped in boiling light lye solution followed by rinsing in water. The grapes are spread over aluminium trays and exposed to Sulphur dioxide fumes and dried. The dry raisins are then freed from stalks & pedicles and kept for moisture equilibrium. These are packed in	**CFTRI**

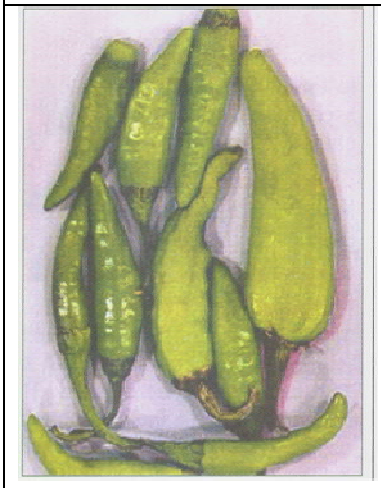
	polyethylene bags, which are further placed in cardboard boxes. **Status of Commercialization:** In commercial production. **Minimum Economic Unit Size:** 0.1 tpd. **Indicative Investment:** Rs.3.5 lakh. **Equipment and Machinery:** Steam jacketed kettle, electric drier, baby boiler, trolleys, aluminium trays and perforated SS baskets. **Raw Materials:** Grapes, lye, Sulphur. **For Further Information, Please Contact:** The Director,Central Food Technological Research Institute.	
	**1.2.5 DRUMSTICK POWDER** **Product/Process:** Process for making dehydrated powder of drumstick (a tropical vegetable popular in south India). **Application/Use:** Used as flavoring agent in various dishes, thickening agent for 'sambar', 'chutney' preparation. It gives a distinct palatable taste and is a rich source of glutamic acid. **Salient Feature of Process/Technology:** Fresh green tender drumstick pods are selected, washed in water, trimmed, scrapped and cut into small pieces. These are blanched in steam and then cooled by spraying tap water. The blanched drumstick pieces are dipped in KMS solution, spread on trays and dried in a cross flow drier. The dried pieces are powdered using a hammer mill. **Status of Commercialization:**Ready for commercialization. **Minimum Economic Unit Size:** 0.1 tpd **Indicative Investment:** Rs.6lakh **Equipment and Machinery:** Pulper/fruit mill, hammer mill, drier, autoclave, steam jacketed kettles, SS vessels and containers, boiler. **Raw Materials:** Drumsticks, potassium metabisulphite. **For Further Information, Please Contact:** The Director,Central Food Technological Research Institute.	**CFTRI**
	1.2.6 JAM, JELLY AND MARMALADE **Product/Process:** Manufacture of fruit based jams, jellies and marmalades. **Application/Use:**	**CFTRI**

	Bread spread for sandwiching and also taken along with chapatti, dosa etc. **Salient Feature of Process/Technology:** Jam is prepared by boiling fruit pulp with sugar to a moderate consistency. Commercially prepared product has 45 parts of fruit pulp for every 55 parts of sugar and contains about 68% soluble solids. Jelly is prepared by boiling clear fruit extract with sugar to a stage at which a clear gel forms. Marmalade is a fruit jelly wherein the fruit slices or peels are suspended. It is generally prepared from oranges and lemons. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 0.1 tpd. **Indicative Investment:** Rs.8 lakh. **Equipment and Machinery:** Pulper, stainless steel kettle, fruit mill, bottle washing machine, bottle drier, plastic bottle jar sealing machine, boiler, washing tank, weighing scale. **Raw Materials:**Fruits, sugar, pectin, citric acid, color and flavor. **For Further Information, Please Contact:** The Director, Central Food Technological Research Institute.	
	**1.2.7 FRUIT BAR** **Product/Process:** Process to manufacture fruit bar, a concentrated fruit product. **Application/Use:** Ready-to-eat fruit based confection, refreshing and nutritious. **Salient Feature of Process/Technology:** The fruit pulp is mixed with sugar. The blend is dried in thin layers in trays. The leathery product is cut into suitable size and packed like chocolates/sweets. **Status of Commercialization:**Commercialized. **Minimum Economic Unit Size:** 50 kg/day. **Indicative Investment:** Rs.3 lakh **Equipment and Machinery:** Pulper, SS kettle/boiling vessel, tray drier, balances, handling vessels, etc. **Raw Materials:**Pulpy fruits, e.g. mango, guava, pineapple, papaya, banana, jackfruit, apple etc. single or in combination. **For Further Information, Please Contact:** The Director, Central Food Technological Research Institute.	**CFTRI**

	**1.2.8 GINGER PRESERVE AND CANDY** **Product/Process:** Process to manufacture ginger preserve (with syrup) and candy (syrup free). **Application/Use:** Confection, appetizer, a mouth freshener and as a health food; also used for top dressing and decoration of cake, puddings and as ingredient in fruit cocktails and salads. **Salient Feature of Process/Technology:** The products are prepared from fresh ginger. The process involves cleaning, peeling and dicing of ginger and steeping/curing in sugar syrup of increasing concentrations up to 70° brix to get ginger preserve. The process is further followed by draining off the syrup, coating the cubes with powdered sugar and drying under controlled conditions. The product is suitably packed in pouches or tins. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 0.2 tpd. **Indicative Investment:** Rs.12 lakh. **Equipment and Machinery:** Cooking and storing vessels, drier (optional), SS knives, batteries of challahs, drying trays, etc. **Raw Materials:** Fresh ginger rhizomes. **For Further Information, Please Contact:** The Director, Central Food Technological Research Institute.	**CFTRI**
	**1.2.9 FRUIT SQUASH AND SYRUP** **Product/Process:** Process for manufacture of fruit squash, crush, cordial,syrup from orange, mango, lime, pineapple, grape and ginger-amla. **Application/Use:** Fruit based refreshingbeverages, consumed after dilution with water. **Salient Feature of Process/Technology:** Fully sound ripe fruits are washed, peeled and destoned. The juice/pulp is extracted and is mixed with sugar syrup, citric acid, preservatives, color and flavor. The product is bottled. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 250 bottles/day **Indicative Investment:** Rs.3.75 lakh **Equipment and Machinery:** Fruit pulpier/crusher/extractor, 88 vessels, bottle	**CFTRI**

	washing machine, cap sealing machine, handling vessels. **Raw Materials:** Fruits, flavor, color, sugar, bottles and labels. **For Further Information, Please Contact:** The Director, Central Food Technological Research Institute.	
	**1.2.10 READY-TO-SERVE FRUIT BEVERAGE** **Product/Process:** Process for preparation of Ready to serve (RTS), pasteurized and bottled fruit based beverages. **Application/Use:** Soft drink, to serve chilled. **Salient Feature of Process/Technology:** The fruit pulp/juice from mango, orange, grape, lime, banana or passion fruit along with sugar syrup, citric acid, preservatives, color, flavor, etc., are blended according to specifications, homogenized, bottled and pasteurized. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 100bottles/day. **Indicative Investment:** Rs.4.00 lakh **Equipment and Machinery:** Pulper, SS heating vessels, mixing tanks, bottle washing, crown corking machine, pasteurizing tank. **Raw Materials:** Fruit pulp/juice, sugar, citric acid, preservatives, permitted color and flavors. **For Further Information, Please Contact:** The Director,Central Food Technological Research Institute.	**CFTRI**
	**1.2.11 SUGARCANE BEVERAGE** **Product/Process:** Manufacture of bottled, pasteurized sugarcane juice. **Application/Use:** Ready-to-serve beverage. **Salient Feature of Process/Technology:** Fresh, sound and mature sugarcane is used for juice extraction through crushing. The juice is clarified and filtered. Permitted additives are added. The juice is packed in 200 ml glass bottles, crown corked and pasteurized. **Status of Commercialization:** Commercialized **Minimum Economic Unit Size:** 3000 bottles/ day **Indicative Investment:** Rs.7 lakh **Equipment and Machinery:** Plate and frame	**CFTRI**

	filter press, boiler, cylindrical tanks, bottle washing machine, filling machine, crown corking machine, cane crusher, pasteurization tanks. **Raw Materials:** Sugarcane. **For Further Information, Please Contact:** The Director,Central Food Technological Research Institute.	
	**1.2.12 PICKLE AND CHUTNEY** **Product/Process:** Production of pickles and chutneys from fruits (lime/lemon, green mango, green papaya, tender jackfruit etc.) and vegetables (green chilli, cucumber, cabbage, cauliflower, turnip, carrot, bitter gourd etc.). **Application/Use:** As food adjunct. **Salient Feature of Process/Technology:** Pickles are salt fermented products, which combine salting to selectively control the microorganisms and fermentation to stabilize the treated tissues. The pickle includes a wide variety including oil pickles, brine pickle, vinegar pickle, sweet pickle etc. The chutney is a product prepared by boiling the fruit in sugar with spices, salt and vinegar. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 0.1 tpd **Indicative Investment:** Rs.3.5. lakh **Equipment and Machinery:** Peeler, slicer, steam jacketed kettle, boiler. **Raw Materials:**Fresh fruits and vegetables, oil, vinegar, sugar, salt, spices. **For Further Information, Please Contact:** The Director, Central Food Technological Research Institute.	**CFTRI**
	**1.2.13 INSTANT PICKLE** **Product/Process:** Process to manufacture instant pickles, which can be reconstituted with simple addition of water and oil. **Application/Use:** Food adjunct. **Salient Feature of Process/Technology:** Packaging of traditional pickles involve a high cost due to presence of liquids like brine, oil or vinegar. A new concept has been worked out to make instant dry pickles packed in polythene bags along with spices. Fully matured fresh raw mangoes/ limes are washed and cut into uniform	**CFTRI**

	size, salt- cured and dried. Ground spices are added along with cured dry fruit pieces and packed in polythene bags. For reconstitution the mix is soaked overnight in specified quantity of water to get the pickle ready for use. Oil can be added to taste. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 0.5 tpd **Indicative Investment:** Rs.6 lakh **Equipment and Machinery:** Electric dryer, spice grinder, weighing machine, heat-sealing machine, frying pan, containers, knives. **Raw Materials:** Raw mango, fresh lime, salt, spices, oil, polythene bags, cardboard packing boxes. **For Further Information, Please Contact:** The Director, Central Food Technological Research Institute.	
	**1.2.14 CHILLI SAUCE** **Product/Process:** Production of chilli sauce. **Application/Use:** As food adjunct for use with bread spread, samosa, noodles, gobi manchuri etc. **Salient Feature of Process/Technology:** Fresh green chillies are blanched and mixed with coarse pulp of potato, peeled onion, garlic and ginger. The mixture is passed through a fruit mill and then through a fryma mill along with water to get a fine mass. The whole mass is cooked to 14° brix. Salt, citric acid and sodium benzoate are added in required quantities and mixed thoroughly to get a brix of 25°. The hot product is filled in airtight bottles. **Status of Commercialization:**Commercialized. **Minimum Economic Unit Size:** 0.2 tpd. **Indicative Investment:** Rs.6lakh. **Equipment and Machinery:** Fruit mill, homogenizer, steam jacketed kettles, SS vessels and containers, boiler, crown corking machine. **Raw Materials**: Green chilli, potato, onion, garlic, ginger, spices, acetic acid, sodium benzoate, salt, sugar. **For Further Information, Please Contact:** The Director Central, Food Technological Research Institute.	**CFTRI**
	1.2.15 TOMATO PRODUCTS **Product/Process:** Process for production to tomato products:	**CFTRI**

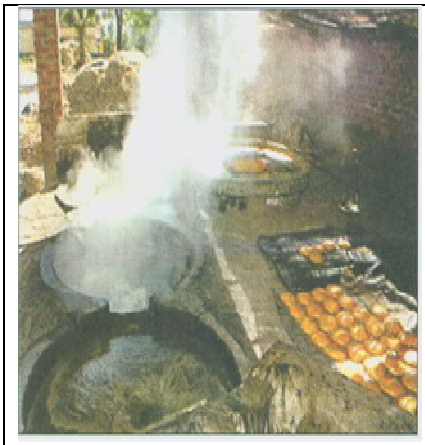
	juice, puree, ketchup, chutney, sauces. **Application/Use:** Ready-to-eat products used as food adjunct. **Salient Feature of Process/Technology:** The process consists of crushing the tomatoes, deseeding and extraction of juice, mixing with sugar, salt and spices and heating. The juice is bottled/canned. The ketchup manufacture involves concentration of juice, addition of spice extract, salt, sugar and then boiling to attain 28-30% brix, addition of vinegar and preservatives. It is then bottled. Tomato chutney preparation consists of crushing of tomatoes, addition of sugar, spice extractives and boiling; vinegar and preservatives are added and bottled. **Status of Commercialization:** Commercialized **Minimum Economic Unit Size:** 250 kg/day **Indicative Investment:** Rs.10 lakh **Equipment and Machinery:** Tomato pulper, SS vessels/kettles, bottle washing machine, crown corking machine, boiler, etc., **Raw Materials:**Tomatoes, spices and condiments. **For Further Information, Please Contact:** The Director, Central Food Technological Research Institute.	
	1.2.16 POTATO PRODUCTS **Product/Process:** Manufacture of potato products: flour, chips and wafers. **Application/Use:** For making tikki, chops, pakora, stuffed parantha, sewain, kofta etc.; deep fat fried chips/wafers. **Salient Feature of Process/Technology:** **Potato flour:**Washed potatoes are peeled, diced and soaked overnight in a solution of salt and KMS. Diced potatoes are granulated, pressed and dried. The dry granules are ground to get the flour. **Potato chips/wafers:** Washed potatoes are peeled, sliced and blanched in water and KMS. The slices are deep fat fried and suitably spiced. **Status of Commercialization:** Commercialized **Minimum Economic Unit Size:** 200-250 kg/day **Equipment and Machinery:**Abrasion peeler, mechanical cabinet dryer, slicer, mincer or grater, hydraulic press, blanching tank, frying unit. **Raw Materials**: Potato, preservatives and packaging materials.	**CFTRI**

	For Further Information, Please Contact: The Director, Central Food Technological Research Institute.	
	**1.2.17 VINEGAR** **Product/Process:** Manufacture of natural or brewed vinegar from fruits, molasses etc. **Application/Use:** Pickles, sauces, various dishes and in all types of Chinese food preparations. **Salient Feature of Process/Technology:** Vinegar can be made from fruits e.g. pineapple, grape, orange, banana, apple, peach, apricot as well as from sugarcane juice, coconut water, malt, molasses. The juice/aqueous extract is fermented with Saccharomyces cerevisiae yeast after adjusting the brix. The fermented alcoholic liquor is passed through vinegar generator for acetic acid fermentation using acetobactor culture. It takes nearly 15 days for completion of process. Vinegar contains about 4% acetic acid. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:**100U/day, working 100 day/annum. **Indicative Investment:** Rs.3.5 lakh. **Equipment and Machinery:** Vinegar generator, wooden barrels, sterilization tank. **Raw Materials**: Fruits / malt / molasses / sugarcane / coconut water, yeast culture, mother vinegar and chemicals. **For Further Information, Please Contact:** The Director, Central Food Technological Research Institute.	**CFTRI**

	**1.2.18 GARLIC PASTE** **Product/Process:** **Application/Use:** Garlic paste is mainly used as a spice in culinary preparations for imparting a characteristic fresh garlic flavor. It is a ready to use preparation that can be used in place of fresh garlic cloves inhomes, restaurants and institutional catering. **Salient Feature of Process/Technology:** Garlic paste is a viscous product retaining the strong aroma and flavor of the raw material namely fresh garlic. The product is generally creamy- white or off white in color the product is microbiologically stable and free from pathogenic bacteria. Product can be packed in glass jar can be stored under ambient temperature. The product is microbiologically is stable. **Status of Commercialization:** Commercialized **Minimum Equipment Size:** 100 Kg/day **Indicative Investment:**Equipment and Machinery Fruit washing machine, Hammer mill, Colloidal mill, Sigma mixer, Steam jacketed kettle and Paste filling unit. **Raw Materials**: Garlic Bulb. **For Further Information, Please Contact:** The Director, Central Food Technological Research Institute.	**CFTRI**
	**1.2.19 Ginger Paste** **Product/Process:** **Application/Use:** Ginger paste is mainly used as a spice in culinary preparations for imparting acharacteristic fresh ginger flavor. **Salient Feature of Process/Technology:** Fresh Ginger is converted into a paste and heat processed after adjusting the acidity and addition of preservative. Heat processed paste is packed into sterile glass bottles in hot condition. The product is generally creamy- white or off white in color the product is microbiologically stable and free from pathogenic bacteria. Ginger paste can find application in place of fresh ginger or ginger powder in culinary preparations. Preparation of ginger paste can be carried out at cottage scale. **Status ofCommercialization:** Commercialized. **Minimum Equipment Size**: 100 Kg/day **Indicative Investment:**Equipment and Machinery Fruit washing machine, Hammer mill, Colloidal mill, Sigma mixer, Steam jacketed	**CFTRI**

	kettle, Peeler, Soaking tanks and Paste filling unit. **Raw Materials**: Ginger rhizome. **For Further Information, Please Contact**: The Director, Central Food Technological Research Institute.	
 o	**1.2.20 READY TO SERVE (RTS) FRUIT JUICE & BEVERAGES** **Product/Process:** Process for preparation of Ready_to_serve (RTS), pasteurized and bottled fruit based beverages. **Application/Use:** Manufacture of RTS fruit beverages based on fruit juices/pulps are nutritious. **Salient Feature of Process/Technology:** Almost all varieties of the pulpy fruits can be used for the extraction of their pulp or juice. The preserved fruit pulps, sugar syrup, citric acid, preservatives, color, flavor, etc. are blended according to the formulation, homogenized and bottled. The bottles are then processed in retorts and cooled carefully. After inspection they are marketed. **Status of Commercialization:** Commercialized **Minimum Equipment Size:** 200Kg/day **Indicative Investment:** Rs.2 lakh **Equipment and Machinery:** Pulper (optional), homogenizer, SS steam jacketed kettle mixing tanks, bottle filling machine, bottle washing (brushing) unit, crown corking machine, retorts, hoist, etc. **Raw Materials**: Fruit pulp/juice, sugar, citric acid, preservatives and permitted colors, flavors and other additives. The fruits are Mango, Guava, Oranges, Pineapple, Grapes, Papaya, Acid limes, Litchi, Apples, Pomegranate. **For Further Information, Please Contact**: The Director, Central Food Technological Research Institute.	**CFTRI**
	**1.2.21 VALUE ADDED CRISPY FRUITS** **Product/Process:** **Varieties/Use:** Crispy Fruits retains near to original texture, taste, aroma and color in addition of having long shelf stability. Keeps the fruit nutritionally same as of a fresh fruit. No added preservative. Refrigeration is not needed for storing. Excellent reconstitution capacity.	**IHBT**

	Suitable Region in India: **Soil & Climate:** **Propagation:** **Agripractices:** **Yield:** Crispy fruits serve as healthy snacks and good substitute of unhealthy snacks like fried potato chips. It can be used as convenience foods, as ingredient for fruit drinks, ice creams, thick shakes, yogurt, desserts, making instant juice mixes, flavoring baby / infant foods, preparing food premixes, and range of bakery products etc. **For Further Information, Please Contact:** The Director,Institute of Himalayan Bioresource Technology.	
	1.2.22 POMEGRANATE ARIL EXTRACTOR **Product/Process:** Machine for separation of arils from pomegranate fruit. **Application/Use:** For making pomegranate juice, anardana. **Salient Feature of Process/Technology:** The machine is made of SS wire basket containing vanes mounted at 45o angle to the shaft axis. The centrifugal basket moves at a speed of 400 rpm. It operates on ¼ HP motor. For separation of arils, mature pomegranate fruits are halved manually and fed into the hopper of the machine. The seeds are extracted from the fruit and separated from the rind mechanically as a result of centrifugal action. **Status of Commercialization:**Know-how available for commercialization. **Minimum Economic Unit Size:** 60 kg fresh fruit/ha. **Indicative Investment:** Rs.6,000 lakhs **Equipment and Machinery:** Pomegranate aril extractor (design available from CSIR). **Raw Materials:** Fresh pomegranate fruits. **For Further Information, Please Contact:** The Director,Indian Institute of Integrative Medicine, Jammu, Central Food Technological Research Institute, Central Institute of Medicinal &Aromatic Plants.	**IIIM**

	**1.2.23 IMPROVED JAGGERY PRODUCTION** **Product/Process:** Improved design of furnace, chimney and fuel charging system for jiggery plant. **Application/Use:** Modifications to be carried out in existing jaggery making plant. **Salient Feature of Process/Technology:** Jaggery is made in the villages by concentration of sugarcane juice in open pans using underground furnace and bagasse fuel. The exhaust gases are released through a vertical chimney. The improved design of furnace and chimney as well as the charging systems result in 23% increase in productivity, 12% savings in fuel and improved quality of jaggery having a light brown color. Due to efficient fuel combustion, the smoke in the flue gases is significantly reduced thereby mitigating environmental pollution. The plant life is also enhanced. **Status of Commercialization:** Installed at one demonstration unit. **Equipment and Machinery:** Civil construction as per modified design. **For Further Information, Please Contact:** The Director, Indian Institute of Petroleum.	**IIP**
Without photo	**1.2.24 NEERA** **Product/Process:** Process to manufacture Neera- A Traditional Drink from Palmyra. **Application/Use:** Improvement of quality and storage stability of Neera using a membrane based process. **Salient Feature of Process/Technology:** Fresh Neera is traditionally consumed in several coastal states of India. It has a large microbial population (Bacteria and yeast), due to which it starts fermenting within an hour of its collection. The fermented product, known as Toddy (tadi) is a pungent sour smelling liquid containing,5.0% alcohol. The keeping quality of Neera is very poor and unless stored under chilled conditions it deteriorates within 5-8 hours after collection. By passing the Neera through a membrane filter, it is possible to remove the microbial contaminants in Neera, thereby dramatically increasing its shelf life and stability. Moreover, this process does not	**NCL**

	adversely affect the taste and nutrient profile of fresh Neera. **Status of Commercialization:** Ready for Commercialization. **Minimum Economic Unit Size:** 300-2000 liters/day. **Equipment and Machinery:** Membrane Unit consisting of membrane, Profiler, SS pump, Rotameter, Pressure gauges, fittings, SS Tank, Steam Boiler, Diesel Gen Set, Neera filling machine, Laboratory equipment, Cold storage refrigerator. **For Further Information, Please Contact:** The Director, National Chemical Laboratory.	
	1.2.25 SEEDLING SEX DETERMINATION IN PAPAYA **Product/Process:** This is a simple PCR based test for early sex determination in Papaya using DNA marker. **Application/Use:** Papaya is mostly a dioecious plant with male: female ratio 1: 1. The female fruit bearing plants can be identified at one-month stage much before flowering using the DNA marker. The fields can be organized to maintain maximum 5% of male plants for pollination. **Salient Feature of Process/Technology:** The test can be performed in the laboratory within a day. Accuracy of the test is more than 98%. **Status of Commercialization:** Ready for commercialization. **Minimum Economic Unit Size:** Minimum 94 samples. **Equipment and Machinery:**Basic molecular biology related equipment. **Raw Materials:** Tender leaf, SSD and sex neutral primers and other DNA/PCR related chemicals. **For Further Information, Please Contact:** The Director, National Chemical Laboratory.	**NCL**
	**1.2.26 FRESH GINGER PROCESSING TECHNOLOGY** **Product/Process:** Process for fresh ginger oil & ginger powder. **Application/Use:** Value added products of the fresh ginger. **Salient Feature of Process/Technology:** Yield of ginger oil is 30% more than the conventional process. **Status of Commercialization:** Commercialized	**NIIST**

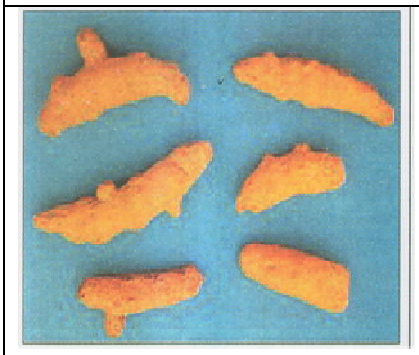
	Minimum Economic Unit Size: 5/10 ton per day. **Indicative Investment:** Rs.100/155 lakh per annum. **For Further Information, Please Contact:** The Director, National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram.	

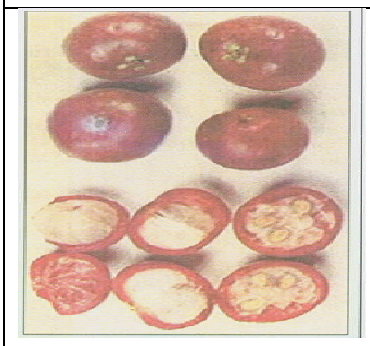
1.3 SPICES AND CONDIMENTS:

	**1.3.1 MUSTARD POWDER** **Product/Process:** Production of dehusked mustard seed powder. **Application/Use**: Table mustard for seasoning and pungency in foods, as condiment in pickles, meat and salad dressings. **Salient Feature of Process/Technology:** The process involves grading, conditioning, drying, splitting and dehusking. The mixture of husk and the cotyledons are screened and classified to individual fractions. These are ground to the desired fineness using triple roller mill and packed. The final clean product is of good quality and meets standard specifications. The facilities can also be used for production of spice powders. **Status of Commercialization:** Ready for commercialization. **Minimum Economic Unit Size:** 0.5 tpd. **Indicative Investment:** Rs.91akh **Equipment and Machinery:** Triple roller mill, grader, classifier, boiler, steam jacketed kettle. **Raw Materials:** Mustard seeds. **For Further Information, Please Contact:** The Director, Central Food Technological Research Institute.	**CFTRI**
	**1.3.2 GARLIC POWDER** **Product/Process:** Manufacture of dehydrated garlic powder. **Application/Use:** Garlic is used as a condiment and for flavoring mayonnaise, tomato ketchup/sauce, meat sausages, chutneys, pickles etc. It aids digestion and absorption of food. **Salient Feature of Process/Technology:** The process involves scrubbing of the bulbs manually under mild pressure to remove the papery skin. The bulbs are conditioned and dried. The dehydrated bulbs are powdered to desired mesh size and packed in airtight containers. The dried bulbs can also be made into flakes. **Status of Commercialization:**commercialized. **Minimum Economic Unit Size:** 0.2 tpd. **Indicative Investment:** Rs.20 lakhs. **Equipment and Machinery:** Pre-conditioning equipment, drier, husk remover, air classifier, powdering unit, flaker, packaging unit. **Raw Materials:**Garlic bulbs.	**CFTRI**

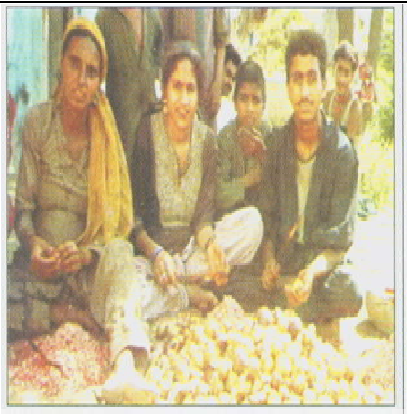
	For Further Information, Please Contact: The Director, Central Food Technological Research Institute.	
	**1.3.3 GINGER POWDER** **Product/Process:** Manufacture of ginger powder. **Application/Use:** As food flavoring agent and in pharmaceutical preparations. **Salient Feature of Process/Technology:** Fresh ginger is cleaned with water to remove the adhering soil and dirt. It is sliced and dried under controlled conditions. The resultant product is the sliced dry ginger. The dry ginger is passed through a pulverize and ground to 40 mesh size to obtain ginger powder. The powdered ginger is fumigated if necessary and packed in suitable flexible pouches. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 200 Kg/day Indicative **Investment:** Rs.5lakh. **Equipment and Machinery:** Slicer, drier, pulverizer **Raw Materials:**Fresh ginger rhizomes. **For Further Information, Please Contact:** The Director, Central Food Technological Research Institute.	**CFTRI**
	**1.3.4 BLEACHED DRY GINGER** **Product/Process:** Production of bleached/limed dry ginger. **Application/Use:** Used as spice in traditional dishes. **Salient Feature of Process/Technology:** Fresh ginger is cleaned thoroughly to remove the adhering soil and dirt. The outer skin is scrapped off using SS knives or sharp-edged bamboo device. It is washed, partially sun-dried and then soaked in limewater overnight and dried in the sun. The process of dipping and drying is repeated two or three times and finally dried to a moisture level of 10-12% and packed in polythene-lined gunny bags. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 50 kg/day **Indicative Investment:** Rs.2 lakh **Equipment and Machinery:** No major equipment **Raw Materials:** Fresh green ginger, lime. **For Further Information, Please Contact:** The Director, Central Food Technological	**CFTRI**

	Research Institute.	
	**1.3.5 DRYING OF RED CHILLI** **Product/Process:** Process for quick drying of red chillies. **Application/Use:** As spice. **Salient Feature of Process/Technology:** Conventionally, mature chillies are harvested from plants and dried in the open yards for 15 to 20 days. This method is time consuming, unhygienic and gives low yield owing to loss of seeds through breakage. The process involves dipping the red chillies in a specially prepared "Dipsol" solution followed by sun drying. Dipsol is a water-based emulsion containing potassium carbonate, refined groundnut oil, gum acacia and butylated hydroxyanisole. The technique ensures a consistent end product. The time taken for drying is 1 week. It requires less drying space and retains the natural color and pungency resulting in higher returns. A solar drier has also been developed which effects drying of chillies in 5 days. **Status of Commercialization:** Commercialized. **Equipment and Machinery:** Drying yard. **Raw Materials:** Dispol solution available from CSIR licensee. **For Further Information, Please Contact:** The Director,Central Food Technological Research Institute.	**CFTRI**
	**1.3.6 PEPPER PRDOUCTS** **Product/Process:** Process for manufacture of value added products from black pepper. **Application/Use:** For flavoring culinary preparations. **Salient Feature of Process/Technology:** Dehydrated green pepper: It retains natural shape and green color through controlled processing; Dry packed green pepper: 4-5 months old green pepper cleaned with water, cured and packed; White pepper: The mature green berries are bleached, dried, ground and packed; Premium quality black pepper: Mature berries are blanched and dried; the berries having uniform glossy black color; Pepper oleoresin: The spice extract is prepared by solvent extraction of ground pepper; Encapsulated pepper flavor: The flavor is released instantly on contact with	**CFTRI**

	water. **Minimum Economic Unit Size:** 0.5 tpd. **Indicative Investment:** Rs.7lakh. **Equipment and Machinery:** Drier, solvent extraction system, packaging equipment. **Raw Materials:** Pepper, carriers, chemicals, solvent, etc. **For Further Information, Please Contact:** The Director, Central Food Technological Research Institute.	
	**1.3.7 TURMERIC: CURING AND POLISHING** **Product/Process:** Process for curing and polishing of turmeric. **Application/Use:** Used as spice and food colorant. **Salient Feature of Process/Technology:** Fully mature rhizomes are harvested and cleaned. The finger and bulbs are separated manually and processed separately. The fingers are dipped in boiling water for 40-60 min. and spread out in the sun for drying. The drying time in good sunshine is 12-15 days. The. dried fingers are polished using a polisher. The yield of dry polished turmeric is 18- 20% on fresh rhizome basis. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 50 kg/day **Indicative Investment:** Rs.2 lakh **Equipment and Machinery:** Boiling vessels, drying yard, polisher. **Raw Materials:** Fresh turmeric rhizomes. **For Further Information, Please Contact:** The Director, Central Food Technological Research Institute.	**CFTRI**
	**1.3.8 TAMARIND POWDER** **Product/Process**: Manufacture of tamarind powder: free flowing. **Application/Use:** Condiment/adjunct used as souring agent in various food preparations. **Salient Feature of Process/Technology:** Tamarind pulp is cleaned manually, de- seeded and fibers removed. The pulp is processed under standardized conditions of temperature, humidity and mill- settings to get a hygienic product in powder form. The final product has good reconstitution characteristics and is packed in HOPEpouches for marketing.	**CFTRI**

	Status of commercialization: Commercialized. **Minimum economic unit size**: 0.5 tpd tamarind. **Indicative investment**: Rs.10 lakh **Equipment and Machinery:** Drier, disintegrator, mixer, packaging unit. **Raw Materials:** Tamarind. **For Further Information, Please Contact:** The Director, Central Food Technological Research Institute.	
	**1.3.9 KOKUM POWDER** **Product/process:** Process for making kokum juice powder. **Application/Use:** As food acidulate in various dishes. **Salient feature of process/technology:** Dry kokum is cleaned to remove seeds and extraneous matter. It is cut into bits, loaded in percolators and extracted with water to obtain kokum concentrate. The concentrate is mixed with a suitable carrier and dried under controlled condition to obtain kokum powder. **Status of commercialization**: Commercialized **Minimum economic unit size:** 50 kg dry kokum/ day. **Indicative investment:** Rs.3 lakh **Equipment and machinery**: percolators, disintegrator, drier, gas-oven facility. **Raw materials:** Dry kokum. **For further information, please contract:** The Director,Central Food Technological Research Institute.	**CFTRI**
	**1.3.10 SPICE POWDERS** **Product/ process:** Process for making ready spice/curry powders for sambar ransom and pulao. **Application/use:** In various food and gravy preparations and also as flavoring agents. **Salient Feature of Process/Technology:** The dried clean spices are powdered to 40-50 mesh size. The powder is cooled toroom temperature and sifted. The spice powder is placed in airtight container and fumigated. The powder is packed in flexible pouches for marketing. For curry powder preparation, the cleaned dry spices are given a mild roasting (optional step), mixed as per recipe and ground to 40-50 mesh, cooled to room temp., sifted, fumigated and packed.	**CFTRI**

	Status of commercialization: Commercialized. **Minimum economic unit size:** 150 kg/ day **Indicative investment:** Rs.5 lakh **Equipment and machinery:** Roaster, hand-shifter, storage bins, balance, heat sealer **Raw materials:** Dry spices of good quality **For further information, please contact:** The Director,Central Food Technological Research Institute.	
	**1.3.11 INSTANT GRAVY MIXES** **Product/Process:** Manufacture of processed dehydrated multipurpose gravy mixes: 11 different formulations. **Application/Use:** For preparation of products like chicken in gravy, chicken masala, mutton gravy, vegetable korma, vegetable curry or gravy base for any kind of preparation within short period of time. They impart convenience, delicacy in taste and save time by 1-2 hr. **Salient Feature of Process/Technology:** These are made available in different flavors with minor modifications in processing. Product can be stored at ambient temperature up to 6 months in metallized polyester pouches. It does not contain any added chemical, color or preservative. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 50 kg/day **Indicative Investment:** Rs.4.5 lakh **Equipment and Machinery:** Grinder-cum-mixer or bowl chopper, cross flow drier, steam jacketed kettle, grinding mill, planetary mixer, heat sealer. **Raw Materials:** Oil and spices. **For Further Information, Please Contact:** The Director, Central Food Technological Research Institute.	**CFTRI**

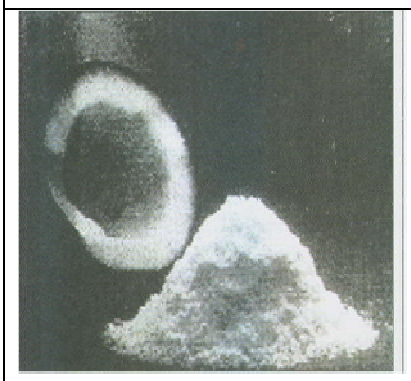
	**1.3.12 NATURAL FOOD COLOURS AND DYES** **Product/Process:** Process for manufacture of edible natural dyes. **Application/Use:** The dyes used are safe and eco-friendly food and beverage colorants. **Salient Feature of Process/Technology:** Economical extraction and isolation of colorants & dyes from Carthamus tinctorus (yellow &dark red to reddish brown), Butea monosperma (yellow), Tagetes erecta (red to reddish brown), Beta vulgaris (red), Daucus carota (dark red), Capsicum annum (green and red), Bixa orellana (yellow), Curcuma longa (yellow). **Status of Commercialization:** The process for a few dyes has been licensed. **Minimum Economic Unit Size:** 50 kg - 100 kg dye/yr. **For Further Information, Please Contact:** The Director,Indian Institute of Integrative Medicine, Jammu, Central Food Technological Research Institute, Central Institute of Medicinal &Aromatic Plants.	**CFTRI**
	**1.3.13 ANARDANA** **Product/Process:** Production of 'Anardana' (dried arils from tart wild pomegranate). **Application/Use:** Food acidulent, digestive candies, traditional system of medicine. **Salient Feature of Process/Technology:** The dry seeds of wild pomegranate yield Anardana of commerce. Nearly 1000 units of anardana is produced annually in India valued at Rs. 150 crores. The traditional method consists of manual extraction of arils followed by sun drying, which is unhygienic. The improved processing technique consists of pre-cleaning, mechanized extraction of arils, solar/sun drying and packaging. **Status of commercialization:**Widely demonstrated under field **Minimum economic unit size:** 100 kg anardana/ day. **Indicative investment:** Rs.0.2 lakh **Equipment and Machinery:** Aril extractor as per CSIR design, solar drier. **Raw materials:** `Daruni' (wild, tart pomegranate fruit).	**IIIM**

	For further information, please contact: Director,Indian Institute of Integrative Medicine, Jammu.	
	**1.3.14 SAFFRON PROCESSING** **Product/Process:** Cottage scale post-harvest processing of saffron: mechanized systems for harvest, stigma separation, drying. **Application/Use:** Food flavoring, traditional system of medicine, religious ceremonies. **Salient Feature of Process/Technology:** The saffron flowers are harvested using a mechanical device. The cut flowers are passed through an air classifier to separate Lachha, stamen and the petals. The stigma component of the Lachha is the actual saffron, which is, separated from the style mechanically (cap. 5 kg/hr.) and dried, in a solar drier to a final moisture content of 8%. The dry material is packaged in consumer packs. **Status of Commercialization:** Demonstrated at various field operation levels. **Minimum Economic Unit Size:** 50 kg/day **Indicative Investment:** Rs.0.25 lakh **Equipment and Machinery:**Flower harvester, air classifier, mechanized separator for stigma and style (as per CSIR designs). **Raw Materials:** Saffron flowers. **For Further Information, Please Contact:** The Director,Indian Institute of Integrative Medicine, Jammu.	**IIIM**
 	**1.3.15 TURMERIC CULTIVATION AND VALUE ADDITION TECHNOLOGIES** **Product/Process:** Turmeric variety KESARI. **Application/Use:** Leaves for essential oil extraction and Rhizomes for turmeric powder. **Salient Feature of Process/Technology:** NBRI released variety Kesari is suitable for partially reclaimed sodic soil, known for good rhizome yield and curcuminoid contents. Beside this, essential oil is also extracted from the senescence leave of the variety. It yields 0.6-0.8% essential oil. Major components of leaf essential oil are 34.0% α-phellandrene, 17.3% p-cymene and 17.26% Terpinolene. It yields 30-35	**NBRI**

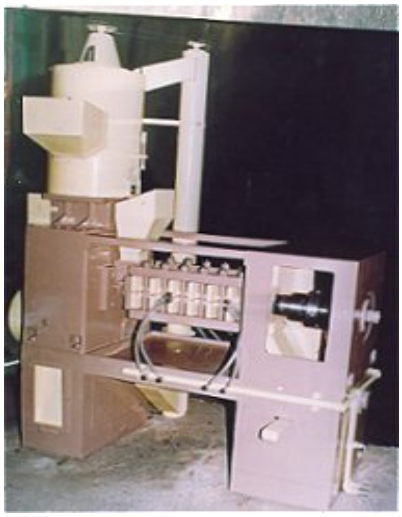
	ton fresh rhizomes per hectare. **Status of Commercialization:** Being commercialized in Aroma mission. **Minimum Economic Unit Size:** Based on agricultural practices. **Indicative investment:** Based on agricultural practices. **Equipment:** Hydro-distillation unit. **Raw Materials:** Turmeric leaves and rhizomes. **For Further Information, Please Contact:** The Director, National Botanical Research Institute.	

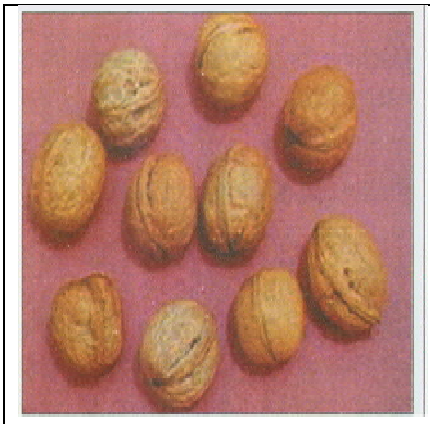
1.4 NUTS AND OILSEEDS:

	**1.4.1 RAPID MILK ANALYZER** **Product/Process:** Rapid Milk Analyzer. **Application/Use:** Mill Collection Centres, Sweet makers and Enforcement Agencies. **Salient Feature of Process/Technology:** The system is capable of measuring milk contents like butterfat (%), solid nonfat (%), proteins (%), lactose (%) density and added water (%) in milk. **Status of Commercialization:** Transferred and ready for commercialization. **Minimum Economic Unit Size:** New measurement method. **Indicative Investment:** **Equipment and Machinery:** **Raw Materials:** **For Further Information, Please Contact:** The Director,Central Electronics Engineering Research Institute.	**CEERI**
	**1.4.2 HANDHELD MILK FAT TESTER** **Product/Process:** Handheld Milk Fat Tester. **Application/Use:** Domestic Use as Limited milk sample testing. **Salient Feature of Process/Technology:** **Status of Commercialization:** Transferred and ready for commercialization. **Minimum Economic Unit Size:** Handheld. **Indicative Investment:** **Equipment and Machinery:** **Raw Materials:** **For Further Information, Please Contact:** The Director,Central Electronics Engineering Research Institute.	**CEERI**
	**1.4.3 HANDHELD MILK ADULTERATION TESTER** **Product/Process:** Handheld Milk Adulteration Tester. **Application/Use:** Domestic Use as Limited milk sample testing. **Salient Feature of Process/Technology:** **Status of Commercialization:** Transferred and ready for commercialization. **Minimum Economic Unit Size:** Handheld.	**CEERI**

	Indicative Investment: **Equipment and Machinery:** **Raw Materials:** **For Further Information, Please Contact:** The Director,Central Electronics Engineering Research Institute.	
	**1.4.4 MILK DENSITY MEASURING SYSTEM** **Product/Process:** Milk Density Measuring System. **Application/Use:** Cooperative diaries, village's milk collection centre, private diaries, low enforcement dairy market. **Salient Feature of Process/Technology:** **Status of Commercialization:** Transferred and ready for commercialization. **Minimum Economic Unit Size:** **Indicative Investment:** **Equipment and Machinery:** **Raw Materials:** **For Further Information, Please Contact:** The Director,Central Electronics Engineering Research Institute.	**CEERI**
	**1.4.5 DESICCATED COCONUT** **Product/Process:** Process for production of desiccated coconut. **Application/Use:** Culinary purpose, manufacture of biscuits, sweetmeat, cake dressings, pastries, puddings, etc. **By products Coconut:**Shell, testa, coconut water. **Salient Feature of Process/Technology:** About one-fourth of the total coconut production in the country goes for desiccated coconut and other culinary items. The process consists of shelling, paring, removal of coconut water, washing, disintegration, drying and packing. **Status of Commercialization:** Commercialized **Minimum Economic Unit Size:**100 kg/day, working 300 days/annum. **Indicative Investment:** Rs.3 lakh **Equipment and Machinery:** Drier, disintegrator, handling gadgets, sieves, etc. **Raw Materials:** Coconut. **For Further Information, Please Contact:** The Director, Central Food Technological Research Institute.	**CFTRI**

	1.4.6 DEHULLED SESAME SEEDS **Product/Process:** Production of dehulled sesame seeds. By products: sesame oil (light color, low FFA), flour (protein rich), cake. **Application/Use:** Confectionery, cooking, oil, protein-rich formulations. **Salient Feature of Process/Technology:** It is a dehulling process for easy removal of the husk from the sesame seed. The process consists of preliminary cleaning and grading, hot lye treatment, removal of the skin and pigments, thorough washing and drying. The dehulled seed can be expelled to get high-grade oil. The cake is further expelled to recover the residual oil and protein- rich sesame cake flour. **Status of commercialization:** Commercialized **Minimum economic unit size:** 1 tpd **Indicative investment**: Rs.9 lakh **Equipment and Machinery:** Precleaning unit, destoner, pulper, drier, vibratory screen, mixing tanks. **Raw Materials:** Commercial quality sesame seed. **For Further Information, Please Contact:** The Director, Central Food Technological Research Institute.	**CFTRI**
	1.4.7 PEANUT CHIKKI **Product/Process:** Production of chikki - a popular Indian sweetmeat made of puffed/roasted Bengal gram/ groundnut/sesame/puffed rice, beaten rice and copra. **Application/Use:** Ready-to-eat food: long shelf life, nutritious, protein supplement. **Salient Feature of Process/Technology:** The raw materials are cleaned, roasted, decuticled and added to hot jaggery/glucose syrup (when dropped in water becomes soft ball or bead), and mixed. The hot mass is transferred on a wooden board smeared with starch powder. The hard mass is rolled to a thickness of 6-8 mm. After few minutes of settling, chikki is cut into pieces and packed. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 0.1 tpd	**CFTRI**

	Indicative Investment: Rs.6 lakhs. **Equipment and Machinery:** Frying pan, iron ladles, wooden table, burners, wooden rollers, weighing balance, sealing machine. **Raw Materials:** Groundnut/puffed Bengal gram/sesame/puffed rice, jaggery, glucose syrup and starch. **For Further Information, Please Contact:** The Director, Central Food Technological Research Institute.	
	**1.4.8 MODERN OIL EXPELLER** **Product/Process:** Machine for extraction of oil from oilseeds. **Application/Use:** High oil yield and quality. **Salient Feature of Process/Technology:** Features of the machine are: single pass crushing replaces three/four successive crushing normally required in conventional expellers, high oil extraction efficiency and increased recovery of oil, less residual oil in the cake; low power consumption and low operating cost; less residual oil in the cake; low power consumption and low operating cost; improved pungency and better quality of oil and cake. **Status of Commercialization:**Licensed to a number of parties. **Minimum Economic Unit Size**: Two models: 1 tpd and 10 tpd. Approx. cost/machine: Rs.0.6 lakh and Rs.7.0 lakh resp. **Indicative Investment:**General workshop machines. **Equipment and Machinery:** Modern oil expeller, available from CSIR licensee. **Raw Materials:** Mustard seed, oil cake, cage bars, cake conveying system, worms, spacers, cone. **For Further Information, Please Contact:** The Director, Central Leather Research Institute, Central Mechanical Engineering Research Institute.	**CLRI, CMERI**
	1.4.9 WALNUT PROCESSING SYSTEM **Product/Process:** Machines and improved process for dehulling of green walnuts, surface cleaning of in-shell nuts and inert gas packaging of walnut kernels. **Application/Use:** Higher productivity and quality in walnut	**IIIM**

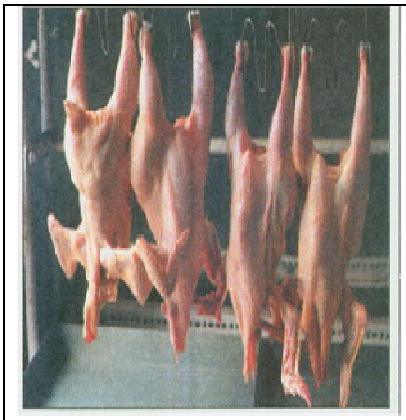
	processing. **Salient Feature of Process/Technology:** The green walnuts, after harvest, are cured for a week and dehulled mechanically. For surface cleaning/bleaching, the dehulled nuts are loaded in a machine along with a bleach solution. The eccentric rotary motion effects vigorous swirling of the nuts in the chemical solution followed by water rinsing which results in a spotless bright product in 5 min. treatment. The nuts are subsequently dried. The machine can process 300 kg walnuts in a batch or 10 tpd. The kernels are packed in inert gas flexible packages for enhancing shelf like. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 10 tpd **Indicative Investment:** Rs.18 lakhs **Equipment and Machinery:**Walnut dehulling machine, bleaching machine (designs available from CSIR), flexible film packing unit. **Raw Materials:** Green/in-shell walnuts, wooden trays, bleaching chemicals, nitrogen gas cylinder. **For Further Information, Please Contact:** The Director, Central Food Technological Research Institute, Indian Institute of Integrative Medicine, Jammu.	
	**1.4.10 CONFECTIONERY GRADE WHITE SESAMUM** **Product/Process:** Process for production of uniform bright white sesame seeds without dehulling. **Application/Use:** Confectionery industry. **Salient Feature of Process/Technology:** The destoned sesame seeds along with 2 times volume of solution are placed in a concrete cylindrical tank, 1.5 m dia x 1.4 m ht and whirled by a rotor assembly at 30 rpm for 5 min. The liquid is drained off through a perforated disc provided at the bottom using the wheel valve. A secondary treatment is given in the same tank for 5 min. The liquid is drained off. The seeds are rinsed with water and dried in a mechanical drier. The blemished seeds are removed using a color sorter. **Status of commercialization:** Commercialized. **Minimum economic unit size**: 15 tpd **Indicative investment:** Rs.30 lakh **Equipment and machinery:** Cylindrical concrete tanks with rotor assembly, drier, sorter.	**IIIM**

	Raw materials: Commercial white variety sesame seeds. **For Further Information, Please Contact:** The Director,Indian Institute of Integrative Medicine, Jammu.	
WITHOUT PHOTO	**1.4.11 AGREMONE OIL DETECTION KIT** **Product/Process:** Process for detection of Argemone Oil. **Application/Use:** To detect Argemone oil adulteration in mustard oil can be used by: Mandi Oilseed Dealers, Retailers/ Bulk packagers, Consumers / Housewives, Consumer Guidance Organizations, Edible Oil Expellers, Food Inspectors and Health Authorities. **Salient Feature of Process/Technology:** Test is easy to perform and takes about 15-20 minutes and is very sensitive with a minimum detection limit of 0.01 % (100 ppm). A portion of the test oil is shaken with a specific clean up cum - extraction reagent and two layers are allowed to separate and a drop from lower layer is applied on a filter paper strip and viewed under Fluorescent Detection Device developed at ITRC, orange to purplish fluorescent spot appearance indicates the presence of Argemone Oil. **Status of Commercialization:** Commercialized. **For Further Information, Please Contact:** The Director,Indian Industrial Toxicology Research.	**IITR**
	**1.4.12 MO CHECK (MUSTARD OIL CHECK)** **Product/Process:** **Application/Use:** The MO check strips are useful for the detection of an artificial color, Butter Yellow in mustard/edible oils. This can be employed as a handy tool at the retail outlet by cautious dealers, consumers/ house-wives themselves: consumer guidance organization/ societies and for random preliminary checks by food inspectors and health authorities even at the remotest areas. **Salient Feature of Process/Technology:** □ The test is easy to perform, takes only a few minutes. □ Requires only visual observation. □ Sensitive (Minimum detection limit of 0.001%	**IITR**

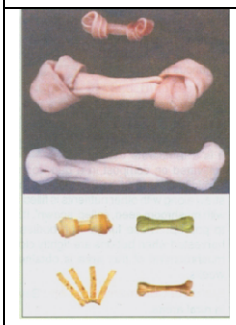
	(10 ppm). □ Cost effective (< 10 Rs. per test). □ Serves as a handy tool for consumers. **Status of Commercialization:** Ready for commercialization. **Equipment's:** No major equipment and machinery required. **Raw Materials:** Locally available materials and minor electronic components. **For Further Information, Please Contact:** The Director, Indian Industrial Toxicology Research.	
	**1.4.13 COCONUT CREAM** **Product/Process:** Process for manufacture of coconut cream. **Application/Use:** As culinary item and in confectionery. **Salient Feature of Process/Technology:** A wet process involving dehusking, splitting, deshelling of fresh matured coconuts, blanching the kernels followed by comminution and milk extraction, emulsification with additives and homogenization followed by pasteurization and canning. Process efficiency is more than 70% with excellent product quality. Coconut shell, coconut water and coconut powder are by-products. **Status of Commercialization:**Technology in production. **Minimum Economic Unit Size:** 1000 nuts/day **Indicative Investment:** Rs.15 lakhs **Equipment and Machinery:** Hammer mill, screw press, pasteurization unit, filling unit, seaming machine, rotary retort etc. **Raw Materials:** Mature fresh coconuts, emulsifiers **For Further Information, Please Contact:** The Director,National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram.	**NIIST**
WITHOUT PHOTO	**1.4.14 PALM OIL EXTRACTION TECHNOLOGY** **Product/Process:** Process for manufacture of Palm oil **Application/Use:** Edible oil **Salient Feature of Process/ Technology:** Wet process to extract palm oil from oil palm fresh fruit bunches (FFB). The major process steps are sterilization, stripping, digestion, extraction, clarification and purification. Process efficiency is >93%.	**NIIST**

	Status of Commercialisation: Commercialized. Minimum economic unit size: 50 tones FFB/day Indicative investment: Rs.450 lakh **Equipment and Machinery:** Sterilizer, stripper, digester, clarifier, scrapper, centrifuge, vacuum drier etc. **Raw Materials:** Oil Palm FFB **For Further Information, Please Contact:** **The Director,National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram.**	

1.5 POULTRY AND MEAT:

	**1.5.1 POULTRY DRESSING** **Product/Process:** Production of dressed poultry/cut up portions. **Application/Use:** Clean and hygienic product in convenient form, utilization of waste. **Salient Feature of Process/Technology:** The process involves ante mortem inspection, slaughtering, scalding, defeathering, singeing, evisceration and post-mortem inspection. The edible internal organs are separated, washed and packed separately. The carcasses are washed, packed and chilled in crushed ice for further storage. The marketing of dressed chicken is done in fresh, chilled or frozen form. It is also feasible to market in cut up portions like half chicken, drumstick, thigh, back breast and wing. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:**500 birds/day. **Indicative Investment:** Rs.5lakh. **Equipment and Machinery:** Killing cones with bleeding trough, scalder, plucker, wash tank with overflow, chopping block, eviscerating table, chilling tanks, draining rack with speckles, packaging table, cutting knives, singer, balances, ice crusher and deep freezer. **Raw Materials:** Poultry birds. **For Further Information, Please Contact:** The Director, Central Food Technological Research Institute.	**CFTRI**
	**1.5.2 MEAT PICKLES** **Product/Process:** Process for making pickles from fish, prawn, chicken and mutton. **Application/Use:** As food adjunct. **Salient Feature of Process/Technology:** Fleshy meats are suitable for the preparation of pickle. Dressed and filleted meats are cut into 25 mm cubes, marinated with salt and vinegar. The marinated meat cubes are fried in oil and treated again with acid and salt. Boiled tamarind pulp, sugar syrup made in vinegar, fried ginger and garlic pieces and powdered spices (red chilies, turmeric, cloves, cinnamon, cumin, mustard) are mixed with the treated fish/meat cubes and transferred to bottles. The bottles are covered with oil. The pickle is shelf-stable for one yr. at room temp.	**CFTRI**

	Status of Commercialization: Commercialized. **Minimum Economic Unit Size:** 100 KG/ DAY **Indicative Investment:** Rs.7lakh **Equipment and Machinery:** Refrigerator, SS vessels, frying pans and stoves. **Raw Materials:** Fish, meat, slat, vinegar, spices and oil. **For Further Information, Please Contact:** The Director, Central Food Technological Research Institute.	
	**1.5.3 SILAGE FROM ANIMAL OFFALS** **Product/Process:** Production of silage from animal offals such as fish viscera, poultry intestines and silkworm pupae. **Application/Use:** Ingredient in animal feed as a source of valuable animal proteins / fat. **Salient Feature of Process/Technology:** The process involves homogenization of offals with molasses, antimycotic agent, antioxidant and effecting fermentation. The product has a paste - like consistency and free from pathogenic microorganisms. It is rich in animal proteins & fat. It can be stored in polyethylene bags / silos for 3 months. **Status of Commercialization:** Ready for commercialization. **Minimum Economic Unit Size: 110** kg silage/ day **Indicative Investment:** Rs.1 lakh **Equipment and Machinery:**Homogenizer/Disintegrator, antimycotic and antioxidant chemicals. **Raw Materials**: Offals, molasses, antimycotic agents and antioxidant chemicals. **For Further Information, Please Contact:** The Director, Central Food Technological Research Institute.	**CFTRI**
	**1.5.4 RURAL MEAT PRODUCTION CENTRE** **Product/Process:** Process for production of Goat and Sheep Meat in Rural Areas. **Application/Use:** Food Material. **Salient Feature of Process/Technology:** Simple facilities for hygienic production of meat, dressing and packing of meat. Designed for a capacity of 100 animals per day. Use simple equipment (no machines) so as to be compatible to rural environment.	**CLRI**

	Status of Commercialization: Ready for commercialization. **Minimum Economic Unit Size:** 1 tpd **Indicative Investment:** Rs.20 lakh (including land and buildings). **Equipment and Machinery:** Manually operated overhead rails for carcass movement, Water heater, Stainless steel top table, Room air-conditioner, Deep freezer, Dressing knives. **For Further Information, Please Contact:** The Director, Central Leather Research Institute.	
	**1.5.5 DOG CHEWS** **Product/Process:** Process for Production of Dog Chews. **Application/Use:** Used as a pet food for dogs - Animal feed industry. **Salient Feature of Process/Technology:** Salted trimmings (hide/skin) are collected and limed, fleshed, dehaired, delimed, bleached, cut, shaped and dried. The final product can be made into different colors. **Status of Commercialization:** Commercialized. **Indicative Investment:** Rs.10 lakhs. **Equipment and Machinery:** Drums, Vats, Knives, Dyes, hydraulic press. **Raw Materials:** Tannery trimmings and hide splits. **For Further Information, Please Contact:** The Director, Central Leather Research Institute.	**CLRI**
	**1.5.6 ANIMAL FEED FROM APPLE POMACE** **Product/Process:** Process for conversion of apple pomace (a waste from apple processing industry) into animal feed. **Application/Use:** Supplement for sheep/goat feed. **Salient Feature of Process/Technology:** The freshly extracted apple pomace is fortified with molasses, urea and common salt. Potassium metabisulphite is added @ 100 ppm. It is filled into trenches, 2 m x 1 m, manually compacted, covered with polythene sheet and further sealed with 5 mm thick layer of mud. Natural lactic acid fermentation is allowed to proceed under anaerobic condition. The ensiled feed is ready in 60 days. It can be supplemented with normal feed up to 35% level. The harvested feed must be consumed within 2 days in summers and 7 days in winters. **Status of Commercialization:** Demonstrated at 50 t	**IIIM**

	batch. **Minimum Economic Unit Size:**1000 tpa. **Indicative Investment:** Rs.12 lakh **Equipment and Machinery:** Ensilation silos. **Raw Materials:** Apple pomace, urea, KMS, molasses, common salt. **For Further Information, Please Contact:** The Director,Indian Institute of Integrative Medicine, Jammu.	
Without photo	**1.5.7 PROLIFICACY DETECTION IN SHEEP** **Product/Process:** Establishment of prolificacy detection in sheep using FecB gene related molecular marker. **Application/Use:** Development of sheep breed with prolificacy gene which will lead to increased ovulation rate. **Salient Feature of Process/Technology:** FecB test using molecular marker identified by Wilson et al (2001) is a PCR-RFLP based DNA test that can detect the homozygous as well as heterozygous sheep animals with respect to prolificacy gene. This has relevance in sheep breeding programme. **Status of Commercialization:** Not applicable. (Collaborative programme). **Minimum Economic Unit Size:** **Equipment and Machinery:** Basic molecular biology related equipment. **Raw Materials:** Sheep blood, FecB primers and other DNA PCR related chemicals. **For Further Information, Please Contact:** The Director, National Chemical Laboratory.	**NCL**

1.6 FARMING:

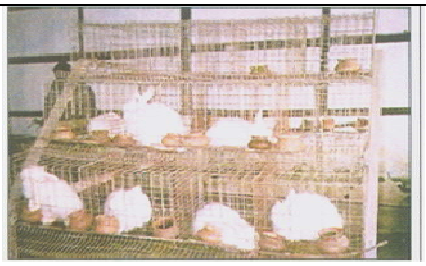
	**1.6.1 INTER ROW ROTARY CULTIVATOR** **Product/Process:** Product. **Application/Use:** Precision Agriculture**,** Intercultural operations in wide row crops like vegetables, sugarcane, maize, cotton, soybean, peas, grams etc. **Salient Feature of Process/Technology:** □ Adjustable Working Width □ Adjustable Working Depth □ High Ground Clearance □ Adjustable Row Spacing □ Adaptable to small & marginal farmers [suited for 35-45 hp tractors] □ Machine Width: 2000mm □ Row Spacing: 40 – 60 cm □ No. of Rows: Three □ Weight of machine: 450 kg. **Status of Commercialization:** Commercialized **Minimum Economic Unit Size**: Prototype Cost Rs.60,000/-. **Indicative Investment:** Prototype Cost Rs. 60,000/-. **Equipment and Machinery:** General. Engineering Workshop, Vendors for Castings. **Raw Materials:** Common Steels, Steel Castings, Sheet metal fabrication. **For Further Information, Please Contact:** The Director, Central Leather Research Institute, Central Mechanical Engineering Research Institute.	**CMERI**
	**1.6.2 PNEUMATIC PRECISION PLANTER FOR VEGETABLE** **Product/Process:** Product. **Application/Use:** **Precision:** Agriculture, Direct planting/seeding of small/ irregular vegetable seeds. **Salient Feature of Process/Technology:** High Singulation accuracy Designed for Indian Crop Production Practices Direct Seeding of small/irregular seeds at uniform depthEmpower Indian small & marginal farmers [suited for 35-45hp tractors]Specifications Singulation of seeds at least 95%Planting of seeds of diameter : less than 4 mmRow spacing-35 cm (minimum)Modular planting units adaptable for all tractorsDepth controlling and profile following mechanism Speed of planting - 4-5km/hr. **Status of Commercialization:** Commercialized	**CMERI**

	Minimum Economic Unit Size: Prototype Cost Rs.1.2 Lakhs for a three-row machine against imported equipment of Rs.6.0 Lakhs & above. **Indicative Investment:** Rs.25.0 Lakh **Equipment and Machinery:** General Engineering Workshop, Vendors for Castings, CNC – EDM / Wirecut / Milling machinePneumatic Precision Planter for vegetable available from licensee. **Raw Materials**: Common Steels, Aluminum Castings, Sheet metal fabrication like aspirator. **For Further Information, Please Contact:** The Director, Central Leather Research Institute, Central Mechanical Engineering Research Institute.	
	**1.6.3 PROGRAMMABLE IRRIGATION SCHEDULER** **Product/Process:** Product. **Application/Use:** Precision & Conservation Agriculture. Automatic Irrigation scheduler along with pump operation. **Salient Feature of Process/Technology:** □ Irrigation Controller for small and marginal farmers. □ 8 Stations with Pump Operation. □ Greenhouse / Open Field / Orchard Specification. □ **Irrigation Program:** Number of Valves up to 8, Sequential or grouped. □ Control**:** Single Pump. □ **Irrigation Method:** Time based. □ Day Access**:** Odd/Even day, Weekly; up to 30 days. **Status of Commercialization:** Commercialized **Minimum Economic Unit Size:** Very low cost controller. **Indicative Investment:** Prototype Cost Rs.10,000/ **Equipment and Machinery:** Electronic Manufacturing Facilities. Programmable Irrigation Scheduler available from licensee. **Raw Materials**: Electronic Components. **For Further Information, Please Contact:** The Director, Central Leather Research Institute, Central Mechanical Engineering Research Institute.	**CMERI**

	**1.6.4 FLUIDIZED BED DRYER FOR AGRO CROPS** **Product/Process:** **ProductApplication/Use:** For drying in a safe desired level, storage & further processing of different oilseeds such as mustard, sunflower, soybean, groundnut etc. and other agro crops, this dryer is used extensively by • State Oil & Oilseed Federations, Oilseed Growers Association, Oil Mill and Solvent Extraction plants. • Agencies dealing with storage ofseeds, agrocrops, etc. **Salient Feature of Process/Technology:** **Status of Commercialization:**Ready for commercialization **Minimum Economic Unit Size:** Prototype Cost Rs.4.0 Lakh/- **Indicative Investment:** Rs.20.0 Lakh **Equipment and Machinery:**Dryer available from licensee. **Raw Materials:**Different oil seeds, harvested/wet seeds. **For Further Information, Please Contact:** The Director, Central Leather Research Institute, Central Mechanical Engineering Research Institute.	**CMERI**
	**1.6.5 CABINET DRYER FOR GINGER & TURMERIC** **Product/Process:** Dry flakes from raw ginger/turmeric. **Application/Use:** Drying of agro crops like ginger, turmeric etc. **Salient Feature of Process/Technology:** Cabinet Type, Batch Process, Batch Size:50 kg per batch, Moisture reduction: From initial moisture of 80-90% to final moisture of 10-12 % in 4-5 hrs. at drying temperature of 60oC, Faster drying rate, Uniform drying. **Status of Commercialization:**Ready for commercialization. **Minimum Economic Unit Size**: 2.5 Lakh **Indicative Investment:** Rs.20.0 Lakh **Equipment and Machinery:** No major equipment is required; only temperature sensors and controller, fin-type electrical heaters and small capacity exhaust fan are required.	**CMERI**

	Raw Materials:SS/MS sheet, flat, angle, channel, fasteners etc. **For Further Information, Please Contact:** The Director, Central Leather Research Institute, Central Mechanical Engineering Research Institute.	
	**1.6.6 ROTARY DRUM WASHER FOR GINGER & TURMERIC** **Product/Process:** Cleaned ginger/ turmeric rhizomes. **Application/Use:** washing and cleaning of raw muddy ginger collected from field. **Salient Feature of Process/Technology:** Continuous washing, Food grade SS304 material for ginger contact components, perforated rotary drum with spray nozzles to wash intricate-shaped ginger and turmeric. □ Uniform washing @ 250 kg/hr. □ Recirculation of the used water with mud filter and pump. □Manual washing of such intricate shapes is next to impossible for large scale application. **Status of Commercialization:**Ready for commercialization. **Minimum Economic Unit Size:** Rs7.0 Lakh **Indicative Investment:** General workshop machines. **Equipment and Machinery:** A feeding hopper, an electric motor with rotating mechanism for the drum and a small pump for recirculation of the used water after cleaning are all that required to run this continuous mode washer. **Raw Materials:** Freshly harvested ginger and turmeric for washing. **For Further Information, Please Contact:** The Director, Central Leather Research Institute, Central Mechanical Engineering Research Institute.	**CMERI**
	**1.6.7 SERICULTURE** **Product/Process:** Process of silk production through disease resistant high yielding strain of mulberry silkworm. **Application/Use:** High yield in silk. **Salient Feature of Process/Technology:** The silk worm races, traditionally used by the cottage industry, yield 20-25 kg cocoons/ 100	**IICT**

	eggs. With the use of a high yielding variety, 35-40 kg cocoons/100 eggs can be produced with are disease resistant. Integrated sericulture technology package is available including model rearing house, horticulture, silkworm rearing, disease control measures etc. **Status of Commercialization:** Demonstrated to large number of cottage production units. **Minimum Economic Unit Size:** 200 kg cocoon/ yr. **Indicative Investment:** Rs.2.0 lakh. **Equipment and Machinery:** Rearing sheds, rearing equipment. **Raw Materials:** Mulberry cuttings, silkworm. **For Further Information, Please Contact:** The Director,Indian Institute of Chemical Technology.	
	**1.6.8 BUTTON MUSHROOM CULTIVATION** **Product/Process:** Process for cultivation of button mushroom (Agaricus bisporus). **Application/Use:** Culinary preparations. **Salient Feature of Process/Technology:** It is a temperate variety cultivated on compost in a dark room at temperature 15-18°C and humidity around 95%. For this, the compost made of wheat/paddy straw along with other nutrients is filled in the wooden trays and planted with mushroom seed, called 'spawn'. It takes 30-35 days for mushroom to pop up. These fungal fruit bodies appear in flushes, which are harvested when buttons are tightly closed. An average yield of 10 kg mushroom/m" of tray area is obtained in a cropping cycle of 8-10 weeks. **Status of Commercialization:** Several cottage scale units working in rural areas. **Minimum Economic Unit Size:** 25 kg/day. **Indicative Investment:** Rs.0.4 lakh**Equipment and Machinery:** Straw chopper. **Raw Materials:** Spawn, wheat/paddy straw, wooden trays, chemicals. **For Further Information, Please Contact:** The Director, Indian Institute of Integrative Medicine, Jammu, North-East Institute of Science and Technology, Jorhat.	**IIIM**

	**1.6.9 RABBIT FARMING** **Product/Process:** Process for rearing rabbits. **Application/Use:** For edible meat. The skin is used for making fur garments and the wool for making shawls, blankets and woolen garments. **Salient Feature of Process/Technology:** Rabbits are prolific breeders. A doe produces 3 to 10 offspring after a gestation period of 29-31 days i.e. it yields 30-40 more rabbits in a year. These animals can be raised under fruit trees, house backyards, and cottages without much investment. New Zealand White, Gray Giant, Soviet Chinchilla are fur and meat varieties while Angora is the wool variety. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 12 animals (10 females + 2 males) to start with. **Indicative Investment:** Rs.0.2 lakh **Equipment and Machinery:** Wire mesh cages, feeding troughs, wooden nest boxes. **Raw Materials:**Rabbit litters **For Further Information, Please Contact:** The Director,Indian Institute of Integrative Medicine, Jammu.	**IIIM**
	**1.6.10 QUAIL FARMING** **Product/Process:** Process for rearing Japanese quail or 'Batter' (Coturnix coturnix japonica). **Application/Use:** Source of meat, egg and for sport. **Salient Feature of Process/Technology:** Quail meat is highly cherished as a table delicacy. Its farming is more remunerative than poultry farming due to higher rate of egg laying, smaller floor space (one-tenth) and less feed consumption. No vaccination or deworming is required. Litter or battery system of brooding and rearing can be employed. A quail consumes 400-500 g feed in 5 weeks' time and weighs 150-180 g when it is ready for consumption. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 2000 quails/month. **Indicative Investment:** Rs.0.9 lakh (including Rs.0.65 lakh for 50 m2 building). **Equipment and Machinery:** Battery brooders,	**IIIM**

	rearing cages. **Raw Materials:**Quail eggs. **For Further Information, Please Contact:** The Director, Indian Institute of Integrative Medicine, Jammu.	
	**1.6.11 BIOFERTILISERS** **Product/Process:** Process for manufacture of biofertilizer based on Rhizobium, Azospirillum, Azobacter, Phospahte solubilisers etc. **Application/Use:** Eco-friendly fertilizer for enhancing the productivity of soil by fixing atmospheric nitrogen/ solubilising soil phosphorus/ stimulating plant growth through synthesis of growth promoting substances. **Salient Feature of Process/Technology:** The manufacturing process consists of collection of bacterial strains, preparation of mother culture, multiplication, blending of the bacterial broth culture into sterile carrier materials such as peat, lignite or charcoal and packing in plastic bags. **Status of. Commercialization:** Production and application of biofertilisers is rapidly growing. **Minimum Economic Unit Size:** 100 tpa. **Indicative Investment:** Rs.20 lakhs. **Equipment and Machinery:** Fermenter. autoclave, boiler, blender, packing machine and laboratory equipment. **Raw Materials:** Vermiculture/lignite/peat, microorganisms, chemicals, packing material etc. **For Further Information, Please Contact:** The Director, Indian Institute of Integrative Medicine, Jammu.	**IIIM**
	1.6.12 POWER OPERATED PADDY THRESHER **Product/Process:** Paddy Thresher **Application/Use:** For filtration of turbid water from pond, lake, river etc. to get clean drinking water. **Salient Feature of Process/Technology:** The Thresher operates by one hp electric motor or diesel engine. It separates paddy grains from the straw completely. The threshing capacity of	**IMMT**

	the machine is 300 kg/hr. paddy, compared to 35 kg/hr. by manual methods. It is a hold on type open thresher and cheapest in price. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 300 units/year **Indicative Investment:** Rs.10.00 lakh **Equipment and Machinery:** Welding machines, cutting machines, jigs and fixtures. **Raw Materials:** Mild steel angle, rod and sheet, bearings, V-belt, 1 HP Electric motor etc. **For Further Information, Please Contact:** The Director, Institute of Minerals and Materials Technology, Bhubaneswar.	
	1.6.13 BIOFERTILIZER & PLANT GROWTH PROMOTING SUBSTANCES FOR IMPROVED PRODUCTIVITY **Product/Process:** Rzobium, PSB and Azotobacter based biofertilizers **Application/Use:** • Simple and low cost technique to treat seeds, seedlings, tubers and other planting materials with inoculants for efficient use by farmers. • Microbes mass-multiply easily and are compatible with Good Agricultural Practice, food safety, and environmental concerns. • Application of our bioinoculant with chemical fertilizers is complementary. • The results of field demonstrations have indicated the effectiveness and cost efficiency of our inoculants against many commercial products. • The bioinoculants, prepared from CSIR-NBRI technology have been used successfully in common agricultural crops like Urd, Arhar, Mung, Soybean, Ground nut, Gram, Pea, Lentil, Mustard, Wheat, Sunflower, Sugarcane and Paddy. These have also shown promising results in trees, floricultural crops like Gladiolus, Tuberose and Calendula, spices, medicinal and aromatic crops. **Salient Feature of Process/Technology:** 1. Microbial strains with multiple PGP attributes, stress tolerant ability and shelf life for 9-12 months. 2. Proven competence in the rhizosphere of different host plants in different soil types. 3. Increases yield by approximately 20-30%.	**NBRI**

	4. Also enhances the crops nutritional value. 5. Minimizes the usage of chemical fertilizers by 50%. 6. Intellectual property rights protected. Commercial and farmer's friendly application packages developed. **Status of Commercialization:** Commercialized **Minimum Economic Unit Size:** 30002 Feet **Indicative investment:** 1.4 Crores **Equipment:** 1. One Temperature controlled Room (12X12 feet) 2. Two Floor Shaker (4X4 feet) 3. One BOD Incubator 4. One Horizontal autoclave 5. One Water Purification System 6. One Cold Room (10X10 feet) 7. One Biofertilizer packaging machine 8. One Biofertilizer homogenizing machine **Raw Materials:** Culture medium, Carrier Base, Glass and plastic wares and packaging materials. **For Further Information, Please Contact:** The Director, National Botanical Research Institute.	
	**1.6.14 OYSTER MUSHROOM CULTIVATION** **Product/Process:** Process for cultivation of Oyster mushroom (Pleurotus sajor caju), also known as Dhingri mushroom. **Application/Use:** Culinary preparations. **Salient Feature of Process/Technology:** Oyster mushroom is grown in subtropical regions at temperature 21-28°C, relative humidity 55-75%, for a period of 6 to 8 months in a year. The clean dry paddy straw is soaked in water for 18 hr. and mixed with a bottle of master spawn along with horse gram powder. The mixture is filled into polyethylene bags and kept at room temperature. The compact mass is watered regularly. Mushrooms start growing all over the surface and are harvested. **Status of Commercialization:** Several cottage scale units working in rural areas. **Minimum Economic Unit Size:**25 kg mushroom/day; working 200 days/annum, **Indicative Investment:** Rs.1 lakh. **Equipment and Machinery:** Straw cutter,	**NEIST**

	soaking vessel, water sprayer. **Raw Materials:** Paddy straw, spawn, horse gram powder, polythene bags. **For Further Information, Please Contact:** The Director, North-East Institute of Science and Technology, Jorhat.	
	**1.6.15 TP-16 BIOFERTILIZER** **Product/Process:** Technology for production of TP16 Biofertiliser **Application/Use:** The product is suitable for promoting yield in plantation crops (Tea) and agronomically important crops. **Salient Feature of Process/Technology:** • Reduces the amount of use of synthetic nitrogen urea by half the amount • The microbial strain bears multiple plant growth promoting characters • Improves nutrient uptake by the plants • Suitable for recovery of degraded soil • Environment friendly product **Status of Commercialization:** In commercial production. **Minimum Economic Unit Size:** 560 L/ day **Indicative Investment:** **Equipment and Machinery:** Fermenter of 670 L Capacity; Mixer. **Raw Materials:** Cheap naturally raw material used for cultivation of Microbes. **For Further Information, Please Contact:** The Director, North-East Institute of Scienc and Technology , Jorhat.	**NEIST**
	**1.6.16 OP-12 BIOFERTILIZER** **Product/Process:** OP-12 Bio-Fertilizer Mediated Plant Health Improvement in Normal and Water Deficit Condition. **Application/Use:** In agriculture for plant growth improvement. **Salient Feature of Process/Technology:** • OP-12 bio-fertilizer could improve plant growth in normal and water deficit conditions. The bacteria have tolerance capacity against high osmotic stress as it could grow at -0. 73MPa.This bacterium is also found to be nontoxic to human and animals. • It is cost-effective, simple production technique, eco-friendly, user affable and also	**NEIST**

	proven to be effective in various crops in different agro-climatic conditions. **Status of Commercialization:** In commercial production **Minimum Economic Unit Size:** 1 ton per day **Indicative Investment:** **Equipment and Machinery:** A bioreactor of suitable capacity with necessary accessories is necessary for large scale production. **Raw Materials:** Talc Powder & Jaggery (Gur) **For Further Information, Please Contact:** The Director, North-East Institute of Scienc and Technology , Jorhat.	
	**1.6.17 SUFAL: BIO-ORGANIC FERTILIZER** **Product/Process:** Technology for production of SUFAL: bio-organic fertilizer. **Application/Use:** □ The organic fertilizer SUFAL is applied in the field for different crops at the rate 5-10 ton per hector, depending upon the type of cultivation. □ It can be used after properly ploughing, prior to planting/ sowing the seed, when there is sufficient moisture in the soil. □ Application of chemical fertilizer is not recommended if SUFAL is used. **Salient Feature of Process/Technology:** □ The organic fertilizer formulation-SUFAL consists of 5 different easily available bio materials, rich in essential nutrients/micro nutrients required for growth & development of crop plants. □ All the ingredients used in the formulation are eco-friendly, non-toxic and having capacity to mixed easily with the soil and make the nutrients available to absorbed by the crop plants. □ The ratio of different bio-materials was maintained in the formulation in such a way that the plants can easily absorb balanced nutrients from the soil which helps rapid growth and development. □ The ingredients used in the formulation doesn't release any toxic/heavy metals to the soil and hence the product is fully an eco-friendly one and safe to use as fertilizer by the farmers. □ There is no possibility of contamination & health hazard effect of SUFAL on farmers in handling as it is free from the use of animal excreta or any municipal wastes material which	**NEIST**

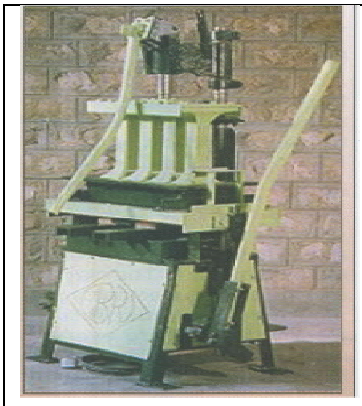
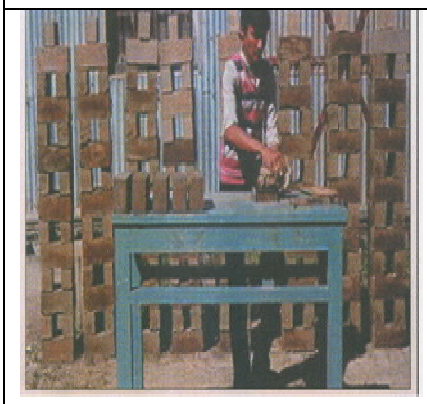
	normally used for production of compost manure/ vermicompost production. **Status of Commercialization:** Transferred to 1 Party. **Minimum Economic Unit Size:** 1 Ton/day **Indicative Investment:** Rs.57.23 Lakhs **Equipment and Machinery:** Shredder cum Pulveriser, Hopper, Mixing Machin, Hopper with inclined Belt Conveyor, Packaging Machine & Weighing Balance. **Raw Materials:** (i) NPK and micro nutrient rich aquatic weed material (ii) Phosphorus riched bio based component (iii) Cake of an extracted oil seed (iv) Calcium supplement material (v) Mineral riched agro waste (vi) Carrier material (vii) Insect repellent natural oil **For Further Information, Please Contact:** The Director, North-East Institute of Scienc and Technology , Jorhat.	

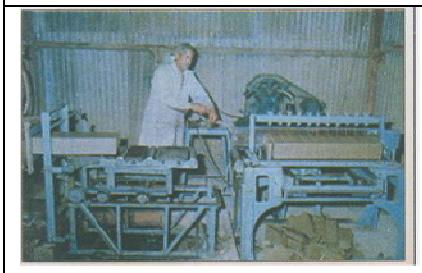
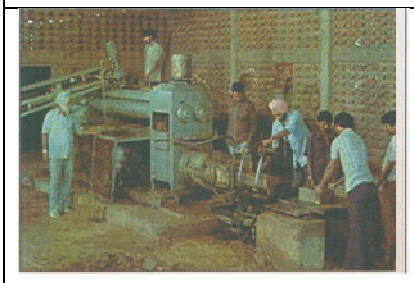
1.7 TISSUE CULTURE:

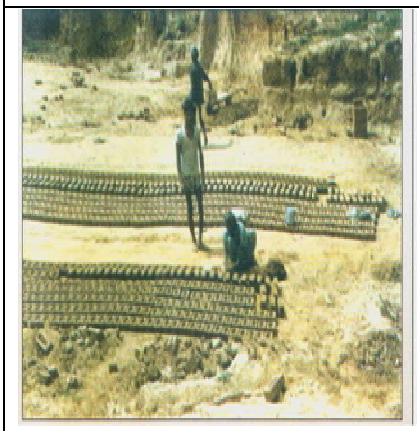
	**1.7.1 HIGH QUALITY BANANA PLANTING MATERIAL** **Product/Process:** Process for the production of high quality disease-free banana planting material. **Application/Use:** Disease-free planting material of any variety of banana can be produced in minimum space in large number throughout the year. **Salient Feature of Process/Technology:** Banana varieties such .as Cavendish, 'Rasabale' and others can be mass multiplied by tissue culture technology. The method involves establishment of plant tissue culture, large-scale production of plantlets, growing tissue culture-plants in poly-house and field cultivation. The steps involved are, selection of high yielding mother clones, disinfection of explants, removal of bud/ meristem, establishment of shoot cultures on nutrient medium with suitable hormone in recommended containers & incubation at specified conditions, multiplication of shoots in nutrient medium with specific hormones, transfer of selected shoots for shoot multiplication or rooting, hardening of tissue-culture plants in polyhouse and transportation for field cultivation. **Status of Commercialization:** Ready for Commercialization. **Minimum Economic Unit Size:** 75,000 plants per annum. **Indicative Investment:** Rs.7.5 lakh. **Equipment and Machinery:** Small laboratory with Laminar-flow chamber, autoclave, balance, pH meter, electric heater/ gas burners, water distillation unit, some glassware and chemicals, furniture and fixtures, a small polyhouse. **Raw Materials:** Macro and micro nutrient salts for Murashige and Skoog's culture medium, good quality water, growth regulators, soil compost etc. **For Further Information, Please Contact:** The Director, Central Food Technological Research Institute.	**CFTRI**

2. BUILDING & CONSTRUCTION TECHNOLOGIES

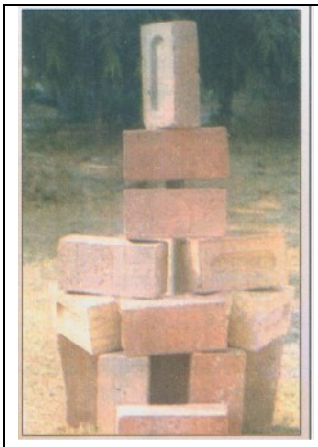
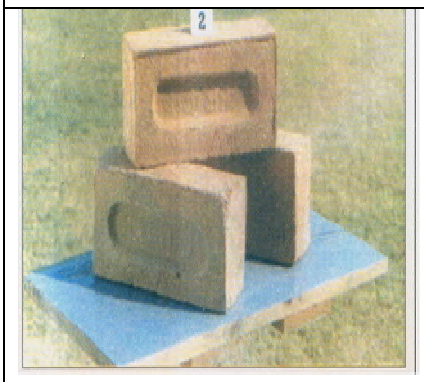
2.1 BRICKS:

	**2.1.1 C-BRICK** **Product/Process:** Process for manufacture of specialty bricks (size 23x11x 7.5 ern") through a portable C-brick machine. **Application/Use:** Building industry. **Salient Feature of Process/Technology:** Raw materials e.g. flyash, sand, lime/ cement are proportioned and mixed with additives if needed along with water in a pan mixer. The bricks are shaped through c-brick machine based on vibro-compaction principle. These are then air dried for 24-48 hr., steam cured for 6 hr. when lime is used or wet cured for 28 days when cement is used as mortar. **Status of Commercialization:** Four licensees, technology in production. **Minimum Economic Unit Size:** 3,000 bricks/ shift. **Indicative Investment:** Rs.0.75 lakh **Equipment and Machinery:** C-brick machine (available from CSIR licensee), pan mixer, baby boiler. **Raw Materials:** Flyash, sand, lime/cement. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	**CBRI**
	**2.1.2 BRICK MOULDING TABLE** **Product/Process:** Table fitted with moulding machine. **Application/Use:** Rapid moulding of clay bricks for the increased productivity. **Salient Feature of Process/Technology:** A simple hand-moulding table moulds bricks in accurate shape and size. The table is fitted with a mould and also provided with movable MS bottom plate. The clay, kneaded with water, is fed into the mould and the brick is ejected by pressing down the pedal. Uniformly shaped moulded bricks thus produced, after drying can be evenly set inside the kiln to facilitate even burning with efficient utilization of fuel. Improved dimensional accuracy of burnt bricks facilitates perfection in masonry construction and saving in mortar consumption. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 1000-1500	**CBRI**

	moulded bricks/day though a table. **Indicative Investment:** Rs.3,000. **Equipment and Machinery:** Brick moulding table available from CSIR licensee. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	
	**2.1.3 BRICK CUTTING TABLE** **Product/Process:** Semi-automatic pneumatically operated wire cutting table. **Application/Use:** For making wire-cut bricks/tiles/ blocks. **Salient Feature of Process/Technology:** This pneumatically operated machine provides 7 cutting strokes per min, controlled by a hand lever. Movable battery of wires cuts 10 bricks per stroke. The cut bricks/tiles/blocks from extruded column possess accurate shape and size. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:**4000 bricks/hr. (size 230x11 Ox75 mrn"). **Indicative Investment:** Rs.1.0 lakh Pneumatically operated cutting table as per CSIR design. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	**CBRI**
	**2.1.4 BRICK MANUFACTURE: SEMI-MECHANISED** **Product/Process:** Semi-mechanized brick extrusion machine. **Application/Use:** For making building bricks, canal lining tiles, other clay units for flooring and roofing. **Salient Feature of Process/Technology:** The machine produces uniform size better finish and superior strength clay bricks. It is adaptable for clay products, easy to operate and maintain. **Status of commercialization:**Commercialized **Minimum Economic Unit Size:** 2500 bricks/hr. **Indicative Investment:** Rs.7.0 lakh **Equipment and Machinery:** Double-deck extruder with a hand operated cutting table as per CSIR design, helical gear box. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	**CBRI**

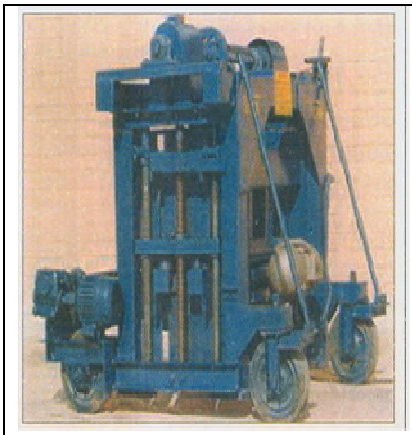
	**2.1.5 IMPROVED BRICK KILN** **Product/Process:** Design of a fuel-efficient fixed chimney brick kiln **Application/Use:** For efficient firing of bricks/brick tiles. **Salient Feature of Process/Technology:** High thermal efficiency of the kiln reduces fuel consumption by 25%; yield of Grade I bricks is higher by 15-20%. Exhaust from the' chimney is within pollution standards. Design ensures continuous operation. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 30,000 bricks/ day. **Indicative Investment:** Rs.25-30 lakh **Equipment and Machinery:** Cap and plate dampers, masonry chimney-30m. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	**CBRI**
	**2.1.6 BRICKS FROM SALINE/ ALKALINE SOILS** **Product/Process:** Manufacture of quality bricks from saline/alkaline clays. **Application/Use:** Building bricks from 'Ussar' or 'Kaliar' soils as available in large parts of Punjab, Haryana, UP and Bihar. **Salient Feature of Process/Technology:** Saline and alkaline clays are considered unsuitable for brick manufacture due to incidences of surface efflorescence and disintegration on weathering of fired bricks. Quality bricks conforming to BIS specification and free from perceptible scum can be manufactured through appropriate processing compatible with conventional practices. Coal ash and common salt solution are mixed with the raw soil using U-mixer. The bricks possess compressive strength 100-210 kq/cm", water absorption 10-12% and are durable. **Status of commercialization:** Ready for commercialization. **Minimum Economic Unit Size:** 30,000 bricks/day. **Indicative Investment:** Rs.25-30 lakh by manual processes. **Equipment and Machinery:**U-mixer, other	**CBRI**

	equipment as used in traditional brick production plant. **Raw Materials:**Saline/alkaline clay, common salt, coal ash, coal as fuel. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	
	**2.1.7 BRICKS FROM BLACK SOILS** **Product/Process:** Process for making quality bricks conforming to BIS specifications from expansive soils. **Application/Use:** Building bricks from black soil as available in large parts of MP, Gujarat and Maharashtra. **Salient Feature of Process/Technology:** Inherent expansive nature of black soil coupled with the presence of nodular calcareous mass usually yield poor quality building bricks. Such clays can be processed/modified to yield good quality building bricks. Process consists of optional particle size gradation, wet sieving to remove calcareous nodules and addition of fine grain siliceous material with screened clays in optimum proportions. **Status of Commercialization:** Commercialized **Minimum Economic Unit Size:** 30,000 bricks/ day. **Indicative Investment:** Rs.25-30 lakh **Equipment and Machinery:** Double shaft mixer and other implements as needed in traditional brick plant. **Raw Materials:**Graded and processed. argillaceous mass, fine grained siliceous additives like flyash, rice husk, ash, siliceous stone dust, and coal fuel. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	**CBRI**

	**2.1.8 BRICKS FROM MARINE CLAYS** **Product/Process:** Process for making semi vitrified bricks from marine clays. **Application/Use:** Building bricks from coastal alluvial clays as available in deltaic locations. **Salient Feature of Process/Technology:** The marine clay presents difficulty in the production of bricks due to the presence of seashells, high proportion of soluble salts and organic matter. These bricks crack due to excessive shrinkage, burst on firing and possess low vitrification range. The improved process for making quality bricks involves the use of calcined clay (grog) as an admixture with the soil and burning in down draught kiln to produce vitrified bricks of compressive strength: 100-200 kg/cm^2, water absorption: below 10% bulk density: 1.80-2.00 g/cc. **Status of commercialization:** Ready for commercialization. **Minimum Economic Unit Size:** 20,000 Bricks/ day. **Indicative Investment:** Rs.25-30 lakh **Equipment and machinery:**Double shaft mixer, de-airing extrusion machine. **Raw Materials:** Marine clay, calcined clay (grog) and coal as fuel. **For Further information, please contact** The Director, Central Building Research Institute.	**CBRI**
	**2.1.9 BRICKS FROM RED SOILS** **Product/Process:** Process for making quality bricks from red soils. **Application/Use:** Building bricks from kaolinitic red soils of Karnataka and other peninsular region wherein large tracts of iron rich red clay deposits exist. **Salient Feature of Process/ Technology:** The traditional clamp burning method yields porous bricks with poor strength of 25-35 kg/cm2. Incorporation of 10-15% well graded, processed carbonaceous material and firing in the temperature range of 900-100oG enables manufacture of bricks with a compressive strength: 70-110 kq/cm", water absorption: 16-20% and bulk density: 1.65-1.85 g/cc. **Status of Commercialization:** Ready for commercialization.	**CBRI**

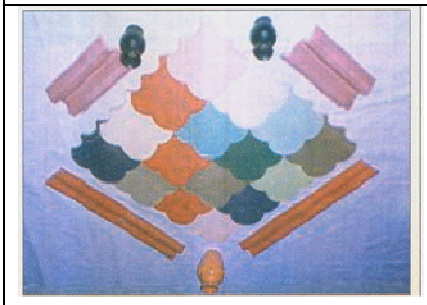
	Minimum Economic Unit Size: 30,000 bricks/ day. **Indicative Investment:** Rs.25-30 lakh **Equipment and Machinery:** Double shaft mixer. **Raw Materials:**Moderately plastic graded red clay, potable water, fine graded carbonaceous materials (flyash, screened cinder, pulverized rice husk! rice husk ash) in optimum quantities, coal as fuel. **For Further information, please contact:** The Director, Central Building Research Institute.	
	**2.1.10 FLYASH-CLAY BRICKS** **Product/Process:** Process for making clay bricks through incorporation of flyash. **Application/Use:** Building industry. **Salient Feature of Process/Technology:** 10-40% flyash is incorporated with the clay depending on the characteristics of clays. The process involves wire cutting of plastic clay mass by manual process and subsequent firing in conventional Bull's kiln or intermittent type kiln at a temp. 950-1050^0 C. The bulk density of such bricks is low resulting in better thermal insulation for the walls and reduced dead load on the masonry structure. Theses bricks otherwise can be used in all constructions in place of normal clay bricks. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 30,000 bricks/day **Indicative Investment:**Rs.25-30 lakh (manual process), Rs.SO-90 lakh (semi-mechanized). **Equipment and Machinery:** Mixer, extruder, brick cutting table, pug mill and/or double shaft clay mixer. **Raw Materials:**Moderately plastic clay mass, flyash and coal. **For Further Information, Please Contact:** The Director, Central Glass & Ceramic Research Institute.	**CGCRI**

2.2 BLOCKS:

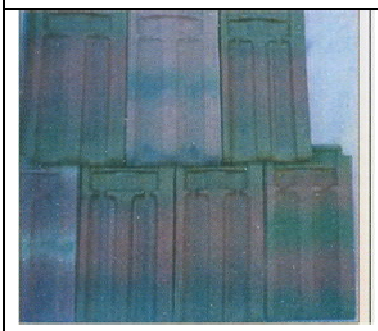
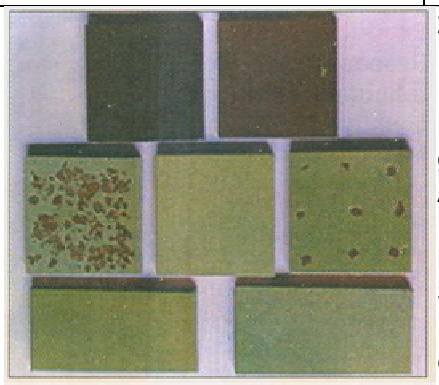
	**2.2.1 CONCRETE BLOCK MAKING MACHINE** **Product/Process:** Machine for casting concrete blocks: (solid and hollow). **Application/Use:** Making Blocks for building and construction industry. **Salient Feature of Process/Technology:** The machine is available in 2 models: (i) Hydraulic machine (ii) Power screw operated egg laying machine. Both model, have capacity to cast 6 solid blocks in a single operation with output of 1000 solid concrete blocks (size 30x20x15 ern) or 650 hollow concrete blocks (size 40x20x20 cm) in 8 hour shift. 5Movement of machine is on 4 wheels and the power requirement is 3 Who. **Status of Commercialization:**Commercialized. **Indicative Investment:** Hydraulic: Rs.2 lakh and **Power Screw Driven:** 1.25 lakh **Equipment and Machinery:**Both models available from CBRI licensees. **For Further Information, Please Contact:** The Director, Central Building Research Institute. Advanced Materials and Processes Research Institute, Bhopal.	**CBRI**
	**2.2.2 SOLID STONE BLOCK** **Product/Process:** Process for making precast stone blocks. **Application/Use:** Economical substitute to traditional random rubble masonry in building construction. **Salient Feature of Process/Technology:** These are cast in 30x20x15 cm or any other size in single mould or battery moulds or by block making machine developed at CBRI. One or two large size stone pieces are placed inside the mould and the voids are filled with smaller stone pieces and lean concrete (1: 5: 8) and then compacted using a plate vibrator or in block making machine. The blocks are then tacked, cured by water and dried. The blocks have a compressive strength of 7 N/mm^2 in the above conc. Mix. **Status of Commercialization:** Commercialized. **Minimum economic Unit Size:** Use of precast stone masonry results in 15-30% savings in the cost. **Equipment and machinery:** Plate vibrator, Block	**CBRI**

	making machine. **Raw Materials:** Stone pieces up to 150 mm size, smaller stone aggregate, cement & sand. **For further information, please contact:** The Director, Central Building Research Institute.	
	**2.2.3 SOLID CONCRETE BLOCK** **Product/Process:** Process for casting solid concrete blocks using a Concrete Block Making machine. **Application/Use:** In building construction. **Salient Feature of Process/Technology:** These are made manually or with help of a machine. In the manual process, single block moulds are used wherein the concrete is compacted with help of a plate vibrator. With the use of a portable power screw driven egg laying type machine, solid concrete blocks are made with higher productivity at low cost. Six blocks of 30x20x5 cm3 size are cast in single operation with an output of 120-150/hr. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** **Manual process:** 200 blocks/shift, investment Rs.0.5 lakh **Mechanical process:**1000 block/shift, investmer Rs.1.5 lakh **Indicative Investment:** **Equipment and Machinery:** Concrete block making machine (available from CSIR licensee), mixer, trolley, plate vibrator (manual process). **Raw Materials:**Cement, concrete, stone aggregates. **For Further Information,Please Contact:** The Director, Central Building Research Institute.	**CBRI**

2.3 TILES:

	**2.3.1 CEMENT BASED VERMICULITE TILES** **Product/Process:** **Application/Use:** Suitable for thermal insulation in Residential, Commercial & Industrial Buildings. **Salient Feature of Process/Technology:** Maximum heat transmission takes place through the exposed surface of the roof (more than 60%). Use of the thermally insulated material provide thermal comfort inside the room on one end and reduce the energy requirement for cooling in summer and heating in winter. Therefore, keeping this in view, we have developed cement based vermiculite tiles using water dispersible polymers along with additives. To get the improved physio-mechanical properties, high pressure compaction technique has been used. These tiles are light weight. All the parameters such as polymer ratio, conditions etc. have been optimized. These tiles can provide thermal insulation to the computer rooms, cold storages etc. as the material arrest the heat dissipation. **Status of Commercialisation:**Commercialized **Minimum Economic Unit Size:** Approx. 1000 m2 (profitability: 20~22%). **Indicative Investment:** **Equipment and Machinery:**Hydraulic Press, Vibration Table, Mixer and Moulds etc. **Raw Materials:**Cement, Water dispersible polymers, Different grades of vermiculite, compatible additives. **For Further Information,Please Contact:** The Director, Central Building Research Institute.	**CBRI**
	**2.3.2 DOUBLY CURVED TILES** **Product/Process:** Manufacture of doubly curved tiles. **Application/Use:** Durable and economical roofing system for low cost houses. **Salient Feature of Process/Technology:** The doubly curved tiles are made by spreading cement concrete (M:15) on hessian cloth stretched over a wooden frame. It is later lifted and the cloth allowed to sag to provide funicular (doubly curved) shape to the mass. This forms the tiles on setting. This tile acts as support for	**CBRI**

	casting of further tiles. **Status of Commercialization.** Extensively used in low cost houses. **Minimum Economic Unit Size:** 200 tiles/day. **Equipment and Machinery:** Wooden moulds. **Raw Materials:** Timber, hessian cloth, cement, sand, stone aggregate. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	
	**2.3.3 FLOORING TILES FROM FLUORO-GYPSUM** **Product/Process:** Flooring Tiles from Fluoro-Gypsum. **Application/Use:** Suitable for use in flooring and general purpose as a replacement to ceramic and cement tiles /Blocks **Salient Feature of Process/Technology:** Tiles are cast by vibration moulding of moist mixture containing gypsum anhydrite plaster/fluoro-gypsum, pigments, polymers, fibers etc. Tiles are of high strength, low water absorption and wear resistance and complied with the requirement of IS:1237-2012. **Status of Commercialisation:**Commercialized **Minimum Economic Unit Size:** 40 sq. tiles per day (3 shifts) **Indicative Investment:** **Equipment and Machinery:**Vibrating table, moulds, mixers, curing chamber, drying chamber, rotatory kiln, ball mill, grinding and polishing machine and demoulding plates. **Raw Materials:**Fluoro-gypsum/Phospho-gypsum as solid waste from Hydrofluoric and Hydrochloric acid Industry. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	**CBRI**
	**2.3.4 TERRACOTTA TILES** **Product/Process:** Manufacture of unglazed semi - vitreous clay tiles. **Application/Use:** Facing, flooring and decoration purpose in buildings. **Salient Feature of Process Technology:** These tiles are less porous, have higher modulus of rupture in comparison to the conventional terracotta tiles and meet BIS specifications. Locally available ferigunious clays are used. For manufacture, the triaxial body composition with	**CGCRI**

	common clay is processed by wet grinding. Tiles can be fabricated in different shapes, sizes and designs. These are fired in an improved up draught kiln at 1000°C-1100°C. Different transparent/color glazes can also be provided subsequently. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 75 tpa. **Indicative Investment:** Rs.12 lakh **Equipment and Machinery:**Pulveriser, ball mill, blunger, agitator, kiln, granulator, pressing machine, etc. **Raw Materials:** Common clay, plastic clay, common clay grog, fire clay grog, quartz, feldspar, etc. **For Further Information**, **Please Contact:** The Director, Central Glass & Ceramic Research Institute.	
	**2.3.5 SELF GLAZED TILES** **Product/Process:** Process for making flooring and facing tiles using clay and flash. **Application/Use:** In building industry, pavements, railway platforms **Salient Feature of Process/Technology:** Constituents are ball milled to desired fineness. The material is filter pressed and dried for pressing. It is sintered at temperature 1280-1300°C. After grinding and polishing, the tiles are ready for use. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 50 m2/day. **Indicative Investment:** Rs.60 lakh. **Equipment and Machinery:** Ball mill, filter press, drier, press, kiln, grinding and polishing machine. **Raw Materials:** Flyash, alumina, talc, clay/silt. **For Further Information, Please Contact:** The Director, Central Glass & Ceramic Research Institute.	**CGCRI**
	**2.3.6 IMITATION GRANITE TILES** **Product/Process:** Process for production of synthetic imitation granite tiles. **Application/Use:** Exotic colored flooring and wall tiles for building industry. **Salient Feature of Process/Technology:** Fly Ash and/or beach sand garnet along with clay, feldspar and some additives are ground to	**CGCRI**

	desired fineness, spray dried and pressed. It is sintered to temp. 11 00-1150°C. The sintered tiles are subjected to grinding and polishing to granolithic finish. The tile looks similar to polished granite. ltis very dense, has excellent mechanical properties and is free from any micro defects. ltcan be produced in many colors and designs. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 700 tons/annum (560 sq. ft./ton). **Indicative Investment:** Rs.60-105 lakh. **Equipment and Machinery:**Edge runner, ball mill, spray drier, press, kiln, grinding and polishing machine. **Raw Materials:** Garnet beach sand, feldspar, clay, flyash. **For Further Information**, **Please Contact:** The Director, Central Glass &Ceramic Research Institute, National Metallurgical Laboratory.	

2.4 CEMETITIOUS BINDERS:

	**2.4.1 RED MUD CEMENTITIOUS BINDER** **Product/Process:** Process to manufacture cementitious binder from red mud in conjunction with rice husk, clay and lime. **Application/Use:** Building and road construction. **Salient Feature of Process/Technology:** The raw materials along with water are blended into a working mix, made into balls of 8-10 cm dia by hand and left overnight for drying. The dry balls are fired and ground in a ball mill along with hydrated lime. The grinding process is continued for 45-60 min to get a fineness of 4000 cm2/g **Status Of Commercialisation:** Ready for commercialisation. **Equipment and Machinery:** Kiln, ball mill, pulveriser, sieves, plastic bags, weighing machine and product testing equipment. **Raw Material:** Red mud (available as waste from aluminum producing industry), rice husk,clay, lime. **For Further Information, Please Contact:** The Director, Advanced Materials and Processes Research Institute, Bhopal.	**AMPRI**

2.5 COMPOSITES/PARTICLE BOARDS:

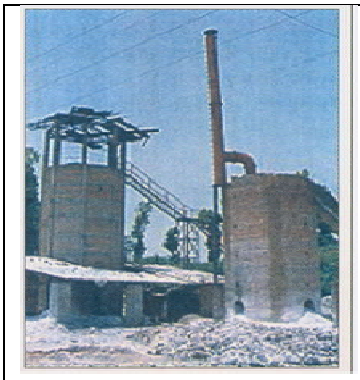
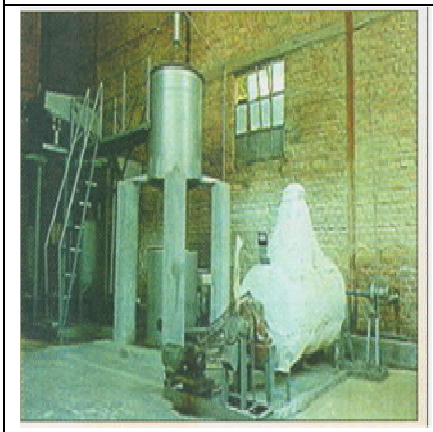
	**2.5.1 WOOD SUBSTITUTES FROM RED MUD** **Product/Process:** Manufacture of R-wood-a composite material from red mud (aluminum industry waste)/fly ash (thermal power plant wastes), natural fiber and polymer. **Application/Use:** As wood substitute for making door panels and building components. **Salient Feature of Process/Technology:** R-wood is stronger than wood; weather resistant; non-corrosive; resistant to termite, fungus, rot & rodents and is fire-resistant. It has bulk density: 1.7 kq/crn", tensile. **Strength:** 25 MPa **flexural Strength:** 75 MPa. For manufacture, the red mud and polymer are mixed with additives and poured in moulds of appropriate size and conditioned. The door shutter/panel, thus fabricated, does not require painting. The flush door shutters are fabricated out of the panels and strips made. The entire processing for the paneled door shutters is done in a single operation. **Status of Commercialisation:**Commercialized. **Equipment and Machinery:** Hydraulic press, moulds & fixtures, mixer, grinder, sander, drill machine, welding machine, pulveriser, oven, kettle, cutter. **Raw Materials:**Red mud, fiber, polymer, additives. **For Further Information, PleaseContact:** The Director, Advanced Materials and Processes Research Institute, Bhopal.	**AMPRI**
	**2.5.2 Hybrid Green Composites Technology ready for commercial production** **Product/Process:** Information not provided. **Application/Use:** Information not provided. **Salient Feature of Process/Technology:** Information not provided. **Status of Commercialization:** Ready for commercialization. **Minimum Economic Unit Size:** 500 panels per shift per day. **Indicative Investment:** Rs.2.5 crores **Equipment and Machinery:** Industrial wastes, Polymers, Fibres. **Raw Materials:** Industrial wastes, Polymers,	**AMPRI**

	Fibres. **For Further Information, Please Contact:** The Director, Advanced Materials and processes Research Institute, Bhopal.	
	**2.5.3 FIBROUS GYPSUM PLASTER BOARD** **Product/Process:** Manufacture of boards from gypsum plaster reinforced with organic fibers like sisal, coir, coconut or Mesta. **Application/Use:** Lightweight partition, false ceiling and lining for interior decoration of buildings. **Salient Feature of Process/Technology:** Process involves sandwiching teased fibers between layers of moist calcined gypsum and slurry poured in steel moulds of 1200 x 600 x 12 mm" size. The product is allowed to set and demoulded after 1-2 hr. These boards are light in weight, fire-resistant and have thermal and sound insulation properties. **Status of Commercialisation:** Commercialized. **Minimum Economic Unit Size:** 3 lakh boards/yr **Indicative Investment:** Rs.60 lakh **Equipment and Machinery:** Mechanized pan calcinator, jaw crusher, roller mill/ball mill, casting tables, MS moulds, wooden racks, buckets and drums. **Raw Materials:** Natural phosphogypsum, marine gypsum, sisal/coir/coconut Mesta fibers, de moulding tools. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	**CBRI**
	2.5.4 GLASS REINFORCED GYPSUM COMPOSITE **Product/Process:** Manufacture of glass reinforced gypsum (GRG) composites. **Application/Use:** As wood substitute material in the buildings for door panel, room partition, wall panel, false ceiling etc., can also be used in furniture industry. **Salient Feature of Process/Technology:** The process employs a spray suction technique which deposits a uniform layer of plaster of Paris slurry intermixed with requisite amount of reinforcing chopped glass fiber. Product exhibits excellent mechanical properties such as impact strength and flexural strength. Panels of any desired size and thickness can be made.	**CGCRI**

	Status of Commercialisation: Commercialized. **Minimum Economic Unit Size:** 50,000 m2/annum. **Indicative Investment:**Rs.35 lakh. **Equipment and Machinery:** Spraying machines, spraying trolley, air compressor, edge trimming & surface grinding machines, screw mixer. **Raw Materials:** High strength plaster of Paris, glass fiber, chemicals. **Further Information, Please Contact:** The Director, Central Glass & Ceramic Research Institute.	
	**2.5.5 MEDIUM DENSITY FIBRE BOARD** **Product/Process:** Process for production of medium density particle boards from agro/forest wastes. **Application/Use:** For making ceiling tiles, partition walls, decorative wall covers, flash doors, show room cabinets, shelves, furniture, fixtures etc. **Salient Feature of Process/Technology:** The process involves cutting and chipping of plant materials to desired size, mixing with binder and other chemicals, pressing in hydraulic press at specific temp, pressure and duration, trimming to desired size and packing. **Status of Commercialisation:** Commercialized. **Minimum Economic Unit Size:** 1.5 tpd (boards). **Indicative Investment:** Rs.50 lakh **Equipment and Machinery:** Chipping machine, particle making machine, sieves, binder mixer, hydraulic press, cutting and trimming machine. **Raw Materials:**Rice husk, agro wastes, forest wastes, weeds, resin binder, chemicals. **For Further Information, Please Contact:** The Director, North-East Institute of Scienc and Technology , Jorhat.	**NEIST**
	**2.5.6 POLYCOIR** **Product/Process:** Manufacture of coir-polymer composite material, named as 'Polycoir'. **Application/Use:** As wood substitute in construction and consumer industries for ready to use parts like door shutters, paneling, chair shells, instrument panel covers, automotive interior, trim parts etc. **Salient Feature of Process/Technology:** Process involves polymer impregnation followed by compression moulding. Process efficiency is	**NIIST**

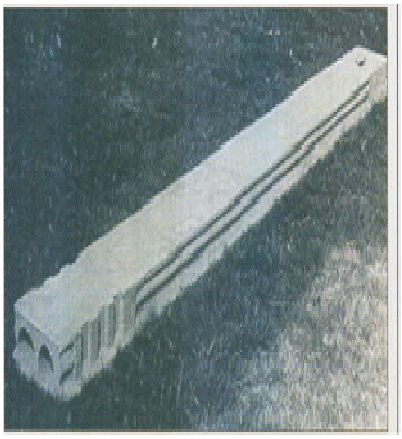
	over 90% and the product quality is superior to standard plywood. **Status of Commercialisation:** Commercialized. **Minimum Economic Unit Size:** 2.5-10 tpct depending on type and size of products. **For Further Information, PleaseContact:** The Director, National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram.	
	**2.5.7BANANA FABRIC POLYMER' COMPOSITE** **Product/Process:** Process for making banana fiber polymer composites. **Application/Use:** Cost effective substitute for glass fiber reinforced plastic to make variety of products e.g. simple trays, mirror casings to voltage stabilizer cover and electrical panels. **Salient Feature of Process/Technology:** The process consists of preparing moulds of metal, wood or plaster of Paris; mixing the resin and dye in requisite proportion; shaping the banana fabric by laying it over the mould; reinforcing the polymer over banana fabric; curing the mould; demoulding; cutting, trimming and polishing. **Status of Commercialisation:** **Minimum Economic Unit Size:** 10 tpa. **Indicative Investment:** Rs.7 lakhs **Equipment and Machinery:** Moulds, storage vessels. **Raw Materials:**Banana fiber, cotton fabric, polyester resin, catalyst, would release agent, dyes and pigments. **For Further Information, Please Contact:** The Director, National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram.	**NIIST**

2.6OTHER BUILDING MATERIAL:

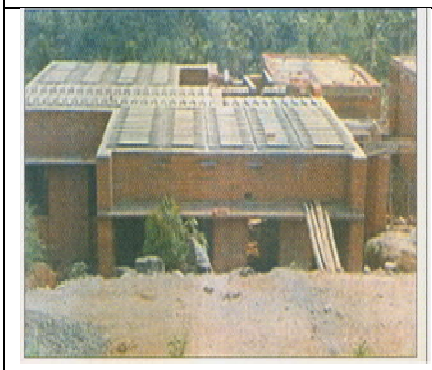
	**2.6.1 POLLUTION MITIGATION IN LIME KILNS** **Product/Process:** A device for washing the emissions of the lime kiln in order to bring down the pollution levels. **Application/Use:** The system is applicable for control of suspended particulate matter (SPM) consisting of dust and tarry organic material emitted from lime kilns. The existing lime kilns can install the system for controlling pollution. **Salient Feature of Process/Technology:** The process involves application of double-deck packed bed scrubber-cum-separator using lime-stone and reusable packing material. The exhaust gases are fed at the bottom of water scrubber. The pollution free gases are sucked through top of the chimney using induced draft fan. SPM levels are brought down from 1,000-2,000 rnq/rn" to within permissible limits. **Status of Commercialisation:** Commercialised. **Indicative Investment:** Rs.3.5 lakh/kiln of 10 tpd capacity. **Equipment and Machinery:** Water scrubber, scrubber-cum-entrainment separator, I.D. fan, chimney with hood, water pump, slurry tanks, pipe fittings and ducting. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	**CBRI**
	**2.6.2 BENEFICIATION OF PHOSPHOGYPSUM** **Product/Process:** Process for beneficiation of phosphogypsum available as by product from phosphatic fertiliser industry. **Application/Use:** Substitute for high purity natural gypsum, suitable for plaster & plaster products. **Salient Feature of Process/Technology:** Beneficiation is done by solubilization of impurities and rejection of coarse fractions retained over 300 microns sieve during wet sieving operation, followed by centrifuging and drying of the product as per IS : 12679-1989. **Status of Commercialisation:** Ready for commercialisation. **Minimum Economic Unit Size:** 3 tpd **Indicative Investment:** Rs.25 lakh **Equipment and Machinery:** Slurry mixer, stirrer,	**CBRI**

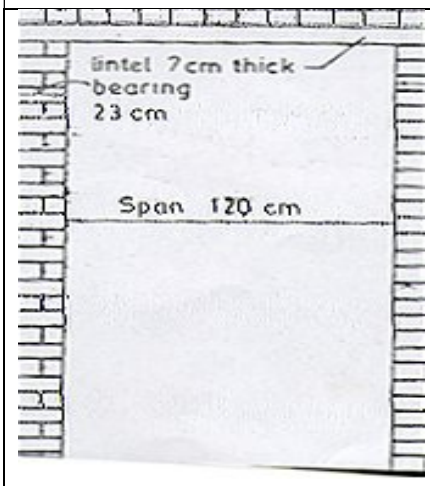
	slurry pump, vibrator separator/screen hydrocyclone, centrifuge filter, rotary drier. **Raw Materials:**Phosphogypsum (a by-product from phosphatic fertiliser industry). **For Further Information, Please Contact:** The Director, Central Building Research Institute.	
	**2.6.3 FORMULATION OF HIGH STRENGTH PLASTER FROM FLUOROGYPSUM** **Product/Process:** Formulation of high strength plaster from fluorogypsum. **Application/Use:** Suitable for use in plastering – Finish coat & base coat. **Salient Feature of Process/Technology:** The high strength plaster is developed by beneficiation and fine grinding of fluorogypsum and admixing it with suitable chemical activators. Plaster showed high compressive strength (30-35 MPa) and low water absorption (< 8 %) and porosity (<10 %) and complied with requirement as given in ASTM C-61-50. The technology for formulation of high strength plaster is simple and no heavy machinery is involved. The plaster is fire resistant, possess good acoustic properties, self-strengthening with time and helps in conservation of cement. **Status of Commercialisation:**Commercialized **Minimum Economic Unit Size:** 1000 tonnes per day (3 shifts). **Indicative Investment:** **Equipment and Machinery:**Ball mill / Vertical Roller mill. **Raw Materials:**Fluoro-gypsum – a waste from hydrofluoric acid industry. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	**CBRI**

2.7 PRECAST/PREFABRICATED BUILDING COMPONENTS:

	**2.7.1 PRECAST CORED UNIT** **Product/Process:** Process for manufacture of precast RC cored units. **Application/Use:** For economical and faster construction of floors & roofs on load bearing wall and framed structures. **Salient Feature of Process/Technology:** Cored units have structurally efficient sections and are suitable for spans of 30cm to 4.2 m. Shuttering &centering are completely eliminated. After erection and assembly, joints between the units are filled with concrete together with the required amount of reinforcement over supports to complete the construction of floors/roof. **Status of Commercialization:** Ready for commercialization. **Minimum Economic Unit Size:** 30 Units/day. **Indicative Investment:** Rs.3 lakhs **Equipment and Machinery:** Timber/steel moulds, concrete mixer, vibrator and light hoisting equipment. **Raw Materials:**Cement, stone aggregates, sand and steel. **For further Information, Please Contact:** The Director, Central Building Research Institute.	**CBRI**
	**2.7.2 PRECAST RC CHANNEL UNIT** **Product/Process:** Process for making precast RC channel units. **Application/Use:** For economical and faster construction of floors and roofs in single and multi-storey buildings. **Salient Feature of Process/Technology:** RC channel units have structurally efficient sections and can span up to 4.2 m. No shuttering or propping is needed. After erection and assembly, joints between the units are filled with concrete to complete the construction of floor / roof. **Status of Commercialization:** Being used in the construction of large number of buildings all over the country. **Minimum Economic Unit Size:** 50 Units/day. **Indicative Investment:** Rs.0.80 lakh **Equipment and Machinery:**Simple steel/timber moulds, concrete mixer, vibrator and light hoisting equipment.	**CBRI**

	Raw Materials: Cement, aggregate and reinforcing steel. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	
	**2.7.3 PRECAST 'L' PANEL** **Product/Process:** Process for making precast 'L' panels. **Application/Use:** Construction of sloping roofs. **Salient Feature of Process/Technology:** The precast 'L' panels are up to 4.2 m long, 30 to 90 cm wide, with 3 to 4 cm thick flanges and 8 to 15 cm deep ribs. These are cast in timber moulds with concrete of M-15 or M-20 grade. After 28 days curing, the units are erected over the gable walls or trusses and laid one over the other with an overlap of 8 to 12 cm. 'L' Panels have several advantages, e.g. shuttering and propping are completely eliminated.However, thermal insulation of these panels is poor and the roof needs anti-corrosive treatment in coastal areas. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 1000 m2 total floor/roof area. **Indicative Investment:** Rs.0.70 lakh. **Equipment and Machinery:**Timber/steel moulds, vibrators, concrete mixer and light hoists. **Raw Materials:**Cement, aggregate, steel reinforcement. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	**CBRI**
	**2.7.4 PRECAST THIN RIBBED SLAB** **Product/Process:** Process for making thin RC ribbed slabs at site. **Application/Use:** For floor & roofs in single and multi-storey residential and other types of buildings. **Salient Feature of Process/Technology:** Thin RC ribbed slab consists of precast! cast-in-situ RC ribs 110x200 mrn", spaced at 1200 mm/cc with 50 mm thick cast in-situ RC flange above. In case of heavily loaded floors and roof, the size and reinforcement of the ribs and flanges are increased appropriately. Its use effects saving of 22% in overall cost. **Status of Commercialization:** Technology released free and is being adopted in a number of residential and school buildings in the country.	**CBRI**

	Minimum Economic Unit Size: 1000 m2 total floor/roof area in repeated design of houses. **Indicative Investment:** Rs.0.80 lakh. **Equipment and Machinery:** Moulds, shuttering panels, mixers, vibrators. **Raw Materials:** Cement, steel, aggregates. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	
	**2.7.5 CONCRETE PANEL SYSTEM** **Product/Process:** Process for making prefabricated concrete panels. **Application/Use:** Rapid and economic construction of roof! floor in low cost houses in areas where good quality bricks are not available but ingredients for cement concrete are locally available. **Salient Feature of Process/Technology:** The system consists of 4 cm thick precast concrete panels and partially precast concrete joists of required length, size and reinforcement. The concrete panels are supported on the joists. 3 cm thick cement concrete is laid over the panels to form monolithic part of the roof/floor along with reinforcement provided in it. **Status of Commercialization:** Extensively being used in rural areas and various housing schemes for EWS. **Minimum Economic Size:** 20 joists and 100 panels/day. **Indicative Investment:** Rs.0.50 lakh. **Equipment and Machinery:** Vibrators, moulds. **Raw Materials:** Cement, sand, stone aggregate, reinforcing steel. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	**CBRI**
	**2.7.6 PRECAST RC PLANK AND JOIST** **Product/Process:** Production of precast RC planks 30 cm wide X 3-6 cm thick x up to 1.2 m long; precast RC joists 15 cm x 15 cm x up to 4.2 m long at construction site **Application/Use:** For economical and faster construction of floors and roofs of single and multi-storied buildings. **Salient Feature of Process/Technology:** The	**CBRI**

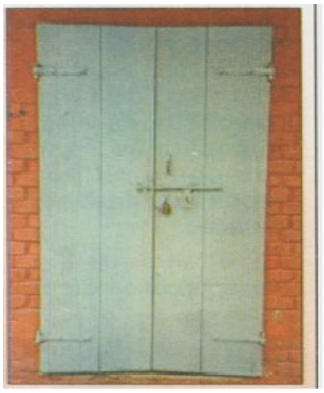
	floor / roof is constructed with precast RC joists and precast RC planks. The components are produced on a casting platform at construction site. As soon as the walls reach the floor / roof level, the components are erected, assembled and partly filled up with concrete to form the floor / roof. This scheme results in saving 20% in overall cost, 25% in cement and 10% in steel as compared to conventional R.C. slab floor / roof. **Status of Commercialization:**Technology being used in mass construction of houses and other buildings by State Housing Boards, PWDs. **Minimum Economic Unit Size:**1000 m2 total floor area in repeated design of houses. **Indicative Investment:** Rs.0.60 lakh. **Equipment and Machinery:**Steel/timber moulds and light hoisting equipment. **Raw Materials:**Cement, aggregate, steel reinforcement. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	
	**2.7.7 PRECAST THIN LINTEL** **Product/Process:** Process for making precast thin R.C. lintels **Application/Use:** For economical and faster construction of floors and roofs of single and multi-storied buildings. **Salient Feature of Process/Technology:** Used in place of traditional cast in-situ lintels over openings for speedy and economic construction of walls. In a wall having lintel and masonry above, the two components act together composite in supporting the load, tension being taken by the lintel and compression by the brick work. Hence, 7 cm thick and 23 cm wide precast lintels with two 10 mm dia ms reinforcement can be used up to 1.5 m span. Use of precast lintels speeds up the construction of walls,besides eliminating shuttering and centering. **Status of Commercialization:**Widely adopted in construction. **Minimum Economic Unit Size:** 100 lintels/day. **Indicative Investment:** **Equipment and Machinery:** Moulds, concrete mixer, vibrator. **Raw Materials:** Cement, steel and aggregate. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	**CBRI**

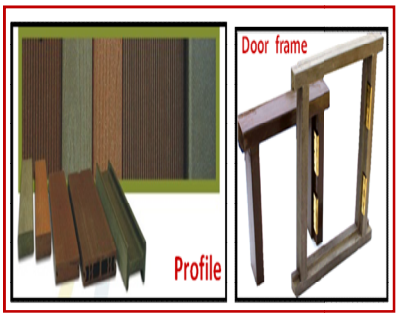
	**2.7.8 LIQUID EXTINGUISHANT FIRE EXTINGUISHER** **Product/Process:** Fire Extinguisher **Application/Use:** Suitable to combat the following fires with the following key uses/application areas: Class A All-type Combustible Material Fires" such as paper, wood, cloth, etc.; Class B Flammable Liquid Fires" such as petrol, diesel, kerosene; Class K Kitchen-Pan Fires for women's fire safety" and the "Electrical fires" due to short-circuits. **Salient Feature of Process/Technology:** Fire Suppression Time: 8-10s on 100 cm2 Size Class A & B Fires and 25-30 on 1000 cm2 Fire, Extinguishant App. Rate: 3-5 g/s for different Classes of fires. **Status of Commercialization:**Licensed, Available for licensing. **Minimum Economic Unit Size:** **Indicative Investment:** **Equipment and Machinery:**Plastic or SS304 Mixing Containers with mixing device @ 30-40RPM at ambient temp. & pressure, storage containers; Spray-bottles can be procured either from the market and/or the Bottling and manufacturing plant for Spray-bottles may be set-up either for Plastic or SS202/304 bottles with conveyer-belt facility. **Raw Materials:**Novel Fire extinguishing composition & water. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	**CBRI**

2.8 ROOFING PLANKS AND SHEETS:

	**2.8.1 SISAL FIBRE-CEMENT ROOFING SHEET** **Product/Process:** Process for manufacture of roofing sheets based on sisal fiber reinforced cement. **Application/Use:** For roofing/partitions in the building. **Salient Feature of Process/Technology:** The sisal fibers are cut into small pieces, treated and mixed with cement sand matrix. The mix is spread on a flat sheet and then placed over a corrugated mould and pressed. Sheets are demoulded and cured for 2 weeks. For a plant of 200 sheets per day cap, 100 L water and 50 HP power is required. **Status of Commercialization:** Ready for commercialization. **Minimum Economic Unit Size:** 200 sheets/day **Indicative Investment:** Rs.15 lakh **Equipment and Machinery:** Hydraulic press, moulds, mixer, gantry crane and trimming equipment. **Raw Materials:** Sisal fiber, sand, cement, wire mesh. **For Further Information, Please Contact:** The Director, Advanced Materials and Processes Research Institute.	**AMPRI**
	2.8.2 CLAY-CONCRETE ROOFING PLANK **Product/Process:**Process for making clay tile roofing planks suitable for sloped roof and clay channel roofing planks suitable for flat roof. **Application/Use:** **Salient Feature of Process/Technology:** It is a low cost, maintenance-free roofing material. The tiles and channels are made of common clay with admixtures of industrial wastes. Burnt tiles are arranged in a mould along with nominal steel reinforcement and joined with concrete. The entire roof is then covered with a monolithic screed concrete. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 100 planks/day **Indicative Investment:**Rs.3 lakh. **Equipment and Machinery:** Mixer, plate vibrator. **Raw Materials:** Clay burnt tiles/channels, stone chips, sand, cement. **For Further Information, Please Contact:** The Director, Central Glass & Ceramic Research Institute.	**CGCRI**

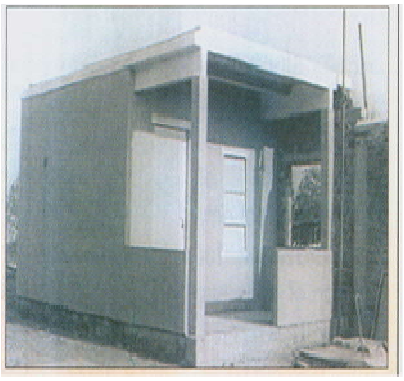
2.9 OTHER BUILDING COMPONENTS

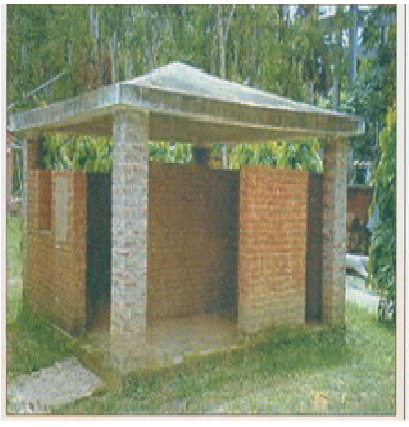
	**2.9.1 FRAMELESS DOOR AND WINDOW FIXTURE** **Product/Process:** Fabrication of frameless door & window fixtures. **Application/Use:** Construction of low cost houses. **Salient Feature of Process/Technology:** The frames for door and windows consume substantial quantity of timber, which is scarce and costly. Frameless door and window fixtures save the use of timber and reduce the overall cost of the house. Special pivot type and fork type hinges are used to eliminate the use of wooden frames. These are directly fixed in the floor and door lintels to support the shutters. **Status of Commercialization:** Extensively used in rural and urban houses constructed for EWS. **MinimumEconomic Unit Size:**500 fixtures/day **Equipment and Machinery:** Welding machine and normal blacksmithy tools. **Equipment and Machinery:** Mild steel bars, plates and angles. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	**CBRI**
	**2.9.2 WATER PROOFING COMPOSITIONS FOR MASONRY SURFACE** **Product/Process:** Manufacture of silicate-based waterproofing compositions for cementitious and non-cementitious exposed masonry surface. **Application/Use:** For application on cement plaster and lime concrete surface in the buildings. **Salient Feature of Process/Technology:** Composition does not interfere with color of the surface, long shelf life if kept sealed, dilutable with potable water, can be applied bysemi-skilled labour; life of treatment is about 5 yr. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 400 U/day **Indicative Investment:** Rs.7 lakh (for each technology). **Equipment and Machinery:** Mixer with impeller, water distillation plant, airtight drums and laboratory equipment. **Raw Materials:**Commercial quality sodium silicate, bentonite clay, distilled water, chemicals. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	**CBRI**

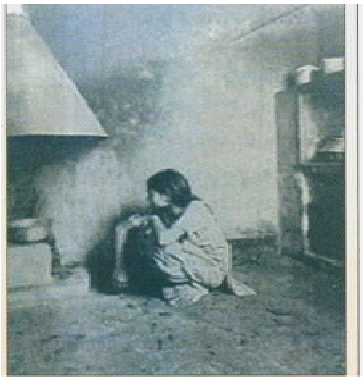
	**2.9.3 RICE HUSK PLASTIC COMPOSITE (WOOD WITHOUT TREE)** **Product/Process:** **Application/Use:** Window & door frames, profile panels, decking, fencing, flooring, park benches etc. **Salient Feature of Process/Technology:** Wood like surface appearance, dimensionally stable, biologically durable, easily recyclable, carpenter friendly, replacement of natural wood, meets requirement of NBC 2005, Sec.3, Timber. **Status of Commercialization:**Commercialized **Minimum Economic Unit Size:** **Indicative Investment:** **Equipment and Machinery:**Digester, k-mixer/k-kneader, extruder, engineering moulds and other ancillary items. **Raw Materials:**Rice husk, thermoplastic resins and additives. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	**CBRI**
	**2.9.4 TOILET UNITS USING THIN PRECAST CONCRETE SEGMENTAL PANELS** **Product/Process:** Toilet **Application/Use:** In India 65% of its population has inadequate toilet facilities. The government aims to make India Open Defecation Free and clean by 2nd October, 2019, through Swachh Bharat Mission. For this scheme central government gives 75% subsidy and State government gives 15% subsidy and 10% beneficiary share. In fulfilling the Swachh Bharat Mission, CSIR-Structural Engineering Research Centre (SERC), Chennai has developed precast thin concrete segmental panels for mass construction of low cost toilet units. **Salient Feature of Process/Technology:** • Ease of Handling • Use of Industrial Wastes • Ease of erection • Ease of Construction • Speedy in Assembling by 3 persons in 1 hour • Cost Effective • Durable **Status of Commercialization:** Transferred to M/s. Lakshmi Srinivas Engineers, Plot No.101, Phase-I, road No.12, I.D.A., Mallapur, Hyderabad-500076. during	**SERC**

	2017. **Minimum Economic Unit Size:** Size of Toilet Unit-4ft. x 3ft. x6t. and Septic Tank size – 6ft. x 3ft. x 2ft. **Raw Materials:**Precast thin concrete **For Further Information, Please Contact:** The Director, Structural Engineering Research Centre.	

2.10 BUILDING SYSTMS:

	**2.10.1 CONCRETE SKELETON SYSTEM** **Product/Process:** Construction of concrete skeleton structure, i.e. column and roof only with provision for subsequent addition of walls etc. **Application/Use:** Construction of a house in stages, depending upon financial availability. Suitable in areas where bricks are of very poor quality and material like sand and stone aggregate are available locally. **Salient Feature of Process/Technology:** The system consists of precast RCC pocket footings, hollow columns, beams and doubly curved tiles to form skeleton structure. Cladding walls can be done later with any local material. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 22 rn". **Indicative Investment:** Rs.0.45 lakh **Equipment and Machinery:** Vibrators, moulds **Raw Materials:** Precast RCC components like pocket footings, columns, beams, joists, doubly curved tiles, cement, sand, stone, aggregate, steel reinforcement. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	**CBRI**
	**2.10.2 INSTANT SHELTER 'FOR DISASTER RELIEF** **Product/Process:** Skeleton structure for a timber based rural house i.e. construction of column and roof only with provision for addition of walls etc. at later stage. **Application/Use:** Construction of cost effective house in stages. **Salient Feature of Process/Technology:** Secondary species of local timbers like mango are utilized. The system provides a span of 286 cm and an overhang of 177 cm on both sides and columns. Two such bays provide a room of 335 x 177 cm with two verandas of 408 x 155 cm size. The timber is treated against white ants by creosote painting. The two columns and members of truss are nail-jointed in the form of three components. These components are then connected together by bolts. It provides 15-40% economy compared to conventional timber structures.	**CBRI**

	Status of Commercialization: Demonstrated at various sites. **Minimum Economic Unit Size:** 25 m2 **Indicative Investment:** Rs.0.30 lakh **Equipment. and Machinery:**Nil **Raw Material:** Timber, nails, bolts. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	
	**2.10.3 PEDESTAL PILE** **Product/Process:** Cost effective, fast and simple foundation system for small buildings. **Application/Use:** Construction of low cost houses in black cotton soil and other filled-up or weak soil areas **Salient Feature of Process/Technology:** The foundation needs to be taken to firm strata in such soils. This technology is an economical substitute to under-reamed pile foundation for small buildings where load on pile is less in comparison to the capacity of under-reamed piles. This system consists of a reinforced precast concrete pile (10 cm x 10 cm), which is lowered, in a borehole of 30 cm dia. The lower part of the pile has projected reinforcement for embedding the pile in-situ concretes and lay in the bottom of borehole to form pedestal. **Status of Commercialization:** Houses constructed in coastal area of Andhra Pradesh and Tamil Nadu **Minimum Economic Unit Size:** 100 piles/day **Equipment and Machinery:** Auger with accessories for making bore holes, mould for casting the piles. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	**CBRI**
	**2.10.4 UN-REINFORCED PYRAMIDAL ROOF** **Product/Process:** Process for making pyramidal brick roof without reinforce- mint. **Application/Use:** Low cost houses in cyclone effected and other coastal areas. **Salient Feature of Process/Technology:** Corrosion of reinforcement is the major cause of failure of RCC structures in coastal areas due to saline and humid conditions. A pyramidal roof with brick and cement concrete without reinforcement has been developed. The roof is	**CBRI**

	provided with peripheral RCC ring beam. The beam is supported on brick columns or walls and is cast as integral part of the pyramidal roof using suitable shuttering. The process eliminates chance of corrosion and enhances the life of roof. The roof is economical in comparison to RCC roof. **Status of Commercialization:**Ready for commercialization. **Minimum Economic:**18 m2 **Indicative Investment:**Rs.0.50 lakh **Equipment and Machinery:**No major equipment is required. **Raw Materials:**Bricks, cement, sand, stone aggregate and reinforcing steel. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	
	**2.10.5 KITCHEN CHIMNEY** **Product/Process:** Design of chimney for extraction of smoke from domestic kitchen. **Application/Use:** Smoke-free kitchen. **Salient Feature of Process/Technology:** The chimney hood is made in the shape of a quarter of a cone with 0.65 m radius of the base and 600 apex angle. A 0.21 m die cylindrical pipe or smooth plastered rectangular masonry duct is mounted atop the hood. A lid is mounted 0.1 m above the flue projecting 0.05 m all around. The grating made of a stretched piece of ordinary fly screen is inserted at the joint of hood and flue. This design effects smokeless environment in the kitchen. **Status of Commercialization:** Ready for commercialization. **Minimum Economic Unit Size:** Rs.600/chimney **Equipment-and Machinery:** No major machinery **Raw Materials:** GI sheets or masonry work. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	**CBRI**
	2.10.6 INSTANT SHELTER FOR DISASTER RELIEF **Product/Process:** Design and construction of instant shelters. **Application/Use:** Suitable for providing instant houses for relief and rehabilitation after natural disasters e.g. earthquake, cyclone, flood etc. **Salient Feature of Process/Technology:**	**CBRI**

	Instant shelter can be erected in 5 to 20 minutes. It is made up of triangular pipe frames joined together with the help of special joints to form a component that can be folded as one triangular bundle. Four such components having 16 triangles provide an octagonal room of 4.41 m x 4.41 m size. The cladding can be made of cloth, tarpaulin, plywood, GI sheet, thatch, insulating coverings etc. depending upon climatic conditions &resources. **Status of Commercialization:** Design and construction know- how available. **Minimum Economic Unit Size:** 20 m2. **Indicative Investment:** Rs.0.20 lakh **Equipment and Machinery:** Standard workshop equipment. **Raw Materials:**ERW steel pipes, special hinges, cleats, nuts and bolts; covering cloth or any other material for cladding. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	
	2.10.7 RAPID REPAIR OF CONCRETE STRUCTURES **Product/Process:** Process for rapid repair of damaged concrete structures using Sulphur concrete technology. **Application/Use:** Suitable for rapid repair of damaged structures in marine and coastal area where tidal conditions restrict the possibility for repair in conventional manner. **Salient Feature of Process/Technology:** Entire process of repair can be completed within a very short time, e.g. 1m^2/hr.since no curing is required. Peak strength is attained within 3-4 hr. after casting and it offers good protection to the embedded reinforcement steel against corrosion. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** Can be applied to any reasonable size. **For Further Information, Please Contact:** The Director, Central Electrochemical Research Institute.	**CECRI**

 	**2.10.8 COST EFFECTIVE WATER TANK USING FLOWABLE CEMENT MORTAR** **Product/Process:** Water Tank. **Application/Use:** Storage of Water for domestic use/ Community us Storage of Water for domestic use/ Community use. **Salient Feature of Process/Technology:** • Cost-effective compared to commercially available tanks. • Easy-to-build. • Durable and safe. • Weight of the tank is relatively less when compared to RCC and masonry tanks. • Viable alternative to plastic tanks. • Water tank can be constructed using thin precast concrete panels and can be assembled in 30 minutes. • No machinery required for lifting the tank. **Status of Commercialization:**Transferred toM/s. Lakshmi Srinivas Engineers, Plot No.101, Phase-I, road No.12, I.D.A., Mallapur, Hyderabad-500076. during 2017. **Minimum Economic Unit Size:**1000 liters' capacity. **Equipment and Machinery:** M S Mould and mixer machine **Raw Materials:**Cement, fine aggregate, mineral admixture, weld mesh, Rs.3000 per 1000-liter capacity tank. **For Further Information, Please Contact:** The Director, Structural Engineering Research Centre.	**SERC**
	**2.10.9 PRE-FABRICATED EPS – LIGHTWEIGHT REINFORCED CONCRETE BUILDING TECHNOLOGY** **Product/Process:** EPS Panels **Application/Use:** For mass and affordable housing For quality and speedy construction Constructions in earthquake prone areas Lightweight buildings suitable for poor soil conditions.For all types of single and multistoried buildings. **Salient Feature of Process/Technology:** Reinforced concrete Expanded Polystyrene (EPS) panels are made of Expanded Polystyrene foam sandwiched between thin and strong	**SERC**

	reinforced concrete skins. The salient features of the reinforced concrete EPS technology developed at CSIR-SERC are: • Use of EPS in the middle of the sandwich panel to act as thermal insulator. • Panels are extremely light in weight, which helps in reducing the seismic loads and are easy to handle, transport and erect. • Based on the lab level testing, the EPS panels are found to be structurally adequate as wall and roofing elements and can withstand wind speeds of 65 m/s and a typical building model is found to have adequate seismic resistance. • By employing this type of construction, formwork is eliminated to a greater extent. • This knowhow/technology allows for customization, stronger and faster mode of construction - the attributes required for mass housing. **Status of Commercialization:**Transferred to M/s. Level 9 Biz Pvt. Ltd., SCO 12, Top Floor, Sector 80, Airport Road, SAS Nagar, Mohali – 140308, Punjab during 2017. **Raw Materials:**Expanded Polystyrene (EPS) panels are made of Expanded Polystyrene foam sandwiched between thin and strong reinforced concrete skins. **For Further Information, Please Contact:** The Director, Structural Engineering Research Centre.	

2.10.10 TEXTILE REINFORCED CONCRETE PROTOTYPING TECHNOLOGY (TRCPT)

SERC

Product/Process: Panels

Application/Use:

• Standalone components - sandwich panels, façade elements, industrial flooring tiles, street furniture, canopy structures partition walls, noise barriers, roofing elements, manhole cover, and non-structural components such as flower pot, wash basin, door and window frame, door panel, etc.

• Repair, rehabilitation and retrofit of concrete and masonry structures.

Salient Feature of Process/Technology:

• A single technology for producing multiple structural and non-structural components of textile reinforced concrete.

• Both pre-fabricated and in-situ applications are possible with TRCPT

• Non-corrosive and hence filigree concrete construction (thickness vary between 8mm to 30mm) is possible.

• Different products can be custom made as per requirement without modification in the apparatus

• Completely different from the conventional method of concrete construction and eliminates the need for molds.

• Less product cost with increased production rate.

• Appropriate scaling up of implementation of this technology to address various construction practices.

Status of Commercialization: Transferred to M/s. Smart Built Prefab PVT. LTD., Regd. Office: Flat No. 401, T-2, Mountain Plaza, Road No.2, Banjara Hills, Hyderabad-500034 during 2017.

Raw Materials:

• Cementitious binder - binder can be modified according to mechanical characteristics of various applications.

• Textile as reinforcement- various textiles such as alkali resistant glass, carbon, aramid, polypropylene, jute, coir, etc.

• For e.g. for a typical case: Glass Textiles- Rs.60-100/m2.

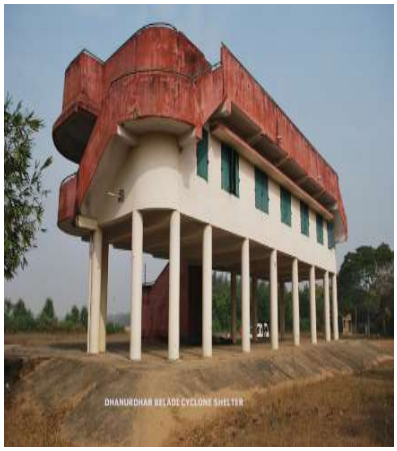
• Binder cost- Rs.9000/m3

For Further Information, Please Contact:

The Director, Structural Engineering Research Centre.

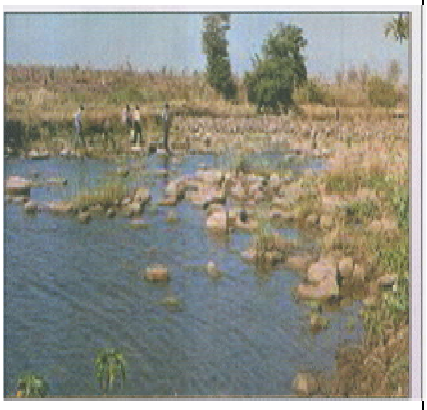
2.11 SHELTERS

	**2.11.1 DESIGN FOR SOLAR HEATING IN HILL SHELTERS** **Product/Process:** Design of Trobe wall system for solar passive heating of buildings for comfortable temperature during winters. **Application/Use:** Built-in solar heating system for residential and office buildings in hilly/cold regions. **Salient Feature of Process/Technology:** The house is constructed as per normal practice. The south wall is painted black and covered with plain 4 mm thick double glass panes. Openings are provided in the wall near the floor level as well as the ceiling level. The air trapped between the wall and the glass gets heated due to the solar radiation absorbed by the wall. Due to temp. difference across two sides of the wall, the exchange of air takes place by stack effect. The room gets heated inside through conduction, convection and radiation. The indoor temp. of 20-22°C is attained while the outside temp. is 10°C at a particular point of time. **Status of Commercialization:** Demonstrated at a building in Neonatal. **Minimum Economic Unit Size:** Rs.350/m2 wall area. **Raw Materials:**Glass panes 4 mm thick, wooden battens, black paint. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	**CBRI**
	2.11.2 DESIGN FOR LIGHTING AND VENTILATION IN RURAL SHELTERS **Product/Process:** Design methodology for adequate indoor day lighting and air ventilation. **Application/Use:** Rural houses. **Salient Feature of Process/Technology:** The norms for natural illumination and ventilation in rural houses are quite different since most of activities there are performed in the open space. The openings (windows and doors) should provide at least 80 Lux of illumination throughout and 160 Lux in the center of the room. Similarly, ventilation of 3 a.m. is essential for comfort requirements whenutdoor wind speed is 2-5 km/hr. Based on data of daylight availability and prevailing wind direction, design parameters are	**CBRI**

	evolved for the location, direction and extent of openings to ensure adequate daylight and breeze indoors. **Status of Commercialization:** Ready for commercialization. **Minimum Economic Unit Size:** Adequate daylight and ventilation at no extra cost, saves 20-60% energy. **Raw Materials:**Plain window glazing **For Further Information, Please Contact:** The Director, Central Building Research Institute.	
	**2.11.3 AERODYNAMICALLY SHAPED CYCLONE SHELTER** **Product/Process:**Cyclone Shelter **Application/Use:**Cyclone shelters are a major infrastructural facility for sheltering marooned people during the occurrence of cyclone events. These shelters will also be used for multi-purpose viz., school, community halls during normal times. CSIR-SERC has developed a novel design of multi-purpose cyclone shelter with stilt and aerodynamically shaped corners. **Salient Feature of Process/Technology:** • To shelter at least 1000 people • Selection of appropriate design wind speed based on risk analysis of cyclonic wind speeds carried out at CSIR-SERC • Provision of stilt, and sloping ground to satisfy functional requirements against storm surges/flood • Selection of suitable aerodynamic shape to effectively resist cyclonic wind forces • Circular columns • Continuous RC hand rails (GI), lintel and loft • Wider Staircase at both ends (0.95 m) • Under-reamed pile/strip footing • 1.2 m high R.C. parapet wall **Status of Commercialization:** Design solutions were provided to the Indian and German Red Cross and KFW, Germany for the construction of 23 cyclone shelters during 1999 Orissa super cyclone that saved more than 40,000 lives More than 1,00,000 affected people were housed in these shelters during Cyclone Paulin of 2013, No economic value can be attached to the people's life saved!! **Raw Materials:**Conventional concrete construction material,Cement, sand, water, coarse aggregate at standard rates. **For Further Information, Please Contact:**	**SERC**

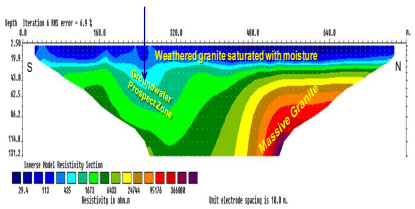
	The Director, Structural Engineering Research Centre.	

3.1 DRINKING WATER (WATER SUPPLY)

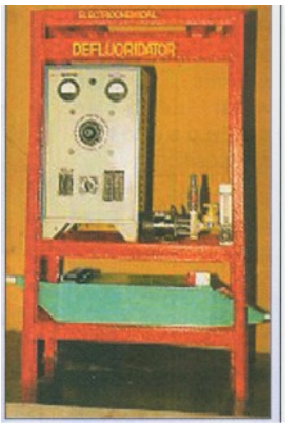
	**3.1.1 WATERSHED DEVELOPMENT** **Product/Process:** Process to augment under-ground water resource and check soil erosion. **Application/Use:** Sustainable water supply in dug *wells hand* pumps; augment drinking water supply &irrigation potential, check soil erosion, reclamation of wastelands. **Salient Feature of Process/Technology:** The concept of 'hill to valley' is adopted to arrest rainwater at selected points in the catchment area. In the hilly terrain, continuous as well as discontinuous trenches are made while in the valley, continuous trenches, boulder check dams or ponds are constructed on *secondary tertiary* drains. These water storage structures recharge the ground water and raise the water table level. This also checks soil erosion. Micro watersheds can be planned in semi-arid zones. It takes 3 yr. for marked impact. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 200/ha **Indicative Investment:** Rs.4,000/hain a typical case. **Equipment and Machinery:** Normal soil digging tools. **For Further Information, Please Contact:** The Director, Advanced Materials and Processes Research Institute, Bhopal.	**AMPRI**
	**3.1.2 ARTIFICIAL RECHARGE OF GROUNDWATER** **Product/Process:** Process for recharge of ground water aquifers/hand pumps/dug wells/tube wells through rainwater. **Application/Use:** For providing sustainable drinking water to villages having acute water scarcity, particularly during summer months. **Salient Feature of Process/Technology:** The groundwater structures are recharged by allowing rainwater to percolate down the aquifers at leisure pace thereby raising the water table. For this activity, suitable weathered/fractured zones are identified for recharge after field investigations w.r.t. geology, topography and	**AMPRI**

	location. Micro catchment artificial recharge plan is developed. In a typical case of hard rock, small stop/check dams are constructed in pervious geological formations, which allow percolation of rainwater. The impact can be noted after 1 yr. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** A village of 200 population. **Indicative Investment:** Rs.0.60 lakh in a typical case. **Equipment and Machinery:** Drilling equipment. **Raw Materials:**Local loose boulders, clay, sand, etc. **For Further Information, Please Contact:** The Director, Regional Research Laboratory, Bhopal.	
	**3.1.3 REJUVENATION OF CLOGGED BOREWELLS** **Product/Process:** Process to rejuvenate old clogged bore wells. **Application/Use:** For improving water yield from old bore wells suffering from clogging problem. **Salient Feature of Process/Technology:** The old bore wells often clog due to mineral deposition. These can be rejuvenated through incorporation of a non-toxic chemical formulation followed by hydrofructuring. During a 5 hr. simple treatment, the clogging material clears out resulting in manifold increase in water output. The rejuvenation success rate is 90%. **Status of Commercialization:** Successfully demonstrated at several sites. **Indicative Investment:** Rs.13,000 for a bore well including cost of chemicals, labor and machine charges. **Equipment and Machine:**Hydro fracturing machine (on hire). **Raw Materials:** Water 2000 L for a bore well, chemicals. **For Further Information, Please Contact:** The Director, Advanced Materials and Processes Research Institute, Bhopal.	**AMPRI**
	3.1.4 ESTIMATION OF GROUNDWATER LEVEL (SHALLOW) APPLYING THERMAL REMOTE SENSING **Product/Process:** A process has been developed to understand relationship amongst Soil moisture, soil temperature and ground water level.	**AMPRI**

	Application/Use: This process will help in management of irrigation water, irrigation scheduling and prediction of crops etc. **Salient Feature of Process/Technology:** Information not provided. **Status of Commercialization:**Ready for commercialization. **Minimum Economic Unit Size:** Rs.1500/-unit cost. **Indicative Investment:** Rs.15 lakh for making 20 filter unit /day basis. **Equipment and Machinery:** Soil moisture and temperature sensor, Ground water level recorder, data logger. **Raw Materials:** Remote Sensing Data, Soil Moisture data, soil temperature data, Ground water level. **For Further Information, Please Contact:** The Director, Advanced Materials and processes Research Institute, Bhopal.	
	**3.1.5 5HP, 3-PHASE PV POWERED VARIABLE-FREQUENCY DRIVE SUITABLE FOR DEEP WELL PUMP** **Product/Process:** 5HP, 3-Phase PV powered variable-frequency drive suitable for deep well pump. **Application/Use:** Irrigation, Drinking Water, Forestry, Fishery, Fountains. **Salient Feature of Process/Technology INPUT:** Max. PV voltage: 750V; Max. MPPT Efficiency:99%; OUTPUT: Rated output voltage, output frequency range, SYSTEM: Efficiency Range, Depth. **Status of Commercialization:** Ready for commercialization. **Minimum Economic Unit Size:** **Indicative Investment:** **Equipment and Machinery:** **Raw Materials:** **For Further Information, Please Contact:** The Director, Central Electronics Engineering Research Institute.	**CEERI**

 	**3.1.6 EXPLORATION AND MANAGEMENT OF GROUNDWATER RESOURCES** **Product/Process:** Exploration and Management of Groundwater Resources for meeting the drinking water needs of rural communities in water scarce areas **Application/Use:**Finding out the appropriate sources of groundwater for drinking and irrigation purposes. Recharge Solutions and Sustainable Management of groundwater resources. **Salient Feature of Process/Technology:** CSIR-NGRI has adopted an integrated geophysical approach which led to the precise understanding of the disposition of sub-surface features in 3-D and delineating potential aquifers for recharging them. This kind of approach requires a multi-disciplinary approach where inputs from geophysics, geology, hydrology, remote sensing & GIS, sociology, environment etc. are needed and help in sustainable groundwater sources to rural communities living in water scarce areas. **Status of Commercialization:** S&T Solution **Indicative Investment:** **Equipment andMachinery:** Resistivity Meter Water level Indicators. **For Further Information, Please Contact:** The Director, National Geophysical Research Institute.	**NGRI**

3.2 WATER PURIFICATION

	**3.2.1 WATER DEFLOURIDATION THROUGH NANO ADSORBENT BASED DOMESTIC FILTER** **Product/Process:** Low cost Nano adsorbent and domestic filter **Application/Use:** Nano coating for the incorporation Nano adsorbent in to the sediment removal filter is a new concept in order to provide simple filtration device at household level. **Salient Feature of Process/Technology:** Nanoadsorbent based defluoridation domestic filter that can work without electricity with 1 liter to 3 liters per hour filtration rate. **Status of Commercialization:**Ready for commercialization. **Minimum Economic Unit Size:** Rs.1500/-unit cost. **Indicative Investment:** Rs.15 lakh for making 20 filter unit /day basis. **Equipment and Machinery:** Furnace, mixture, centrifuge, digestion unit, heating oven etc. **Raw Materials:** Low cost chemical, aluminum metal, sodium hydroxide etc. **For Further Information, Please Contact:** The Director, Advanced Materials and processes Research Institute, Bhopal.	**AMPRI**
	**3.2.2 WATER DEFLUORIDATION: ELECTROLYTIC TECHNIQUE** **Product/Process:** Process for removal of excess fluoride from water by using electrochemical process. **Application/Use:** Fluoride-free safe drinking water. **Salient Feature of Process/Technology:** Aluminum hydroxide is generated in an electrochemical cell fitted with soluble aluminum electrodes. When a DC current is applied, the anode dissolves and provides the required aluminum hydroxide that adsorbs and removes fluoride from the water. The process provides effective de-fluoridation media that has selective high efficiency for fluoride removal. The total system is simple in operation and maintenance. Community de-fluoridation plants of required model and capacity can be designed and fabricated. No chemical is added. It has unit operations like settling and clarification.	**CECRI**

	Status of Commercialization: Commercialized **Minimum Economic Unit Size:** At semi-pilot scale. 200 U/hr. **Equipment and Machinery:**Electrochemical cell fitted with soluble aluminum anodes. **Raw Materials:** Soluble aluminum anodes. **For Further Information, Please Contact:** The Director, Central Electrochemical Research Institute.	
	**3.2.3 MERCURY-FREE PLASMA UV-LAMP (MFP-UV-LAMP) FOR EFFICIENT WATER DISINFECTION** **Product/Process:** Mercury-free PLASMA UV-LAMP (MFP-UV-LAMP) for efficient water disinfection. **Application/Use:** Can replace UV light sources used in household water purifier systems, storage/sewage/waste water treatment plants, municipality water treatment plants. Further, application specific systems can be developed for sterilization of food, medical equipment, surfaces, ill skin conditions, air-conditioners and air fresheners for hospitals, titanium coated toilet sterilization in trains, water supply in trains and buses, portable water purifiers for soldiers, outdoorsmen, farmers, etc. **Salient Feature of Process/Technology:** **Principle of operation:**Dielectric barrier based electrical gas discharge. **Device Type:** UV light Source. Wavelengths generated in 253 nm and 265 nm in UV-C range. **Germicidal range for water:** and also 172 nm in VUV range simultaneously. **Power consumption:** Electrical input per unit arc length ~ 0.1 W/cm. **Lamp dimensions:** 195 mm length and 1.6 cm outer diameter. **Total consumed power:**~ 2.21 W **Electrical to UV conversion efficiency:** ~25% Device operation: High voltage short pulse operation (5kV/25kHz/1□sec) using 220V AC, 50 Hz, single phase, 1. 2 A max. **Tested bacteria for deactivation:**E.Coli, Shigella Boydii, Vibrio, Coliforms and Fecal Coliforms. **Bacteria deactivation efficiency:**Complete deactivation of above bacteria with 4 log reduction has been achieved in 10 secs in an	**CEERI**

	equivalent conventional 8"" house-hold water purifier system.Bacteria deactivation efficiency test for turbid water: Successfully tested for turbidity level up to 20 NTU. Other bacteria and viruses' deactivation: Principle of reciprocity is followed. **Technology type:** Mercury free. **Competing features:** Filament less light source, no end sleeves, negligible start-up time, scalable in dimensions, easily repairable, broad wavelength coverage due to dimer (or molecular) radiations, medium pressure lamp and mercury free. The developed MFP-UV-lamp is a much superior alternative for the presently used mercury based UV lamps in the market. **Status of Commercialization:** Transferred and ready for commercialization. **Minimum Economic Unit Size:** **Indicative Investment:** For 1000 tubes per day production plant cost ~20.00 lakhs. **Equipment and Machinery:** Vacuum pumping station for base pressure ~1x10-5 mbar having Turbo Molecular Pump and Rotary pump, UHV Valves, Bellow Valves, Gas line fitting, Vacuum Dual Gauge for vacuum measurements, Xenon Ultra-pure (99.999%) gas and Iodine Crystals >99.8 % Purity (crystallized)Calibrated UV Spectrometer or Intensity Meter, UV protective eye-wear, Full face Mask, Glass blowing glasses for protection during tube manufacturing, Disposable gloves (vinyl/ latex/ nitrile/polyethylene), Wet Chemical Scrubber, Surface Mix Hand Torch, Double Cheek Lathe Machine 35 ID Bore (Manually operated machine for quartz tube m), Glass-Cutting Machine, LPG cylinder and Oxygen cylinder. **Miscellaneous items:**Carborundum powder, rubber corks, asbestos rope, measurement instruments (Vernier calipers, scales)(For 1000 tubes per day production plant cost ~20.00 lakhs) **Raw Materials:** Quartz, Metal backed foil tapes of silver or Aluminum with conductive epoxy, Teflon rod. **For Further Information, Please Contact:** The Director, Central Electronics Engineering Research Institute.	

	**3.2.4 RO PLANT AUTOMATION SYSTEM** **Product/Process:** RO Plant Automation System **Application/Use:** • Integrated Automation System for Single/Two stage RO water purifier plants. • Water ATMs • Smart water grids with quality monitoring for smart cities/ villages. **Salient Feature of Process/Technology:** 7" Touch Screen based embedded system in tune with the present day smart phones/mobiles; Automatic/Manual mode of single/two stage RO Plant operation; Operational condition monitoring system for prompt operation and maintenance; Decision support system - easy to operate; Online monitoring of critical parameters of water-TDS, pH, water quality parameters. **Status of Commercialization:** Ready for commercialization. **Minimum Economic Unit Size:** **Indicative Investment:** **Equipment and Machinery:**The system is developed using indigenous components. The key components are Microcontroller based embedded system, sensors, relays, valves, aluminum boxes, etc. – which are easily available in Indian market. • Embedded Control System with sensors and valves (2.0 Lakhs INR) up to 1500 LPH RO plant. **Raw Materials:**The system is developed using indigenous components. The key components are Microcontroller based embedded system, sensors, relays, valves, aluminum boxes, etc. – which are easily available in Indian market. • Embedded Control System with sensors and valves (2.0 Lakhs INR) up to 1500 LPH RO plant. **For Further Information, Please Contact:** The Director, Central Electronics Engineering Research Institute.	**CEERI**
	3.2.5 CERAMIC MEMBRANE BASED TECHNOLOGY FOR REMOVAL OF FLUORIDE FROM HIGHLY CONTAMINATED GROUNDWATER **Product/Process:** **Application/Use:** Multichannel ceramic	**CGCRI**

	membrane module provides drinking water from fluoride contaminated ground (5 - 20 ppm). • Water purification cost is about 5 to 10 paisa/L • Purified water is suitable for drinking, fluoride content below 1.4 ppm. • Plant can easily be installed in remote villages due to its small footprint and portable nature. **Salient Feature of Process/Technology:** Multichannel ceramic membrane module provides drinking water from fluoride contaminated ground (5 - 20 ppm). • Water purification cost is about 5 to 10 paisa/L • Purified water is suitable for drinking, fluoride content below 1.4 ppm. • Plant can easily be installed in remote villages due to its small footprint and portable nature. **Status of Commercialization:** On the way of commercialization. **Minimum Economic Unit Size:** **Indicative Investment:**Capital Cost: Rs.3,50,000/- (approx.) for 250 LPH capacity. **Equipment and Machinery:** Ceramic membrane module(s), Skid, Pumps, Pipe and fittings, pressure gauge, control valve, feed tank, filter water tank. **Raw Materials:** Contaminated Surface/ Ground Water which is to be treated. **Further Information, Please Contact:** The Director, Central Glass & Ceramic Research Institute.	
	3.2.6 WATER PURIFICATION THROUGH CERAMIC FILTERS **Product/Process:** **Application/Use:** A technology for arsenic and iron removal based on Ceramic Membrane for production of Quality Drinking Water from contaminated groundwater. **Salient Feature of Process/ Technology:** Technology is essentially a hybrid type comprising of two steps: • Adsorption of arsenic by the colloidal media particles suspended in water and • Application of membrane based separation technique for solid-liquid separation using ceramic micro-filtration membrane modules. • The level of purification achieved is as per WHO recommended limits for arsenic (<0.01 ppm) and iron (<0.3 ppm) in Drinking Water. **Status of Commercialization:** **Minimum Economic Unit Size:**	**CGCRI**

	Indicative Investment: **Equipment and Machinery:** Membrane module made of PVC/SS to accommodate ceramic 19 channel membranes of 34mm ID/1 m L, number of membranes would be based on the requirement.Centripetal Single Phase Recirculation pump (2 to 4 HP capacity).Feed tank and permeate tank, may be of PVC. Auto/Manual Backwash system comprises of a Compressor and corresponding piping's **Raw Materials:** The basic raw materials for the process are alumina and clay for preparation of the ceramic membranes. Stainless Steel or FRP based PVC for housing fabrication with corresponding valves and fittings. **Further Information, Please Contact:** The Director, Central Glass & Ceramic Research Institute.	
	**3.2.7 RECLAMATION OF COAL MINE WATER FOR THE PURPOSE OF DRINKING** **Product/Process:** Reclamation of coal mine water for the purpose of drinking. **Application/Use:** May be used for the reclamation of mine water. Successfully applied for treating coal mine water for drinking uses. **Salient Feature of Process/Technology:** Sequentially integrated operations such as, flocculation, heavy metal removal, clarification, ozonation/chlorination. **Status of Commercialization:** This technology is ready for commercialization. Already a pilot plant has been installed and Commissioned based on this technology in one of the colliery of BCCL, Putki Colliery of P.B Area, which is working. **Minimum Economic Unit Size:** Based on the capacity of the plant. **IndicativeInvestment:** **Equipment and Machinery:** Conventional equipment's such as tanks and vessels, clarifier, ozonozer, chlorination etc. **Raw Materials:**Coal mine water, which is available in plenty. **For Further Information, Please Contact:** The Director, Central Institute of Mining and Fuel Research.	**CIMFR**

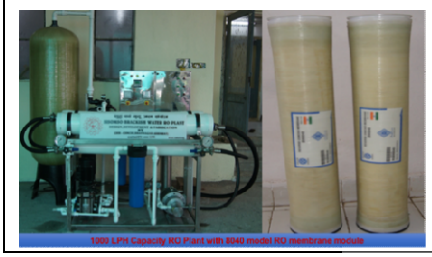
	**3.2.8 ARSENIC REMOVAL FROM WATER** **Product/Process:** Process for domestic level removal of arsenic from water using an encapsulated composition. **Application/Use:** Arsenic-free safe drinking water. **Salient Feature of Process/Technology:** The composition is a synergistic mixture of complexing co-precipitating and absorbing chemicals. Each capsule contains 0.6 g of the composition. A capsule is added to about 10 L water containing arsenic up to 0.3 ppm. Water is stirred well with a rod and allowed to stand for 45 - 60 min. The treated water is filtered through cloth or a water filter candle. Arsenic content in the filtered water is below 0.005 ppm, which is within permissible limits (0.05 ppm). **Status of Commercialization:**Ready for commercialization. **Indicative Investment:**10 Paisa/capsule. (Capsules available from CSIR). **For Further Information, Please Contact:** The Director, Central Institute of Mining and Fuel Research.	**CIMFR**
	**3.2.9 DOMESTIC IRON REMOVAL WATER FILTER** **Product/Process:** Product. **Application/Use:** Areas depending solely on groundwater for livelihood of the rural peoples where the groundwater is contaminated with iron. **Salient Feature of Process/Technology:** Domestic type filtration unit, addressing the removal of iron from groundwater is very much in demand in areas depending solely on groundwater for their livelihood.Remove iron to the desired permissible limit (0.3ppm) of drinking water.No electricity, no chemicals & no running water required can also remove foul odor, bad taste of iron water.Completely green technology. **Status of Commercialization:**Know-how transferred. **Minimum Economic Unit Size**: **Capacity:** 3 L/hr. for household type/family use. **Production Cost:** Rs.1500-Rs.2000/-per unit with Stainless steel body. Rs.1,200/= per unit	**CMERI**

	Indicative Investment: Production cost Rs.1500-Rs.2000/-per unit for Stainless Body Production cost may be less if it is made by plastic. **Equipment and Machinery:** General Engineering Workshop **Raw Materials:** Stainless steel sheet, push fitting valve, Gravels, charcoal, sand, Adsorbent **For Further Information, Please Contact:** The Director, Central Leather Research Institute, Central Mechanical Engineering Research Institute.	
	**3.2.10 PROCESS FOR SOLIDIFICATION/STABILIZATION OF ARSENIC CONTAMINATED SLUDGE GENERATED FORM ARSENIC REMOVAL PLANTS** **Product/Process:** It is completely a societal in nature may not be cost-effective but safe disposal of arsenic sludge is essential otherwise the arsenic sludge again contaminate the groundwater through leaching. **Application/Use:** This process is for safe disposal of arsenic-rich sludge generated from arsenic removal plants. In these plants, large quantity of sludge is generated which contains about 5-7 kg. of arsenic per cubic meter of sludge. This sludge is hazardous as per the Resource Conservancy and Recovery Act (RCRA) of USEPA and it contains arsenic much above the permissible standard (0.2 g./m3) for its direct disposal into the inland water environment (CPCB-MEF, GoI, 1995–1996) as it has very high leaching potential. Arsenic contamination in groundwater and its consequences to the human health have been reported as one of the world's biggest natural groundwater calamities known to mankind.This process is designed for stabilization of arsenic contaminated water treatment sludge for its environmental safe disposal and converting it into products having commercial uses like bricks, concrete blocks, pavement tiles etc. It is very practicable, economical and long lasting. The solidified products meet the specified strength requirement for use in civil construction works and leaching of arsenic is far below the	**CMERI**

	permissible limit. **Salient Feature of Process/Technology:** • It provides safe disposal of arsenic contaminated sludge particularly obtained from arsenic removal water- treatment plants. • Minimizes potential of arsenic to leach back to ground and mix with surface & under-ground water through solidification/stabilization using Portland cement. • Minimizes the effect of arsenic poisoning in human body i.e. arsenicosis, causes due to drinking of arsenic-rich water results in various health effects including skin cancer, diseases of the blood vessels of the legs and feet etc. • Provides technically and economically efficient method towards safe landfill of arsenic contaminated water treatment sludge. • Provides cost-effective, environmentally safe and easy to handle method of arsenic solidification / stabilization. **Status of Commercialization:**Ready for commercialization. **Minimum Economic Unit Size:** Disposal **Capacity of arsenic sludge:**3s-4 m3/day (approx.) Prototype cost Rs.6 Lakh **Approx. cost/machine:** Rs.0.6 lakh and Rs.7.0 lakh resp. **Indicative Investment:** **Equipment and Machinery:** **Major equipment's required are:**Concrete mixture and Compressive strength measuring machine. **Raw Materials:** 1. Portland Slag Cement, Coarse aggregate, Fine aggregate, Lime (CaO), - for preparation of concrete and cement mortar. Approximate cost Rs.7500/- per cum. 2. Soil – for preparation of Bricks. Approximate cost Rs.3000/- per cum. 3. Arsenic contaminated sludge – for stabilization can be obtained from water treatment plants with standard transportation cost. **For Further Information, Please Contact:** The Director, Central Leather Research Institute, Central Mechanical Engineering Research Institute.	

	**3.2.11 IMPROVED IRON REMOVAL PLANT** **Product/Process:** Process **Application/Use:** Improved iron removal plant (IIRP) accommodates a force & lift type arrangement fitted with the existing India Mark-II hand pump, number of holes around the aeration chamber, pre-settling chamber, settling chamber and an outlet tap to collect the safe iron free drinking water.Advanced iron removal process from ground water. **Salient Feature of Process/Technology:** Naturally available sand and gravels used for removal □ No electric power requirement- Implementable in remote villages □ Useful to community service: a small village may cover for drinking purpose only □ Attachable to the existing Mark-II hand pump □ Simple in Design-Operation and Maintenance □ Instant iron free water □ Cost effective No chemicals required for removal purpose **Status of Commercialization:**Commercialized **Minimum Economic Unit Size:** Capacity of the plant: 800 L/hr. (approx.) for community level use. **Total cost:**Rs.90,000/-includes manufacturing, installation, filter media cost (excluding transportation cost) **Indicative Investment:**Cost of manufacturing: Rs.50,000/-per unit. **Equipment and Machinery:** General Engineering workshop. **Raw Materials:** Standard materials available in market like; MS sheet, valve, tap, gravels, charcoal, sand, adsorbent. **For Further Information, Please Contact:** The Director, Central Leather Research Institute, Central Mechanical Engineering Research Institute.	**CMERI**

	**3.2.12 SALIVARY FLUORIDE DETECTION KIT** **Product/Process:** Product **Application/Use:** The indigenous salivary fluoride level detection kit is unprecedented in its kind towards diagnosis of salivary fluoride level for the welfare and betterment of the society. In future salivary fluoride detecting sensor station will be deployed at a kiosk in any rural hospital/ school/ heath center at an affordable cost and with a user friendly manual operation. **Salient Feature of Process/Technology:** - Early detection of Dental Caries - Protection against tooth decay - Helps in detecting fluorosis **Status of Commercialization:**Commercialized **Minimum Economic Unit Size:** The solution kit is available at a very low cost (Rs.10/unit) **Indicative Investment:**Rs. 20 lakh **Equipment and Machinery:** supportive. instrument: fluoride ion meter for cross checking the fluoride level. **Raw Materials:** Readily available chemicals, indigenously developed R&D sensor materials. **For Further Information, Please Contact:** The Director, Central Leather Research Institute, Central Mechanical Engineering Research Institute.	**CMERI**
	**3.2.13 DESALINATION OF BRACKISH WATER BY REVERSE OSMOSIS** **Product/Process:** Reverse osmosis equipment. **Application/Use:** Desalination of brackish water (up to 10,000 ppm total dissolved solids) to get safe drinking water. **Salient Feature of Process/Technology:** The equipment employs improved thin film composite membranes placed in a spiral configuration inside cylindrical vessel operating at 30 kg/cm" pressure. The hardness and fluoride contents are reduced by 85% and bacterial load by 99%. The technology is modular; providing scope to enhance capacity by adding membrane elements. There is no problem of scale or corrosion. It requires electrical power, which also can be generated through solar panels. **Status of Commercialization:**Earlier RO technology based on cellulose acetate membranes has been commercialized. The	**CSMCRI**

	improved version using thin film composite membranes is Ready for commercialization. **Minimum Economic Unit Size:** 30,000 L/day for a unit. **Indicative Investment:** Rs.40 lakhs. **Equipment and Machinery:**RO plant available from CSIR licensee. **For Further Information, Please Contact:** The Director, Central Salt & Marine Chemicals Research Institute.	
	**3.2.14 DESALINATION OF BRACKISH WATER BY ELECTRODIALYSIS** **Product/Process:** Electro dialysis equipment. **Application/Use:** Desalination of brackish water to get safe drinking water, useful in rural tracts where bore well water is brackish. **Salient Feature of Process/Technology:** This device employs both cation and anion exchange membranes, which are alternatively placed between cathode and anode. When a direct electric current is passed through the water, the ion exchange membranes set in a gel structure and allow cations and anions of the salts to pass through. As a result, desalted water is formed between the membranes, which is collected. The system can be made a continuous one. The process provides control on the water salinity by adjustment of flow rate and current input. The technique is modular. **Status of Commercialization:** 3 demonstration plants in operation. **Minimum Economic Unit Size:** 10,000U/day. **Indicative Investment:** Variable depending on quality of feed &plant capacity. **Equipment and Machinery:** Water electro dialysis plant available from CSIR licensee. **For Further Information, Please Contact:** The Director, Central Salt &Marine Chemicals Research Institute.	**CSMCRI**
	**3.2.15 INDIGENOUSLY DEVELOPED RO MEMBRANE BASED INNOVATIVE WATER DESALINATION AND PURIFICATION TECHNOLOGY MOST SUITABLE FOR VILLAGE/RURAL SECTOR TO ACHIEVE HIGHER RECOVERY (> 60%)** **Product/Process:**	**CSMCRI**

	Indigenously developed RO Membrane based Innovative water desalination and purification technology most suitable for village/rural sector to achieve higher recovery (> 60%). **Application/Use:** Safe and clean drinking water from contaminated ground/seawater. Water desalination and purification industry, Waste water treatment industry, Ultrapure water production industry and boiler feed water production. **Salient Feature of Process/ Technology:** Clean and safe potable water from hazardous multiple contaminated (like salinity, fluoride, arsenic, nitrate, pathogens) ground/seawater. Site specific and need based development and therefore unique in nature having relevant advantages.Field tested and implemented in various states to provide safe and clean drinking water. Provides fractional economy and health benefit to village community under societal water mission. No chemical addition and post treatment required hence forth providing better economic footprint. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 200 lick blocks per day. **Indicative Investment:** Rs.1.25 lakh **Equipment and Machinery:** Water pumping system, Pressure vessels, power control system and quality control system. **Cost:** Rs.9-11 Lakh. For product water capacity: 1000-1500 LPH **Raw Materials:** Sand/disc/cartridge filters, RO membranes, mechanical and electrical hardware's Etc. **Cost:** Rs.5.50 Lakh. **For Product water capacity:** 1000-1500 LPH **For Further Information, Please Contact:** The Director, Central Salt &Marine Chemicals Research Institute.	
	3.2.16 CASCADED MEMBRANE SYSTEM FOR PRODUCTION OF DEMINERALIZED WATER **Product/Process:** **Application/Use:** • Production of ultrapure water in Hospitals for	**IICT**

	preparation of saline water and dialyzing fluid for haemodialysis. • Preparation of microbial cultures in Biotech Industries. • Preparation of HPLC and high purity grade analytical reagents, chemicals and aqueous beverages. • Inexpensive substitute for demineralized (DM) water production in Caustic Soda plants and other industries. • Demineralized water for batteries and radiators in Automobile Industry. **Salient Feature of Process/ Technology:** • Novel polyether urea RO membrane that provides high TDS rejection. • The process can be scaled up to higher levels. • Preparation of ultrapure water for saline and dialysis fluids in hospitals, microbial cultures in biotech industry, boiler feed in caustic soda and power plants, radiators and batteries of automobiles etc. • Maintenance free compared to multinational companies that charge Rs.1 lakh per annum. **Status of Commercialization:** Commercialized **Minimum Economic Unit Size:** 25−40 L/h capacity plant. **Indicative Investment:** INR. 50,000 per unit **Equipment and Machinery:** Membrane modules, pumps, fittings, profilers, cans. **Raw Materials:** Raw water source with 250-300 ppm TDS. **For Further Information, Please Contact:** The Director, Indian Institute of Chemical Technology.	
	**3.2.17 COMPACT MEMBRANE UNIT FOR SURFACE AND GROUND WATER PURIFICATION** **Product/Process:** **Application/Use:** The cost effective moderate capacity RO/NF plant is useful for the treatment of water containing high TDS, fluoride etc. The plant is very compact and useful in the small hamlets and fluoride affected remote places. **Salient Feature of Process/Technology:** • Highly compact, moderate systems of 250-1200 L/h capacity. • Easy to use and portable in nature. • Provides purified water for a community of	**IICT**

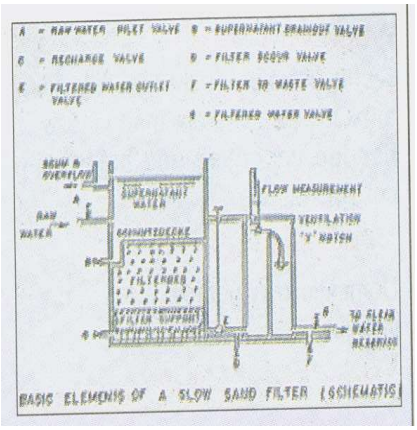
	population around 500 to 2000. • The developed defluoridation membrane technology is deployed at both rural and urban areas in schools, hospitals, hostels and small hamlets. More than 20 installations were carried out till now and all the units are running successfully from past 3 years. **Status of Commercialization:** **Minimum Economic Unit Size:** **Indicative Investment:** **Equipment and Machinery:** Raw Water Pumps, High Pressure Pump, Pressure Vessel (FRP Housing), Pressure Gauges and Rotameters etc. **Raw Materials:** Ground Water or Municipal Water source, Sand Filters with Sand & Carbon, Membrane Modules, CIP tanks, Feed and Permeate water tanks. **For Further Information, Please Contact:** The Director, Indian Institute of Chemical Technology.	
 	**3.2.18 TECHNOLOGY FOR BOTTLING OF PURIFIED DRINKING WATER** **Product/Process:** Provide safe and purified bottled water for drinking purpose. **Application/Use:** • Indigenous reverse osmosis/nanofiltration membranes. • Smaller footprint (Highly compact systems for water purification & Bottling). • Retains or provides essential minerals required for human body. • IICT bottled water meets all specifications as per BIS standards. • Free from all pathogens including E. coli. • Free from pesticides. • Free from heavy metals. • Excellent taste due to post treatment of purified water by specific grade of activated carbon. • IICT's bottled water is tested and certified by NABL accredited Vimta labs Ltd. Hyderabad (passed tests for 85 different parameters). • The average lifespan of packaged bottled water is at least 6 months due to UV and ozone protection. **Salient Feature of Process/Technology:** The character that distinguishes the SOM net from the other cluster algorithms is that not only	**IICT**

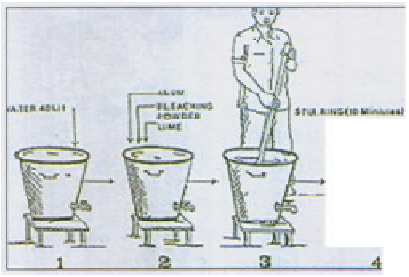
	similar inputs are associated to the same cell but also neighborhood cells contain similar types of documents. This property together with the easy visualization makes the SOM map a useful tool for visualization and clustering of large amount of data sets. The technology will prioritize the control parameters to reduce the outbreak of diseases. **Status of Commercialization:** Ready for commercialization. **Minimum Economic Unit Size:** **Indicative Investment:** 30 Lacs for 1000 L/h drinking water plant with bottling unit **Equipment and Machinery:** Nano filtration Membranes, Skid, Pumps, Profilers, Pipe and fittings, UV light, Ozonator, Tanks, Bottling unit. **Raw Materials:** Surface and ground water with (300-1500 ppm TDS). **For Further Information, Please Contact:** The Director, Indian Institute of Chemical Technology.	
	3.2.19 HIGHLY COMPACT REVERSE OSMOSIS **Product/Process:** Nanofiltration systems for ground water and surface water purification (50-1000 L/h). **Application/Use:** • Skid mounted system provides purified water from surface water or ground water containing moderate TDS (400-600 ppm). • The permeate water is remineralized to 60 to 120 ppm TDS through blending methodology. • Water purification cost is about 3 to 5 paise/L. • Purified water is suitable for cooking purposes, and reduces kitchen boiler corrosion. • Plant can easily be installed in remote villages due to its small footprint and portable nature. **Salient Feature of Process/Technology:** • Indigenous NF membrane based on Hydrophilized Polyamide. • Highly compact & easily portable to remote villages. • Highly efficient for the removal of impurities such as heavy metal ions, turbidity, bacteria and virus etc. **Status of Commercialization:** Ready for commercialization. **Minimum Economic Unit Size:** **Indicative Investment:** Rs.35,000/- for 100 LPH,	**IICT**

	Rs.3,00,000/- for 500 LPH & Rs.6 Lacs for 1000 LPH capacity. **Equipment and Machinery:** Membranes, Skid, Pumps, Prefilters, Pipe and fittings, UV light, Ozonator, Tanks. **Raw Materials:** Contaminated Surface/ Ground Water which is to be treated. **For Further Information, Please Contact:** The Director, Indian Institute of Chemical Technology.	
	**3.2.20 ONEER- A NOVEL SOLUTION FOR SAFE DRINKING WATER** **Product/Process:** **Application/Use:** Disinfection of drinking water having microbial contamination **Salient Feature of Process/Technology:** □ Low-cost water disinfection device that can even treat brackish or turbid water. □ High disinfection efficiency of >8 Log reduction of bacteria viz. Escherichia coli, Vibrio cholarae, Staphylococcus aureus, Salmonella typhimurium and fungus (Candida albicans). □ Conforms to WHO safe limits for drinking water through innovative design of electrodes and controlled treatment energy for specific period. □ No exogenous chemicals added during decontamination process. □ Maintenance-free and long-life water-disinfection device for safe water. □ Domestic model can provide 10 L water per batch and community model can continuously supply~400L/hr treated water (5000 L/day) for schools, hospitals, restaurants and other public places. **Status of Commercialization:** Ready for commercialization. **Equipment's:** No major equipment and machinery required **Raw Materials:** Food grade stainless steel and minor electronic components. **For Further Information, Please Contact:** The Director, Indian Industrial Toxicology Research.	**IITR**
 	**3.2.21 TERAFIL WATER FILTRATION TECHNOLOGY** **Product/Process:** Terafil Water Filter disc / media **Application/Use:**	**IMMT**

  	For purification of both surface and ground water at minimal cost, exclusively for removal of excess iron, turbidity and bacteriological contamination from drinking water through filtration process. **Salient Feature of Process/Technology:** The raw water is filtered through a Terracotta porous filter disc (TERAFIL). The suspended particles, sediment, Iron & many heavy metals, micro-organism, color & bad odour are separated from raw water effectively without clogging the core of the TERAFIL. Rate of filtration = 02 to 04 lits/Hr. TERAFIL is prepared using inexpensive local materials by village potters and cottage industries in rural places. The Terafil is composite of clay membranes, which helps for effective filtration & treatment of raw water in to clean drinking water. Terafil is fitted at the bottom of any container for filtration and treatment of raw water. It can be scaled up for community application (50-100K LPD). **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 25000 units/year. **Indicative Investment:**Rs.10.0 lakh **Equipment and Machinery:** Grinding and mixing machine, Queen Kiln, Jigs & fixtures for preparation of TERAFIL. **Raw Materials:**Pottery clay, sand & wood saw dust for preparation of TERAFIL and Terracotta Water Filter. **For Further Information, Please Contact:** The Director,Institute of Minerals and Materials Technology, Bhubaneswar.	
	**3.2.22 WATER PURIFICATION** **Product/Process:** A process for preparation of flat sheet ultra filtration (UF) membrane. **Application/Use:** For drinking water purification. **Salient Feature of Process/Technology:** It is desirable to have a membrane, which has pores small enough to exclude virus and bacteria, yet porous enough to operate on tap water pressure (0.5 bars minimum). The typical water flux (depending on water quality) of a spiral at 0.5 bar pressure is 45-60 liters/hour (community module) or 15 liters/hour (domestic module). The increase in operational pressure results in increase in water flux. The module / housing material can withstand pressures up to 4 bars.	**NCL**

	The system is self-cleansing. The filtered water at the average rate of 90 liters/hour is collected in the user's own vessel and the balance is returned to the tank or used for non-drinking purposes. The membrane spiral can be mounted on a mechanically operated pump that circulates water from a ground level tank to the membrane module at a given pressure head adjusted by a throttle valve. The various user-friendly assemblies developed are compact, potable and can be operated by foot-pump or cycle-pump, or using electricity. **Status of Commercialization:** Commercialized. **Equipment and Machinery:** Continuous membrane casting machine; Spiral winding machine; Polymer solution making and purification facilities inclusive of overhead stirrers and flasks, vacuum pump, centrifuge machine; membrane characterization facility viz. water flux, bubble point, pore size distribution and MWCO (molecular wt. cut-off) determination, etc. **Raw Materials:**Polyacrylonitrile, N, N-dimethyl formamide, zinc chloride and chemicals required for membrane characterization. **For Further Information, Please Contact:** The Director, National Chemical Laboratory.	
Without photo	**3.2.23 FIELD MONITORING OF ARSENIC IN DRINKING WATER** **Product/Process:** Field Kit for testing of Arsenic levels in Drinking Water. **Application/Use:** To determine the suitability of water for drinking. **Salient Feature of Process/Technology:** Presence of arsenic in groundwater in excess of the permissible limit of 50 ppb has been reported from Bangladesh and West Bengal in significant percentage of wells. More than 25 million people in Bangladesh and India are at heath risk due to consumption of high arsenic drinking water. Periodic monitoring of arsenic levels accurately in such a large number of groundwater sources using the present field test kits is proving difficult as they are not very sensitive and do not give consistently accurate results. The field test kit is developed for assessing total arsenic content (As+3 and as+5) with a range of 10 to 100 ppb in drinking water. **Status of Commercialization:** Available in public domain.	**NCL**

	Equipment and Machinery: Polycarbonate bottle with threaded end, Reactor top assembly, Silicon Rubber tube with washer, Cotton filter plugs (with lead acetate), Instruction card, Tissue papers, Reagents and ascorbic acid mixture, and Potassium Iodide. **Raw Materials:** Drinking water and chemicals. **For Further Information, Please Contact:** The Director, National Chemical Laboratory.	
 BASIC ELEMENTS OF A SLOW SAND FILTER (SCHEMATIC)	**3.2.24 SLOW SAND WATER FILTER** **Product/Process:** Unit for purification of turbid surface water. **Application/Use:** To generate potable water from surface water sources. **Salient Feature ofProcess/Technology:** It is a single step treatment which simultaneously improves the physical, chemical and bacterial quality of raw water. The filter unit consists of a large open water tank 2.5 to 3 m deep, filled with fine graded sand overlying a layer of gravel. Raw water is distributed gently over the top of the filter bed. Clean water is collected at the bottom of the filter. It is readily manageable with local resources by rural women. In case of highly turbid water, pretreatments are required. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 200 L/hr. **Indicative Investment:**Rs.5,000/- **Equipment and Machinery:** RCC construction &fixtures. **Raw Materials:** Turbid surface water e.g. village ponds, lakes, canals, springs, rivers, 'with turbidity less than 20 NTU. **For Further Information, Please Contact:** The Director, National Environmental Engineering Research Institute.	**NEERI**
	**3.2.25 HAND PUMP ATTACHABLE IRON REMOVAL PLANT** **Product/Process:** Design and construction of plant for removal of excess iron from ground water to get safe drinking water. **Application/Use:** Attachment to India Mark II or equivalent hand pump with an average discharge of 1 m^3/hr. **Salient Feature of Process/Technology:** The plant comprises of three chambers. Hand pumped water is sprayed into oxidation chamber. The aerated water flows over baffle plates to the	**NEERI**

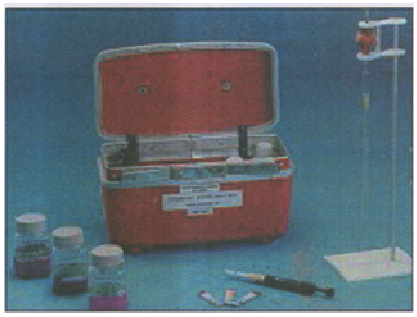
	flocculation chamber and then to the sedimentation chamber. The settled water passes through plate settlers to the filter. The filtered water is drawn through tap after chlorination. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** To serve a population of 250 @ 10 L per capita and 10 hr operation daily. **Indicative Investment:**Rs.0.30 lakh per unit. **Equipment and Machinery:** FC/RCC, PVC pipes & fixtures, pebbles 20-30 mm, filter sand 0.8- 1.0 mm, chlorine solution. **For Further Information, Please Contact:** The Director, Central Mechanical Engineering Research Institute,National Environmental Engineering Research Institute.	
	**3.2.26 WATER DEFLUORIDATION: NALGONDA TECHNIQUE** **Product/Process:** Process for removal of excess fluoride in ground water by using Nalgonda technique. **Application/Use:** Safe drinking water with fluoride content within permissible limits of 1.5 mg/L for domestic and community use. **Salient Feature of Process/Technology:** Excess fluoride in drinking water causes dental and skeletal fluorosis. This water can be purified at domestic and community levels. The process comprises of addition of aluminum salt, lime and bleaching powder to the raw water followed by flocculation, sedimentation and filtration. The domestic level treatment is performed in a bucket or any plastic container. For community level, fill-and-draw type plants are used with capacity up to 400 m^3/day. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** Domestic level, cap 25 U/batch: Rs.400, Community level, cap 400 m": Rs.5 lakh. **Equipment and Machinery:** FC/RCC setting tank, flash mix and pump, flocculator, rapid gravity sand filter and disinfection unit. **Raw Materials:** High fluoride raw water, alum, lime, bleaching powder. **For Further Information, Please Contact:** The Director, National Environmental Engineering Research Institute.	**NEERI**

	**3.2.27 ELECTROLYTIC DEFLUORIDATION (EDF) TECHNIQUE** **Product/Process:** **Application/Use:** To produce potable water with fluoride less than 1 mg/L from the high fluoride content water. **Salient Feature of Process/Technology:** • Removal of fluoride by active species of hydroxide of aluminum produced by passing DC power through aluminum electrodes. • Produces potable water with palatable taste as against the other available chemical treatment methods. • Quantity of sludge produced is much less (60-70%) than conventional treatment methods. •Simultaneous reduction in bacterial contamination in treated water. • Simple to fabricate, easy to operate with minimum maintenance. • Suitable for treatment of raw water with fluoride concentration up to 10 mg/L. **Status of Commercialization:** Commercialized **Indicative Investment:** Rs.10-12 lakhs **Equipment and Machinery:** DC power supply and pump for recirculation of water. **Raw Materials:** Aluminum plate electrodes **For Further Information, Please Contact:** The Director, National Environmental Engineering Research Institute	**NEERI**
	**3.2.28 ARSENIC REMOVAL FROM GROUNDWATER** **Product/Process:** **Application/Use:** Safe drinking water **Salient Feature of Process/Technology:** It is an adsorption technique. A naturally occurring ferruginous manganese ore (FMO) is used as adsorbent for iron and arsenic in contaminated groundwater and may be applied at both domestic and community level. A domestic three compartment filtration unit employing this technique has been developed at NML. It works for both As(lll) and As(V) without any pre-treatment. At domestic level the hardware does not require electricity. The process comes with a sludge management protocol. **Status of Commercialization:** Ready for commercialization. **Minimum Economic Unit Size:** **Indicative Investment:** Hardware cost is	**NML**

	Rs.600/- per unit (one time) lakh. **Equipment and Machinery:** For domestic level it is a three container water filter. For community level plant equipment and machinery may be designed for the client as per scale. **Raw Materials:** Ferruginous manganese ore. **For Further Information**, **Please Contact:** The Director, National Metallurgical Laboratory.	

3.3 WATER QUALITY ASSESMENT

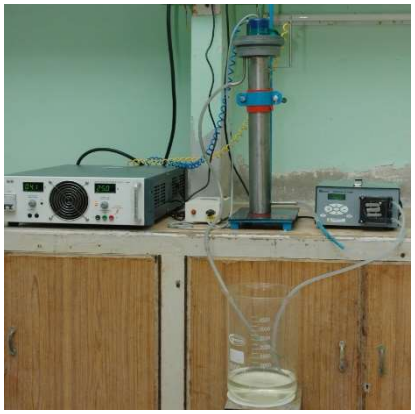
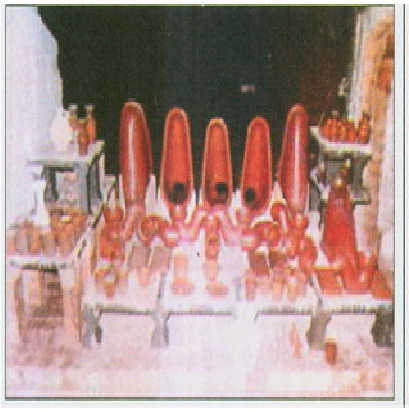
	**3.3.1 PORTABLE WATER ANALYSIS KIT** **Product/Process:** **Application/Use:**The kit is useful for the assessment of drinking water quality in remote areas and can be operated by a person with minimum training. The kit can perform chemical and bacteriological tests to ensure safety of drinking water. **Salient Feature of Process/Technology:** □ The kit is simple in operation. □ Provides quantitative and qualitative results of bacteriological (fecal coliform) and physico-chemical parameters (pH, TDS, total hardness, chloride, residual chlorine, nitrate, fluoride, sulphate, iron and arsenic) as per BIS and WHO guidelines for drinking water. □ The kit can also be operated in a 1 KVA generator in the absence of 220 V electric supply. □ Economical and portable with approx. 12 kg weight. **Status of Commercialization:** Ready for commercialization. **Equipment's:** No major equipment and machinery required. **Raw Materials:** Locally available materials and minor electronic components. **For Further Information, Please Contact:** The Director, Indian Industrial Toxicology Research.	**IITR**
	**3.3.2 RAPID CHEMICAL AQUA TESTER** **Application/Use:** Water analysis in the field. **Salient Feature of Process/Technology:** This instrument is useful for spot analysis of iron, residual chlorine, pH and fluoride up to 2.0 mg/L with a readability of 0.2 mg/L. It works on the principal of visual calorimetry. The reagents are added to the sample in the form of drops to develop the color. The sample color is compared with the standard color disc in the comparator and the concentration is read directly from the disk. The instrument measuring 9.7 x 9.7 x 3.1 cm weighs 300 g. No power is required. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** Rs.4,000. **Equipment and Machine:** Rapid Aqua Tester instrument available from CSIR licensee.	**NEERI**

	For Further Information, Please Contact: The Director, National Environmental Engineering Research Institute.	
	**3.3.3 FIELD KIT FOR IRON ANALYSIS** **Product/Process:** Field kit for estimation of iron level in water. **Application/Use:** Testing of iron content under field conditions. **Salient Feature of Process/Technology:** The kit consists of color comparator, Nessler tube, measuring cylinder and adequate number of 'Ferro ampoules' housed in a lightweight, fiberglass reinforced plastic case. A semi-skilled person can be trained to analyses the sample. Precise and immediate results are provided for iron concentration ranging from 0.3 to 5.0 ppm. Diagrammatic instructions are provided in the kit. **Status of Commercialization:** Commercialized. **Indicative Investment:** Rs.3,000. **For Further Information, Please Contact:** The Director, National Environmental Engineering Research Institute.	**NEERI**
	**3.3.4 TITRIMETRIC WATER ANALYSIS KIT** **Product/Process:** Portable kit containing titration equipment. **Application/Use:** Water analysis under field conditions. **Salient Feature of Process/Technology:** The kit contains a micro-burette, folding titration stand, reagents, glassware and instruction manual. It is used for quick estimation of acidity, alkalinity, hardness and chloride in water under field conditions. **Status of Commercialization:** Commercialized. **Indicative Investment:** Rs.6,000. **Equipment and Machinery:**Kit available from CSIR licensee. **For Further Information, Please Contact** The Director, National Environmental Engineering Research Institute.	**NEERI**

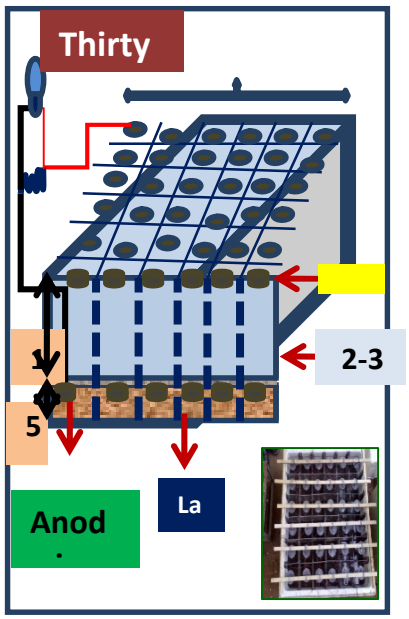
4. ENVIRONMENT

	4.1.1 SISAL GEOTEXTILES FOR SOIL CONSERVATION **Product/Process:** Geotextiles **Application/Use:** soil erosion control application. **Salient Feature of Process/Technology:** Information not provided. **Status of Commercialization:**Ready for commercialization. **Minimum Economic Unit Size:** Rs.1500/-unit cost **Indicative Investment:** Depending upon quantity **Equipment and Machinery:** Looms and Raspador Machine etc. **Raw Materials:** Sisal Fiber **For Further Information, Please Contact:** The Director, Advanced Materials and processes Research Institute, Bhopal.	**AMPRI**
	**4.1.2 LOW COST LATRINE** **Product/Process:** Design and construction of low cost latrines in the areas where sewerage system is not available. **Application/Use:** Low cost sanitation in the areas where sewerage system or septic tank is not feasible due to shortage of water or financial limitations. **Salient Feature of Process/Technology:** Itis a simple, economical and efficient system for disposal of night soil without pollution. The system consists of two leaching pits, WC seat (slope 30^{Q}) and water trap. The leaching pits are connected with the **PRAI**type seat through an inspection chamber using clay/cement concrete/plastic pipes or brick channels. The leaching pits are used alternatively with a gap of 4-5 yr. **Raw Materials:PARI**type WC seat and water-seal traps made of china clay, **FRP mosaic** or cement concrete, bricks, cement, sand, stone aggregate and reinforcing steel. **Status of commercialisation:**Commercialized **Indicative Investment**: Rs.4.550 **For Further Information, Please Contact:** The Director, Central Building Research Institute.	**CBRI**

	**4.1.3 DISPOAL OF DOMESTIC WASTE WATER** **Product/Process:** Silt-ash trap chamber system using brick in-situ construction at site. **Application/Use:** Suitable for disposal of wastewater from kitchen and bathroom in rural houses. **Salient Feature of Process/Technology:** It is a simple, efficient and economical disposal system consisting of a silt-ash trap chamber and a borehole for underground disposal of wastewater within courtyard of the house. The silt ash trap chamber is divided into two compartments each having a triangular duct. The ducts are provided with entry and exist at the bottom and are inter- connected at the top. The second compartment is filled with brick ballast. The system can be constructed in situ by using bricks. It can also be precast by using fibrocement. **Status of Commercialization:**The technology has been extensively used in villages. **Indicative Investment:** Rs.750 **Equipment and Machinery:** 30 mm dia. auger with guide and extension rods **Raw Materials:**Locally available materials such as burnt brick, cement, sand, coarse aggregate, reinforcing steel. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	**CBRI**
	4.1.4 SINGLE STACK DRAINAGE SYSTEM **Product/Process:** An efficient and economic drainage system of plumbing. **Application/Use:** Sanitation plumbing in high as well as low rise buildings. **Salient Feature of Process/Technology:**All the sanitary appliances in a group discharge soil and waste into a single stack. In this system, the main stack itself serves as the vent. It has simple design procedure, which relates hydraulic discharge in the stack to the pipe diameter for permissible suction inside stack. **Status of Commercialization:**Technology incorporated in IS:5329-1969 and National Building Code of India-1970; adopted by construction agencies. **Minimum Economic Unit Size:** It is efficient and	**CBRI**

	economical as compared to conventional two-pipe system. Wet areas are planned around duct and require less space. **Indicative Investment:** **Equipment and Machinery:** **Raw Materials:**Building drainage pipes/fittings **For Further Information, Please Contact:** The Director, Central Building Research Institute.	
	**4.1.5 PHOTO ASSISTED ELECTRO CHEMICAL DEGRADATION AND DECOLORIZATION OF DYE BATH EFFLUENT FROM TEXTILE INDUSTRIES** **Product/Process:** **Application/Use:** Can be integrated with existing treatment techniques in common effluent treatment plant. **Salient Feature of Process/sTechnology:** "Photo assisted electrochemical oxidation. No chemicals are added. Zero sludge process. **Status of Commercialization:**Yet to be commercialized. One industry is ready to implement the technology. **Minimum Economic Unit Size:** 500 L **Indicative Investment**: 5 lakhs **Equipment and Machinery:**Rectifier (1 Lakhs), Pumps (1 Lakhs) for 1000 liter per day operation scale. **Raw Materials:** Mixed metal oxide electrodes, UV Lamp. **For Further Information, Please Contact:** The Director, Central Electrochemical Research Institute.	**CECRI**
	**4.1.6 RED CLAY SANITARY WARE** **Product/Process:** Process for manufacture of red clay based sanitary wares. **Application/Use:** Rural sanitation. **Salient Feature of Process/Technology:** Low cost sanitary wares are produced from inexpensive raw materials like local red clay in conjunction with ball clay, quartz, feldspar, dolomite etc. The raw materials are ground, mixed and de-watered in usual manner and articles cast by slip making process or hand molded. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 0.2 tpd. **Indicative Investment:** Rs.15 lakhs. **Equipment and Machinery:** Ball mill, filter press,	**CGCRI**

	blunger, plaster of Paris molds, agitator, and small shuttle kiln. **Raw Materials:** Red clay, feldspar, ball clay, dolomite, quartz etc. **For Further Information, Please Contact:** The Director, Central Glass & Ceramic Research Institute.	
	**4.1.7 STONE SANITARY WARE** **Product/Process:** Process for manufacture of sanitary pan, footrest, washbasin & P. trap in stoneware quality. **Application/Use:**For sanitation purpose in dwelling units. **Salient Feature of Process/Technology:** Raw materials are processed and wet ground in the grinding mill. Ground slip is filtered through filter press and shapes given by casting method. Dried pieces are glazed and fired in shuttle kiln at $1220^{Q}C$. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 30 t per month in matching capacity shuttle kiln. **Indicative Investment:** Rs.60 lakh **Equipment and Machinery:** Ball mill, blunger, agitator, moulds, filter press, glazing booth, shuttle kiln. **Raw Materials:** Quartz, ball clay, feldspar, barium carbonate, calcite, zinc oxide, china clay, etc. **For Further Information, Please Contact:** The Director, Central Glass &Ceramic Research Institute.	**CGCRI**
	**4.1.8 ACCELERATED ANAEROBIC COMPOSTING (AAC) OF ORGANIC WASTE** **Product/Process:** Accelerated Anaerobic Composting (AAC) Of Organic Waste. **Application/Use:** Treatment of organic waste for the generation of compost. **Salient Feature of Process/Technology:** Accelerated Anaerobic composting. **Status of Commercialization:** Ready for commercialization. **Minimum Economic Unit Size:** 5kg to 10 tons per day. **Indicative Investment:** INR 10lakhs for 10 tons' capacity per day. **Equipment and Machinery:** Major equipment:	**IICT**

	Composting pits (civil construction), Crusher and grinder. **Raw Materials:** Segregated wastes like food waste/water hyacinth/agricultural biomass. **For Further Information, Please Contact:** The Director, Indian Institute of Chemical Technology.	
	**4.1.9 BIOELECTROCHEMICAL TREATMENT SYSTEM FOR EFFECTIVE TREATMENT OF COMPLEX WASTEWATER** **Product/Process:** **Application/Use:** Treatment of complex wastewater. Function effectively with all types of wastewater. Simultaneous remove salts. Used as standalone unit operation or unit in existing effluent treatment plant. **Salient Feature of Process/Technology:** • Non-catalyzed electrodes as anode and cathode. • Wastewater- Domestic Wastewater, low COD wastewater is used as feed stock. • Biocatalyst- Collected from the lake sediments or anaerobic plants. • Remove TDS along with COD. • Membrane less operation. • Multielectrode assembly to cumulative power. • Non-catalyzed electrodes as anode and cathode • Wastewater- Domestic Wastewater, low COD wastewater is used as feed stock. • Biocatalyst-Collected from the lake sediments or anaerobic plants. • Remove TDS along with COD • Membrane less operation • Multielectrode assembly to cumulative power **Status of Commercialization:** **Minimum Economic Unit Size:** **Indicative Investment:** **Equipment and Machinery:** **Raw Materials:** Industrial Wastewater with high COD could be used Non-catalyzed electrodes. **For Further Information, Please Contact:** The Director, Indian Institute of Chemical Technology.	**IICT**
	4.1.10 BIOHOME **Product/Process:** **Application/Use:** Treatment of household kitchen waste for the generation of biogas. **Salient Feature of Process/Technology:** Dry Anaerobic Digestion	**IICT**

	• High solids residence time (SRT) • High Volatile Solids Loading Rate (VSLR) • High methane yield. • End to end solution for solid waste management. **Status of Commercialization:** Ready for commercialization. **Minimum Economic Unit Size:** 5 kg to 100 kg per day. **Indicative Investment:** INR 30,000 for 5 kg capacityper day, INR 4,00,000 for 100 kg capacity per day. **Equipment and Machinery:** **Major equipment:** BIOHOME digester with accessories, biogas holder with accessories. Minor equipment: Waste grinder, valves and pipe fittings. **Raw Materials:** Segregated wastes like food waste. **For Further Information, Please Contact:** The Director, Indian Institute of Chemical Technology.	
	4.1.11 BIOHYDROGEN PRODUCTION FROM WASTE AND SOLID WASTE **Product/Process:** **Application/Use:** Hydrogen can be used as fuel for automobile and chemical industry.The byproduct can be used as platform chemical after separation or as feedstock for secondary product production. **Salient Feature of Process/Technology:** • Operated with wastewater/waste. • Sustainable technology. • Embedded with waste remediation units/ETPs. • Simultaneous remediate waste. • Competing technology is not available at present in the market. **Status of Commercialization:** **Minimum Economic Unit Size:** **Indicative Investment:** 10m3 plant will be costing about Rs.80 lakhs **Equipment and Machinery:** Major equipment: BIOHOME digester with accessories, biogas holder with accessories. **Minor equipment:** Waste grinder, valves and pipe fittings. **Raw Materials:** Industrial Wastewater (BOD/COD > 0.5 with COD > 15 mg/l). Solid waste viz., Food waste, municipal waste, sludge, etc. **For Further Information, Please Contact:**	**IICT**

	The Director, Indian Institute of Chemical Technology.	
	**4.1.12 BIO-POLYMERS PRODUCTION FROM ORGANIC MUNICIPAL SOLID WASTE** **Product/Process:** **Application/Use:** Sustainable replacement to fossil fuel-based thermoplastics Bio-Polymers (Poly hydroxyl Alkanets: PHA) are biodegradable in nature and it can be used as alternative to synthetic (non-biodegradable) plastics in domestic, medical and industrial applications. **Salient Feature of Process/Technology:** • Operated with organic solid/liquid waste. • Biodegradable plastics. • Embedded with waste remediation units/ETPs. • Simultaneous remediate waste. **Status of Commercialization:** **Minimum Economic Unit Size:** **Indicative Investment:** 10 m3 plant will be costing about Rs.80 lakhs **Equipment and Machinery:** 1 m3 plant will be costing about Rs.10 lakhs **Raw Materials:** Organic Municipal Solid Waste (OMSW)OMSW viz., Food waste, Kitchen Waste, Waste Activated Sludge, etc. **For Further Information, Please Contact:** The Director, Indian Institute of Chemical Technology.	**IICT**
	**4.1.13 ECOLOGICAL ENGINEERING SYSTEMS** **Product/Process:** **Application/Use:** Treating low strength wastewater like outlet from ETP, domestic waste and other effluents Used as sustainable platform for lake restoration. **Salient Feature of Process/Technology:** • Operated with low COD bearing wastewater/waste as polishing unit. • Sustainable technology. • No external energy input. • Treated water can be reused for garden/agriculture activities after disinfection. **Status of Commercialization:** **Minimum Economic Unit Size:** **Indicative Investment:** 1m3/day plant will be costabout Rs.20,000/- **Equipment and Machinery:** **Raw Materials:** Wastewater (BOD/COD > 0.5 with	**IICT**

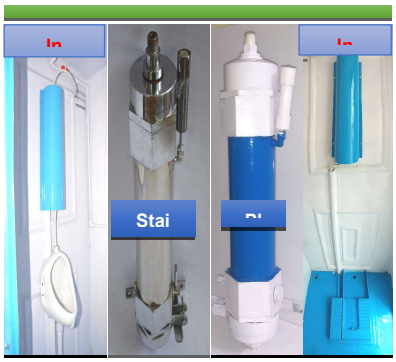
	COD > 300 mg/l). **For Further Information, Please Contact:** The Director, Indian Institute of Chemical Technology.	
	4.1.14 NANOFILTRATION PLANT FOR PROCESSING STEEL INDUSTRIAL EFFLUENT FOR CHLORIDE SEPARATION FROM STEEL QUENCHING TOWER WASTEWATER **Product/Process:** **Application/Use:** Wastewater from steel and iron manufacture industry contains huge amounts of acid, cyanides, oil, grease, sulfur forming compounds, phenols, heavy metal ions, chloride, ore particles, etc. The reuse of water in these industries can reduce the overall water consumption by a factor of two to seven. Conventional processes such as distillation, bio sorption, etc. are found to be highly energy intensive or have low throughput. Membrane-based filtration processes offer higher throughput and do not require any external chemical or any solvent recovery step. CSIR-IICT has designed and developed Nano filtration system equipped with a set of low cost indigenous high flux membranes for separation of harmful chlorides and cyanide from water generated in certain chemical industries. The super thin membrane is economical and the process is low pressure, which can substitute the regularly used Reverse Osmosis for specific applications. The process helps to recover water by separating chloride ions from a steel industrial effluent. **Salient Feature of Process/Technology:** • Developed a fouling resistant Nano filtration membrane that efficiently rejects chloride in the wastewater. • Scale up of the bench scale Nano filtration unit to commercial scale i.e. 5000 L/h capacity plant. • Production of chloride free water from steel quenching tower wastewater. • The performance of the plant was enhanced more than that is desirable (i.e. <800 ppm in permeate water) and is also producing good quality of permeate water that can be recyclable apart from chloride rejection in the effluent. • The unit operates at very high water recovery rate of 80% whereas commercially available Nano filtration membranes offer only 60% water recovery. **Status of Commercialization:** Commercialized.	**IICT**

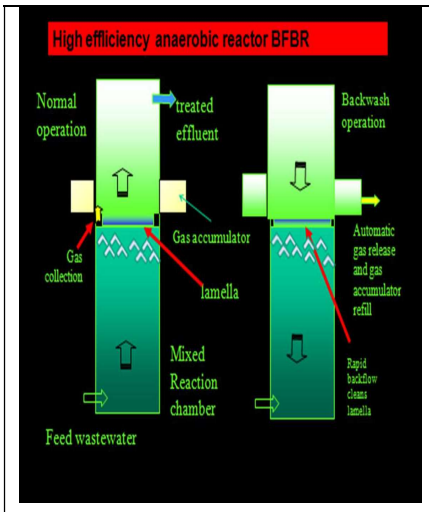
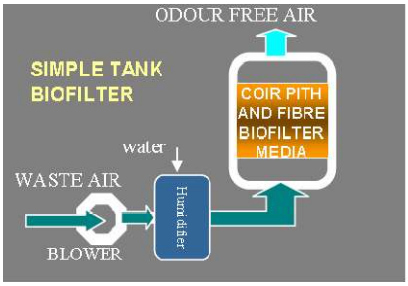
	Minimum Economic Unit Size: **Indicative Investment:** 20 Lacsfor 5m3/h Nano filtration plant. **Equipment and Machinery:** Nano filtration Membranes, Skid, Pumps, Prefilters, Pipe and fittings, UV light, Ozonator, Tanks, Acid and alkali dosing unit. **Raw Materials:** **For Further Information, Please Contact:** The Director, Indian Institute of Chemical Technology.	
 Food waste 50- 100 kg/d) digester at Deolapar (3 m^3)	**4.1.15 ANAEROBIC BAFFLED REACTOR FOR MANAGING VEGETABLE/ KITCHEN WASTE (ORGANIC FRACTION OF MSW) THROUGH BIOMETHANTION** **Product/Process:** Anaerobic baffled reactor for managing vegetable/ kitchen waste (organic fraction of MSW) through biomethantion. **Application/Use:**The technology finds its application for the efficient biogas production from food /vegetable waste for canteens, dining halls, resorts, hostels etc. The biogas can be used for heating purpose in kitchen and the residues can be used in gardens/farms as compost. This can save up to 40 % of LPG usage while reducing the menace of the waste. It helps environment by reducing waste discharge and resource recycle besides saving non-renewable petroleum resource as LPG. Society gets a benefit of odour minimization. **Salient Feature of Process/Technology:** The reactor geometry facilitates stratification of acidogenic and methanogenic bacteria while at the same time wastes of different age histories are not freely mixed as in case of routine digesters. This gives advantages of higher solids concentrations and lower retention. The reactor geometry arrests the solids in the reactor to yield a very high sludge retention time leading to high efficiency and robustness. **Status of Commercialization:** **Indicative Investment:** Rs.15 lakhs for plant of 100-150 kg waste/d. **Equipment and Machinery:**Plant: Baffled reactor constructed in RCC/MS and associated equipment such as grinder, slurry pumps and gas holder and sophisticated safety controls. **Raw Materials:** Segregated vegetable and food	**NEERI**

	waste. Cost not relevant. **For Further Information, Please Contact:** The Director, National Environmental Engineering Research Institute.	
	**4.1.16 FLORAFTER FOR LAKE IN-SITU TREATMENT** **Product/Process:** Florafter for Lake In-situ Treatment **Application/Use:**Sewage treatment • Rejuvenation of lake • Better surface water • Water body restoration **Salient Feature of Process/Technology:** Toxicity reduction • Eco-friendly • No civil construction • Minimal O & M cost **Status of Commercialization:** Licensed and audited **Indicative Investment:** Capital cost for 100 m2 of floating bed is about Rs.8 lakhs **Equipment and Machinery:**No major plant and machinery required. **Raw Materials:** **For Further Information, Please Contact:** The Director, National Environmental Engineering Research Institute.	**NEERI**
 	**4.1.17 HIGH RATE TRANSPIRATION SYSTEM (HRTS) FOR TREATMENT AND DISPOSAL OF WASTEWATER** **Product/Process:** **Application/Use:** Treatment of sewage/municipal and industrial wastewater in land locked areas where disposal is a problem. **Salient Feature of Process/Technology:** 1. HRTS is combination of designed filter bed system and selected plant species for treatment of wastewater. 2. HRTS is an energy free system where. distribution of wastewater is via gravity flow. 3. HRTS is a land treatment system comprising of “Furrows” with designed filter media that initially provides abiotic treatment of wastewater; and “Ridges” with selected plant species which removes high TDS and degrades the pollutants through synergistic action of plant microbe interaction.	**NEERI**

	4. HRTS can be designed with plants having capacity to survive high salinity and adverse environmental condition. 5. Treatment media may consist all or part of low cost materials like coconut husk, bagasse, rice husk and/or rice straw etc. of organic origin along with inorganic materials like gypsum, lime etc. if required. 6. HRTS can be designed for 80-300 m3 day-1 ha-1 depending upon the soil and wastewater quality 7. HRTS provides the green cover and after three years it could result significant carbon credits **Status of Commercialization:** Commercialized. **Indicative Investment:** One-time implementation cost in general @ 60 lakhs/ha excluding land cost. **Equipment and Machinery:**No major equipment or machinery are required for O&M. It only requires Land preparation at initial stage. **Raw Materials:** Organic waste such as rice straw/husk, saw dust or coconut husk may be required based on the availability and characteristics of wastewater to be treated. **For Further Information, Please Contact:** The Director, National Environmental Engineering Research Institute.	
	**4.1.18 PARS (PASSIVE AIR REJUVENATION SYSTEM)** **Product/Process:** Product **Application/Use:**Purification of air using plants. **Salient Feature of Process/Technology:** Purifies air indoor (households, offices, industries) and outdoor (kerbside, parks, divider). Its combination of physical, chemical and biological systems giving good efficiency at faster rate. **Status of Commercialization:** Licensed and audited. **Indicative Investment:** **Equipment and Machinery:**Fans, Pumps, Sensors, Solar system, Timers. **Raw Materials:**Plants, growth media. **For Further Information, Please Contact:** The Director, National Environmental Engineering Research Institute.	**NEERI**

 	**4.1.19 PHYTORID TECHNOLOGY FOR SEWAGE TREATMENT** **Product/Process:** **Application/Use:** • Municipal sewage treatment (gram panchayat/council/corporations). • Nallah water treatment. • Conservation of water bodies by avoiding wastewater disposal. • Commercial or public utility spaces (airports, railway stations, complexes). **Salient Feature of Process/Technology:** • Subsurface mixed flow constructed wetland method. • No mechanical or electrical machineries such as aerators/pumps are involved therefore very low maintenance (about 20% of prevailing electro/mechanical technologies). • Space saving technology as compared to other no-electricity (passive) systems such as Wastewater Stabilization Ponds (WSP). One-day residence time for Phytorid as compared to 10-18 days for WSP. • Scalable from individual household to community to village/township level. • Decentralized system thereby saving cost on sewage pipelines and avoids loss by leakages. • Treated water quality meets discharge and irrigation standards specified by CPCB. • Aesthetic improvements as Phytorid resembles garden. • Due to subsurface flow design, no mosquitoes and odor nuisance as compared to some other surface flow technologies. **Status of Commercialization:** Commercialized and Audited. **Indicative Investment:** Major Civil Work with cost of about 1 to 1.2 Crore/MLD. **Equipment and Machinery:**No major plant and machinery required. **Pumps:** Rs.5 Lakh/MLD. **Bio media Culture:** Rs.18-20 Lakhs/MLD **Raw Materials:**Major Civil Work with cost of about 1 to 1.2 Crore/MLD. **For Further Information, Please Contact:** The Director, National Environmental Engineering Research Institute.	**NEERI**
	4.1.20 Automatic Mechanical Urinal-Toilet Flusher "NEERFLUSH"	**NEERI**

	**Product/Process:** Low Cost & Affordable Technology for Improving the Sanitation & Hygiene for Swachh Bharat Mission **Application/Use:** • Public Toilets o Sulabh Shauchalaya o Municipalitie's Toilets o Urban Public Toilets o Village Panchayat / Local bodies • Commercial Complexes: o Railway Stations o Bus Stands o Markets and Malls o Air Ports, Sport Complexes, etc. • Office/ Residences • Academic Institutions • Tourist Places • Social and Religious Gathering Places **Salient Feature of Process/Technology:** • Needs 'NO' electronic-electrical parts/operation. • Hands free-unintentional (without hand contact) flushing. • Uses minimum requisite quantity of water per flush, thus ensures lesser water requirement and avoid water wastage in flushing. • Leads to assured, regular and compulsory flushing and cleaning of Urinals-Toilets. • Low cost compared with the existing systems. • Can be customized and retrofitted in existing and new urinal-toilets. • Easy and low maintenance. • Reduces associated health risk due to poor sanitation facility. **Status of Commercialization:** Ready and made available for technology transfer/commercialization. **Indicative Investment:** Approximately Rs.3 lakhs **Equipment and Machinery:** No major plant and machinery required. Basic machines like Lathe Machine, Welding M/c, etc. will be required. Alternatively, plastic moulding can be used for mass scale production at much cheaper per unit cost. **Raw Materials:**It can be made using PVC or UPVC or CPVC or Acrylic or Composite or Glass or MS or SS, etc. **For Further Information, Please Contact:** The Director, National Environmental Engineering Research Institute.	
	4.1.21 BFBR-NEW GENERATION ANAEROBIC REACTOR FOR WASTE WATER	**NIIST**

	**MANAGEMENT** **Product/Process:** **Application/Use:** The BFBR is a new generation high rate anaerobic reactor. It can be used effectively in treatment of difficult and complex wastewaters. **Salient Feature of Process/Technology:** • Narrow gap lamella separator for high efficiency separation of poor settling solids. • Floating fat and scum retained and remixed for complete degradation. • Automatic gas driven backwash of lamella with no additional power consumption. • Effective separation of solids retention time and hydraulic retention time. **Status of Commercialization:** Ready for commercialization. **Minimum Economic Unit Size:** Indicative **Investment:** **Equipment and Machinery:** Anaerobic reactor – BFBR with accessories to be incorporated in the waste water treatment plant. **Raw Materials:** Waste water. **For Further Information, Please Contact:** The Director, National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram.	
	**4.1.22 BIOFILTER MEDIA FOR INDUSTRIAL ODOR CONTROL** **Product/Process:** **Application/Use:** • Absorption of volatile gas compounds in the filter material. • Microbial break down of the polluting components • Complete destruction of compounds into harmless products such as carbon dioxide, mineral salts or acids and water. **Salient Feature of Process/Technology:** • Cost-effective for dilute, large volume air streams • Low operation and maintenance costs • High odour removal efficiency >99%. **Status of Commercialization:** **Minimum Economic:** **Unit Size:** Indicative.**Investment:** **Equipment and Machinery:** Bio filter media, bio filter holder, humidifier, blower and other. accessories. Cost depends on bio filter media and blower capacity.	**NIIST**

	Raw Materials: Bio filters are designed based on organic load and accordingly cost can be worked out. **For Further Information, Please Contact:** The Director, National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram.	

5.1 CULTIVATION AND PROCESSING OF ECONOMIC PLANTS (AROMATIC PLANTS)

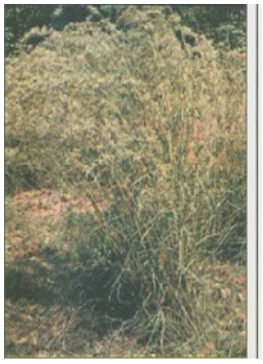
	**5.1.1. LEMONGRASS** **Product/Process:** Agrotechnology for Cymbopogon flexuous, C. pendulus and hybrids. **Varieties/Use:** Krishna, Cauvery, Pragati, Praman, Nima RRL-Cf-100, Jor Lab L-2, OD-19, SD-68 (Flexuous), RRL-16 (C. pendulus) and CKP-25 (hybrid of C. khasianus and C.pendulus). The oil rich in citral is used in perfumery and cosmetic industry and also in manufacture of Vitamin A. Variety RRL-Cf-100 is a selection for valuable a-bisabolol and other monoterpenes. **Suitable Region in India:** Tropical and sub-tropical plains. Variety CKP-25 thrives well in northern plains. **Soil & Climate:** Well-drained sandy loam soil, laterite soil pH 5.5-9.0, and humid climate with sufficient sunshine. Var. Jor Lab L-2, OD-19 and SD-18 also suitable for alkaline soils, jhum, slopes and degraded soils in NE region. **Propagation:**Through vegetative slips during Feb/March, economic life: 4-5 yr. **Agripractices:**Harvesting period May-Dec., 4-5 harvests/yr., 6-8 irrigation; fertilizer; N150, P60, K60 kg, FYM 10tlha. **Yield:** In first year 100-130 kg oil, second year onwards 175-200 kg oil/ha. The variety VKP-25 yields 250-300 kg oil in first year and 380-400 kg oil in subsequent years. The varieties for NE region yields 90 kg oil/ ha under rain fed conditions. **For Further Information, Please Contact:** The Director, Central Institute of Medicinal &Aromatic Plants, Indian Institute of Integrative Medicine, Jammu North-East Institute of Science and Technology , Jorhat.	**CIMAP**
	**5.1.2 JAVA CITRONELLA** **Product/Process:** Agro technology for Java citronella (Cymbopogon winterianus). **Varieties/Use:** Mandakini, Manjusha, Bio-13, Manjari, Jalpallavi, Jor Lab C-2. Oil obtained from steam distillation of leaves is rich in citronellal, citronellal and geraniol and is used in perfumery, cosmetics and	**CIMAP**

	mosquito repellent formulations. **Suitable Region in India:** NE region, southern region, Indo-gangetic plains. **Soil &Climate:** Well drained sandy loam or loamy soil, pH 5.8-8.0; sub-tropical to tropical climate, well-distributed rainfall 200-250 cm. **Propagation:**Vegetative through slips during July/August and Feb/March; about 55,000 slips/ha. **Agripractices:**Irrigation: 4-6 during rain free periods, fertilizer: N-150, P60, K60 kg/ ha/yr. Leaf blade is harvested 15 cm above the ground. First harvest comes 90 days after planting, subsequently at 3-4 months' interval; economic life 4 yr. **Yield:** First yr.: 150, 2nd -3rd yr.: 200, 4th yr.: 150 kg oi//ha. **For Further Information, Please Contact:** The Director, Central Institute of Medicinal & Aromatic Plants, Institute of Minerals and Materials Technology, Bhubaneswar, North-East Institute of Science and Technology, Jorhat.	
	**5.1.3 PALMAROSA** **Product/Process:** Agrotechnology for palmarosa (Cymbopogon martini). **Varieties/Use:** PRC-I, Trishna, Tripta, Motia. Oil is a source of high-grade geraniol. It is used in perfumery and cosmetic industries, flavoring of tobacco and in soaps. **Suitable Region in India:** All regions except temperate hilly areas. **Soil & Climate:** Well-drained sandy loams to loamy soils are ideal; the plant survive in sodic soils at pH 5-9.5, sub-tropical and tropical climate. It can also be cultivated in degraded soils, eroded lands, as well as marginal soils with reasonable returns. Propagated during rainy season through seeds: 10-12 kg/ha. **Propagation:**Propagated during rainy season **Through seeds:**10-12 kg/ha. **Agripractices:**Fertilizers: N 100, P 50 and K 50 kg/ha/year. In poor red soils of Deccan plateau, N up to 250 kg/ha gives good results. 4-6 irrigation (during rain. free period). The crop is harvested 3-4 months after planting; 2-3 harvest obtained in the first yr. and 3-4 in subsequently yr. Economic life 4-6 yr.	**CIMAP**

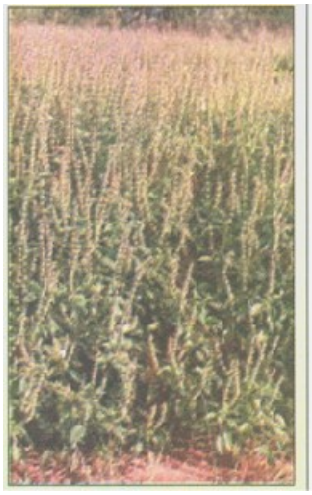
	Yield: First yr.: 60-80 kg, second yr. onwards: 100-150 kg/ha. **For Further Information, Please Contact:** The Director, Central Institute of Medicinal & Aromatic Plants, Institute of Minerals and Materials Technology, Bhubaneswar,Indian Institute of Integrative Medicine, Jammu.North-East Institute of Science and Technology, Jorhat.	
	**5.1.4 MENTHOL MINT** **Product/Process:** Agrotechnology for menthol mint or Japanese mint (Mentha arvensis). **Varieties/Use:** Var: MAS-1, Kalka, Himalaya, Kosi, Saksham, Kushal. Oil is source of natural menthol used in flavor and pharmaceutical industries. **Suitable Region in India:** Punjab, Haryana, UP, Uttaranchal, MP, Bihar, Rajasthan. **Soil & Climate:** Well-drained deep loamy soils; pH 6.5-8.0, tropical and subtropical climate, rainfall 950-1050 mm. **Propagation:**Vegetative propagation through suckers; 5q suckers for direct sowing and 1 q/ha suckers are required for nursery raising and transplantation of seedlings. **Agripractices:**It is a 6-7 months' crop. First harvest 100-120 days after planting, second harvest after another 60-70 days; irrigation: 10-14; fertilizer: 150-200 kg N, 50-60 kg P and 50-60 kg Klha. **Yield:** 150 to 200 kg oil/ha **For Further Information, Please Contact:** The Director, Central Institute of Medicinal & Aromatic Plants, Indian Institute of Integrative Medicine, Jammu.	**CIMAP**
	**5.1.5 PEPPERMINT** **Product/Process:** Agrotechnology for peppermint (Mentha piperita) **Varieties/Use:** Var: Kulkrail. The leaves on distillation yield essential oil (0.4-0.5%). The oil is used in perfumery, food flavoring and pharmaceutical preparations. **Suitable Region in India:** Terai region and hills of UP, Himachal Pradesh, Sikkim. **Soil & Climate:** Well-drained, rich deep loam soils; semi-temperate climate, average rainfall 95-105 cm, average temp. 15-30°C. **Propagation:**Through runners or other vegetative	**CIMAP**

	parts during mid Dec.-mid Jan. **Agripractices:**First harvest 110-130 days after planting, second after another 8-12 weeks; life span 1 yr.; irrigation: 10-12, fertilizer; N 125 kg, P 60 kg, K60 kg, FYM 10 t/ha. The crop is generally allowed to wilt for 24-28 hr. before distillation. This reduces moisture content, allows proper packing of herb and effects savings in steam during distillation. **Yield:** Approx. 100 kg oil/ha. **For Further Information, Please Contact:** The Director, Central Institute of Medicinal Aromatic Plants, Indian Institute of Integrative Medicine, Jammu.	
	**5.1.6 GERANIUM** **Product/Process:** Agro and oil extraction technology for geranium (Pelargonium graveolens L.). **Varieties/Use:** 'CIMPAWAN'. The leaves and branches are steam distilled to get "oil of geranium" (Approx. yield 0.8%-0.1 %), used in high-grade perfumery products and soaps. **Suitable Region in India:** North and south India, both in plains and hilly regions. **Soil & Climate:** Well-drained fertile soil, pH: 5.5-7.5, and Mediterranean type of climate with warm winter and mild summer, average temp. 30-35°C with low humidity, moderate rainfall up to 1000-1500 mm. **Propagation:** Through stem cuttings, about 40000 plants/ha during November-February. **Agripractices:** First harvest after about 5 months, subsequently at 3 months' intervals; grown as annual in north Indian Plains, up to 3 yr. in other irrigation as per need, fertilizer: 150-200 kg N, 60 kg and P 60 kg Klha. 2-3 weeding and regular hoeing are required. **Yield:** 30-35 kg oil/ha/yr. **For Further Information, Please Contact:** The Director, Central Institute of Medicinal & Aromatic Plants.	**CIMAP**

	**5.1.7 LAVENDER** **Product/Process:** Agrotechnology for Lavendula angustifolia Mill subsp. Angustifolia (Syn. L. officinalis Chaix). **Varieties/Use:** The flowering tops of lavender plant yield 1.2-1.5% valuable essential oil, mainly composed of linalool and linayl acetate. The oil is used in high-grade perfumery. Lower quality oil goes for preparation of lavender water, toilet water and soaps **Suitable Region in India:** Kashmir Valley, Uttaranchal. **Soil & Climate:** Well aerated dry and calcareous soil rich in nutrients, pH 7.0-8.4; cold winter and cool summer; rainfall 550-700 mm in the form of rain or snow. It can also be grown on gentile and steep slopes, poor eroded soils. **Propagation:** Through seeds during Nov./Dec. also propagated through rooted cuttings. Seeds germinate in April at 14-15"C. Cuttings of 10 cm length are taken from 1 yr. old plants and firmly planted. Beds are covered with black polythene to protect from cold weather. **Agripractices:** A basal dose of 20 kg and 40 kg P/ha is applied before planting; subsequently 2-3 split doses of 40 kg N are needed. The field requires regular weeding and hoeing. Old lavender plantations are regenerated during winters. Harvesting of flowers is done in dry sunny days during August/September. Oil is extracted by steam distillation. **Yield:** 15 kg oil/ha. **For Further Information, Please Contact:** **The** Director, Central Institute of Medicinal & Aromatic Plants, Indian Institute of Integrative Medicine, Jammu	**IIIM**

	**5.1.8 CELERY** **Product/Process:** Agrotechnology for celery (Apium graveolens L.) **Varieties/Use:** RRL-85-1. The seeds contain 2-2.5% aromatic oil. Dry seeds are used as spice in fresh and processed foods e.g. soups, sauces, pickles, meat, vegetable juices and in form of oleoresins. The seeds are also used in pharmaceutical applications and manufacture of commercial drug 'Ajmoda' used in Unani and Ayurvedic system of medicine. Leaves and stalk are used as salad vegetables. **Suitable Region in India:** Punjab, Haryana, UP and hilly areas having cold and dry climate. **Soil & Climate:** Sandy loam soils, cool climate, winter season. **Propagation:** Direct planting or seedling 1.5-2 kg seeds/ha. Nov. to May (6 months' crop). **Agripractices:** Harvesting period: 2nd and 3rd week of May, 3-4 irrigation, fertilizer: N100, P40, K10 kg/ha. Maturity in 180-190 days. The seed is harvested as soon as color change takes place. It is sun dried and cleaned before packing. **Yield:** 2t seeds/ha. **For Further Information, Please Contact:** The Director, Indian Institute of Integrative Medicine, Jammu.	**IIIM**
	**5.1.9 CYMBOPOGON HARDUS** **Product/Process:** Agrotechnology for Cymbopogon Nardus (L.Rendle var Confertiflours (Steud). Stapf ex Bor.) **Varieties/Use:** RRL-CN-5. The essential oil is used in perfumery and flavouring industries. **Suitable Region in India:** Northern and Central India. **Soil & Climate:** Sandy loam to loamy soil, pH ranges 6.5-8.5, tropical and sub-tropical environment conditions, warm and humid climate with sufficient sun shine hours; 800 to 1500 mm annual rainfall. **Propagation:** Vegetatively through slips, 62,500 slips/ha. Planting period Feb/March, July/August. **Agripractices:** 1st cutting 130 to 150 days after planting, thereafter at 55 to 65 days' interval; life span 4-5 yrs.; irrigation: 8-10 per yr., fertilizers; FYM 10 t, N200 kg, P80 kg, K60 KG/ha.	**IIIM**

	Yield: 1st year: 200-220 kg, 2nd year onwards: 250-280 kg oil/ha. **For Further Information, Please Contact:** The Director, Indian Institute of Integrative Medicine, Jammu.	
	**5.1.10 JAMROSA** **Product/Process:** Agrotechnology for Jamorsa (a hybrid strain of Cymbopogon Nardus var. Confertiflorus and C. jwarancusa). **Varieties/Use:** RRL-82. Freshly harvested foliage and flowering shoots yield 0.4% essential oil on steam distillation, which is used in perfumery/flavor/soap industry. The oil is a good substitute of palmarosa oil. **Suitable Region in India:** UP and other regions **Soil & Climate:** Sandy loam, loam, waste lands-tropical and sub-tropical. It can withstand water stress conditions though returns in irrigated conditions are higher. **Propagation:**Planting in Feb-March; 50,000 slip/ha. **Agripractices:** Harvesting period: May to December at 90-95 days' interval, 10 irrigations, fertilizers: N180, P60, K60 kg/ha. **Yield:** First year: 160 kg and in second year onwards: 220 kg oil/ha. **For Further Information, Please Contact:** The Director, Indian Institute of Integrative Medicine, Jammu.	**IIIM**
	**5.1.11 OCIMUM CANUM** **Product/Process:** Agrotechnology for basil (Ocimum canum Simms). **Varieties/Use:** RRL-Oc-11 (70-75% linalool in oil) RRL-Oc-12 (80-85% methyl cinnamate in oil). The herb yields 0.5-0.7% oil, useful in perfumery and flavouring industry. **Suitable Region in India:** Punjab, UP, MP, Kerala, Tamil Nadu. **Soil & Climate:** Well-drained loam and sandy loam soil, tropical & sub-tropical climate; also grows on moderate acidic, saline and alkaline soils at **pH** 6-8. **Propagation:** Through seed, 500 g/ha, planting in Feb-March and June-July. **Agripractices:** Harvesting period: June, August	**IIIM**

	to October; irrigation: 9; fertilizer N: P: K:90:60:60, FYM 5 VA. It is a month crop. **Yield:** 180-210 kg oil/ha (during 7 months) **For Further Information, Please Contact:** The Director, Indian Institute of Integrative Medicine, Jammu.	
	**5.1.12 CLOCIMUM** **Product/Process:** Agrotechnology for a new strain of Ocimum gratissimum L. It is named “Clocimum" because the oil extracted from this ocimum plant is clove-scented. **Varieties/Use:** RRL-Og-14. It yields about 0.5% oil with 80-85% eugenol therein, useful in flavouring, pharmaceutical industry and synthesis of vanillin. **Suitable Region in India:** Punjab, UP, MP, Kerala, Bihar, Tamil Nadu. **Soil & Climate:** Well-drained rich loam to poor laterite, saline and alkaline to moderately acidic soils, fair to high rain fall and humid conditions, tropical and sub-tropical climate at altitude up to 900 m. **Propagation:**Through seed & tender cutting, planning material: 500 g/ha, transplanting during Feb-March and June-July. **Agripractices:**First harvest 90-95 days after transplanting, thereafter at 65-75 days’ interval. 2-3 harvests in the first yr. and 4 each in subsequent yr. during May, July, Sept. &Dec. Life span: 5 yr.; irrigation: 8; fertilizer: FYM 10 t, N: P: K:90:60:60 kg/ha. **Yield:** 1st yr.: 175-180, 2nd yr. onwards: 200-250 kg oil/ha. **For Further Information, Please Contact:** The Director, Indian Institute of Integrative Medicine, Jammu.	**IIIM**

	**5.1.13 CLARY SAGE** **Product/Process:** Agro and extraction technology for Clary sage (Salvia scalaria L.) **Varieties/Use:** The flowers yield 0.15-0.25% essential oil rich in linalool and linalyl acetate. The oil is used in high-grade perfumes, cosmetics, flavouring liquors and as modifier in spice compounds. **Suitable Region in India:** Kashmir valley, HP and UP hills. **Soil & Climate:** Poor, dry and slightly acidic soils, temperature climate, bright light and 28-33° C temp during harvesting in June/July. **Propagation:**Though seeds in Nov. or March/April using 3-4 kg seeds/ha. Propagation through seedlings gives better results. Seedlings raised in March/April are transplanted in Nov. And those raised in August! September are transplanted in next season. **Agripractices:**Plant does not require frequent irrigation. 100 kg N/ha is required in 3 split doses. 25 kg N, 30 kg P and 30 kg K are applied as basal dose. Flowering tops are harvested twice/ye i.e. in July and September; remunerative life: 4 yr. **Yield:** 20 kg oil/ha. **For Further Information, Please Contact:** The Director, Indian Institute of Integrative Medicine, Jammu.	**IIIM**
	**5.1.14 Jammu Monarda** **Product/Process:** Agro technology for Jammu Monarda (Monarda citriodora Cerv. Ex Lag.). **Varieties/Use:** IIIM (J) MC-02, Essential oil having Thymol content 75-82% and used in pharmaceuticals, flavor and fragrance Industry. **Suitable Region in India:** Jammu, UP, MP, Bihar, Rajasthan, Chhattishgarh, Punjab, Haryana, Gujarat etc. **Soil & Climate:** Tropical and subtropical region, Sandy loam, loam and light clay soil suitable for such crop. **Propagation:**Propagated by seeds. **Agripractices:** Nursery time- Mid Sep- Mid Oct., Transplantation time- Last Oct. to Nov., Harvesting time- March- April.	**IIIM**

	Yield: 10-15 tones fresh herbage yield/ ha, oil yield 100-125 kg/ha. **For Further Information, Please Contact:** The Director, Indian Institute of Integrative Medicine, Jammu.	
	**5.1.15 HOPS** **Product/Process:** Agrotechnology for hops (Humulus lupulus L.) **Varieties/Use:** The female inflorescence of the plant, called hop cones, are chiefly used in the manufacture of beer. **Suitable Region in India:** Kashmir valley, Lahaul-Spiti in Himachal Pradesh and Champawat in UP hills. **Soil & Climate:** Sandy loam to clay loam, pH 6-8 **Propagation:** Vegetatively through cuttings, planted in Nov-Dec or March. Row to row and plant-to-plant spacing of 2mx2m each resulting in 2500 plants/ ha with 5-6 m as the height of hop trellis. **Agripractices:** Cow/mule dung or poultry manure is the traditional organic manure. Nitrogen is most important plant nutrient in addition to P&K along with micronutrients. After vines are trained, the field is irrigated repeatedly, particularly during June-July. Harvesting in August. Immediately after picking, the cones are dried in a kiln, pressed and baled. The price of hops is determined by the concentration of alpha acids. **Yield:** 1st year: 2,500, 2nd yr: 5,000, 3rd yr: 6,250 kg cones/ha. **For Further Information, Please Contact:** The Director, Indian Institute of Integrative Medicine, Jammu.	**IIIM**
	**5.1.16 PATCHOULI** **Product/Process:** Agrotechnology for Patchouli (Pogostemon patchouli). **Varieties/Use:** Oil is used in perfumery and cosmetic industry as a fixative as it provides tenacity to other perfumes. **Suitable Region in India:** NE India, Southern states where temperature is moderate. **Soil & Climate:** Well-drained medium loam fertile soils are favorable, while tropical & sub-tropical regions are also suitable. **Propagation:**	**NEIST**

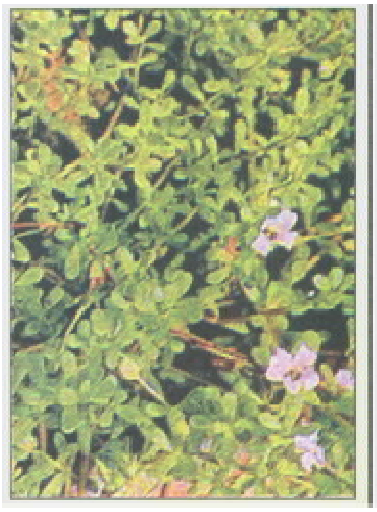
	Seedlings raised from cuttings, transplantation at 6-7 leaves stage, propagation during Feb-April, planting preferred in coconut orchards or under shade trees. **Agripractices:**Spacing: 60 cmx60cmx1 m, fertilizer: N 100, P 50, K 50 kg/ha, irrigation: 2-3 during Dec.-Feb. Perennial crop life span: 3-4 yr. First harvest 5- 6 months after planting, subsequently at 3-4 months' interval. The leaves are dried in shade for 3-6 days. The leaves yield 1.8-3.0% oil on distillation. The plant is highly susceptible to root knot disease, which is controlled by adopting crop rotation and use of nematicides. **Yield:** 50 kg oil/ha. **For Further Information, Please Contact:** The Director, Central Institute of Medicinal & Aromatic Plants,North-East Institute of Science and Technology.	

5.2 MEDICINAL PLANTS

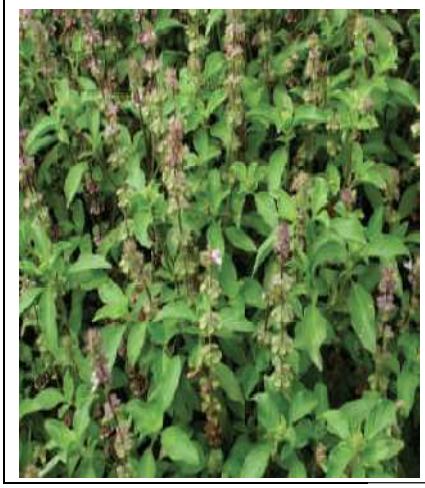
	**5.2.1 QUINGHAOSU** **Product/Process:** Agro technology for quinghaosu (Artemisia annua L.). **Varieties/Use:** The plant is a source of artimisinin used for the manufacture of arteether - drug for treatment of malaria; also yields essential oil (0.3%). The new variety 'Jeevan Raksha' suitable for northern plains contains artimisinin up to 1 %. **Suitable Region in India:** Himalayan region, subtropical northern plains. **Soil & Climate:** Sandy loam-to-loam soils with proper drainage; light textured soil ideal; temperate climate with cold winter and moderate summer. It can also be cultivated during winter in northern plains. **Propagation:** Through seeds: in temperate region during March/April, in northern plains during Oct.; 35 days old seedlings are transplanted. **Agripractices:**Fertilizer: N150, P50, K50 kg/ha. Irrigation: during summers in tropical region, regularly in subtropics. region; water logging to be avoided. Crop is harvested during Oct.-Nov. in tropical and in May-June in subtropics. region. The herbage is immediately steam distilled for essential oil. If artimisinin is the desired product, herbage is shade dried, leaves and flowers separated from stalks for processing. **Yield:** Artemisinin 5 kg/oil 55 kg. **For Further information, Please Contact:** The Director, Central Institute of Medicinal & Aromatic Plants, Indian Institute of Integrative Medicine, Jammu.	**CIMAP**
	**5.2.2 CHAMOMILE** **Product/Process:** Cultivation of German Chamomile (Chamomilla recutita syn. Matricaria chamomilla), post harvest storage and extraction of oil. **Varieties/Use:** The flowers yield blue oil containing 1-15% camazulene. It is used in pharmaceutical industry, to flavor high quality wine, tea and in perfumes. **Suitable Region in India:** UP, Bihar, Punjab, Haryana, Rajasthan as winter crop, hills of J&K, Himachal Pradesh, UP as summer crop. **Soil & Climate:** Moderate cool weather, well-drained moist, moderately heavy soils rich in	**CIMAP**

	humus are ideal; can also be cultivated in medium and light loam soils with pH up to 9. **Propagation:**Through seeds during Oct-Nov in north Indian plains and March-April in the hills. Transplanted after 6-8 weeks. **Agripractices:** 40 kg N/ha in north Indian Plains Trace elements like molybdenum and boron help flower and oil yield, 3-4 irrigation: during Dec-March; flowering during Feb; harvesting 4-5 times/yr. **Yield:** 1,000-1,500 kg dry flowers/ha. **For Further Information, Please Contact:** The Director, Central Institute of Medicinal & Aromatic Plants, National Botanical Research Institute, North-East Institute of Science and Technology, Jorhat.	
	**5.2.3 PYRETHRUM** **Product/Process:** Agro technology for cultivation of pyrethrum (Chrysanthemum cineraria folium). **Varieties/Use:** Var. Hansa. The flowers are source of pyrethrins (1.0-1.3%) which are safe and useful natural insecticides for house hold insects and protection of food grains. **Suitable Region in India:** Nilgiri and Palani hills in Tamilnadu, Kashmir valley, UP, Uttaranchal hills. A new variety suitable for north Indian plains has also been developed. **Soil & Climate:** Fertile, well-drained soil with adequate moisture, temperate climate and cool summer, temperature below 10^{Q}C for 6 weeks to initiate flowering; planting on ridges in areas with excessive rainfall. **Propagation:** Through seeds, nursery raised during April/Mayor Oct-Nov. **Agripractices:**N 40, P 120, K 60 kg/ha; irrigation required to maintain moisture in the soil and to enhance pyrethrin concentration. In Nilgiri & Palani, flowers are harvested every 15 days during 10 months. In Kashmir, one harvest is obtained during June-July. Optimum yields are obtained during 2nd & 3rd yr. The flowers are sun dried soon after picking. **Yield:** lnPalani: 600 kg; **In** Kashmir: 300 kg dry flowers/ha. **For Further Information, Please Contact:** The Director, Central Institute of Medicinal & Aromatic Plants.	**CIMAP**

	**5.2.4 ASHWAGANDHA** **Product/Process:** Agro technology for Ashwagandha (Withania somnifera). **Varieties/Use:** WSR, Poshita. Used for treatment of rheumatism, hypertension, gout, and cancer, as a tonic and sex stimulant in Ayurveda system of medicine. **Suitable Region in India:** MP, UP, Bihar, J&K, Haryana, Tamilnadu, Gujarat, Rajasthan, Punjab, Maharashtra. It can also be cultivated in arid lands and wastelands. **Soil & Climate:** Porous sandy loam soil, subtropical climate. **Propagation:** In Aug-Sept, seed 10-12kg/ha. **Agripractices:**Harvesting period: March-April; FYM: 20 t/ha. No chemical fertilizer required. Thrives under little irrigation or rain fed conditions. **Yield:** 0.8 dry roots/ha annually. **For Further Information, Please Contact:** The Director, Central Institute of Medicinal & Aromatic Plants, Indian Institute of Integrative Medicine, Jammu.	**CIMAP**
	**5.2.5 SARPAGANDHA** **Product/Process:** Agro technology for 'Sarpagandha' (Rauvolfia serpentina), also known as 'Chandrabhaga' or 'Chhota Chand' in Hindi. **Varieties/Use:** The long tapering snake - like roots of the plant are rich source of reserpine alkaloid, used in the manufacture of anti- hypertensive and sedative drug. The roots are also used in Ayurveda and Unani systems of medicine for curing a wide range of ailments. **Suitable Region in India:** Sub-Himalayan tract in north and east India, NE region, Eastern and Western Ghats, south India and Andaman Islands. **Soil & Climate:** Wide variety of soils. However, clay or clayey loam soils rich in humus, pH acidic to normal, humid climate with 10-38^{Q}C temp. and 250-500 cm rainfall is ideal. **Propagation:**Through seeds as well as root cuttings. Seedlings are raised in nursery in May and transplanted at the break of monsoon. **Agripractices:**Fertilizer: N 40 kg, P 30 kg, K 30 kg, FYM 5 t/ha; irrigation: 4-5; roots of 2-3 yr. old plants harvested in Dec. and dried in air/oven to	**CIMAP**

	8% moisture. Dry roots are broken into 10-15 cm pieces, stored in airtight containers in cool dry place. **Yield:** 1 t dry roots/ha. **For Further Information, Please Contact:** The Director, Central Institute of Medicinal & Aromatic Plants.	
	**5.2.6 BRAHMI** **Product/Process:** Agro technology for Brahmi (Bacopa monnieri). **Varieties/Use:** Subodhak and Pragyashakti varieties containing 1.6 and 1.8% bacoside - A resp. The plant is used in Ayurveda system of medicine for treatment of mental disorders, asthma, rheumatism and snakebite. Bacosides are responsible for improving intellect and enhancing memory. Modern medicines for this purpose use Brahmi as a major component. **Suitable Region in India:**Most of tropical/subtropical regions with adequate rainfall. **Soil & Climate:** Wide range of soil and climate conditions; performs well in poorly drained soils and water logged areas under subtropical conditions. Plant grows faster at high temp. (33-40QC), humidity (65-80%) and is cultivated as summer-rainy season crop. **Propagation:**Through cuttings obtained from mother plants; transplantation during March-June; flood irrigation after planting. **Agripractices:** N 100 kg, P 60 kg, K 60 kg, FYM 5 t/ha; irrigation: every week except monsoon season. Harvest: first in Oct, second in June. Plants are dried in oven/shade and stored in cool dry place. **Yield:** 1 t dry herbage (whole plant)/ha. **For Further Information, Please Contact:** The Director, Central Institute of Medicinal &Aromatic Plants.	**CIMAP**
	**5.2.7 KALMEGH** **Product/Process:** Agro technology for Kalmegh (Andro- graphis paniculata). **Varieties/Use:** It is important medicinal plant used in Indian system of medicine for treatment of dysentery, cholera, diabetes, fever, throat infections, hypertension, piles, jaundice, etc. **Suitable Region in India:** Plains of UP, Bihar, W.	**CIMAP**

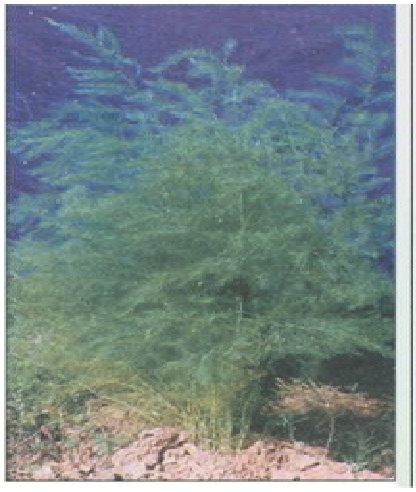
	Bengal, Assam, Orissa, MP, AP, Tamil Nadu, Kerala, Karnataka. **Soil &Climate:** Wide range of soils from loam to laterite with moderate fertility including shady wastelands; hot and humid climate with ample sunshine. **Propagation:**Through seeds; vegetative propagation also done through layering as each node produces enough roots. Seedlings are raised during late May and transplanted in late June at a row and plant spacing of 45-60 cm and 30 to 45 cm respectively. **Agripractices:** Application of 80 kg N in 2 split doses and 40 kg P/ha increases herb yield. 3-6 t FYM is required for raising nursery. Fairly distributed rainfall during monsoon is sufficient, but 2-3 irrigation: are needed prior to rains. Harvesting in Sept (after 90-1 00 days) when flowering is initiated. Whole plant is dried in shade and powdered. **Yield:** 3.5-4.0 t dry herbal/ha. Approximately Rs. 15,000 ha/yr. **For Further Information, Please Contact:** The Director, Central Institute of Medicinal &Aromatic Plants, North-East Institute of Science and Technology, Jorhat.	
	**5.2.8 MANDOOKPARNI** **Product/Process:** Agro technology for Mandookparni or Gotukola (Canella asiatica). **Varieties/Use:** Var. 'Kayakirti' and 'Majjaposhak', containing 0.8% and 1.1 % asiaticoside resp. The plant is widely used in traditional systems of medicine in India and other countries for curing skin diseases and in the manufacture of memory enhancing tonics. It is also used as vegetable in culinary preparations and salads. **Suitable Region in India:** Tropical regions. **Soil &Climate:** Wide variety of soils & tropical climate. **Propagation:**Through stem cuttings, transplanting in Oct at spacing 30cmx30cm. On establishment, the plant gives off stolon's, which root in contact with the soil. **Agripractices:**Grown under polythene shading nets. Fertilizer: FYM 5t, N 100 kg, P 60 kg/ha; irrigation every 10 days till plant establishes, later as per need; harvest: January onwards fortnightly, bulk harvest in June. The herb is dried in	**CIMAP**

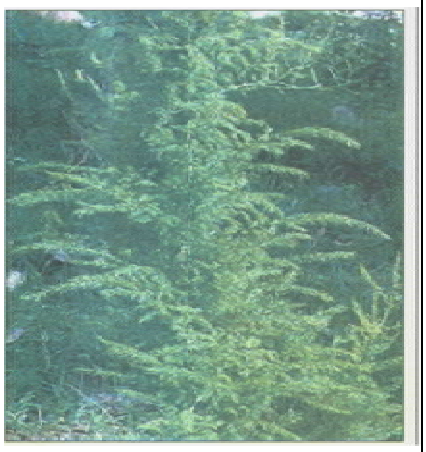
	oven/shade, packed in boxes and stored in cool dry place. **Yield:** 5.5 t fresh herb or 2t dry herb (20 kg asiaticoside)/ha. **For Further Information, Please Contact:** The Director, Central Institute of Medicinal &Aromatic Plants.	
	**5.2.9 BHUMYAMALAKI** **Product/Process:** Agro technology for Bhumyamalaki (Phyllanthus amarus Schum. &Thonn. Syn P. niruri) **Varieties/Use:** 'Navyakrit'. It is an important medicinal plant, rich in phyllanthin (0.5%), used in patent drugs and in Ayurveda system of medicine as ingredient of poly herbal drugs for treatment of jaundice, diabetes and hepatitis. **Suitable Region in India:** Throughout India in tropical to semi-temperate regions with high rainfall. **Soil & Climate:** This circumtropical plant is well adapted to a variety of soils at **pH ranging** from alkaline to acidic and in water logged areas; requires high rainfall. **Propagation:** Through seeds: nursery raised in April/May and seedlings transplanted after 30-40 days. **Agripractices:** No specific fertilizer except FYM. In northern plains with infrequent rainfall, one irrigation is required every fortnight; regular weeding desirable; harvesting in September. **Yield:** 1 t dry herbage (whole plant)/ha. **For Further Information, Please Contact:** The Director, Central Institute of Medicinal &Aromatic Plants.	**CIMAP**
	**5.2.10 TULSI** **Product/Process:** Agro technology for Tulsi (Ocimum basilicum) **Varieties/Use:** CIM-Saumya, CIM-Jyoti, CIM-Sharda. Oil used in pharmaceuticals, soap, perfumery industry and aroma therapy main chemical constituents are Methyl chevicol, Linallool, Citral. **Suitable Region in India:** UP, Bihar, Punjab, Haryana, Rajasthan and Himachal Pradesh. **Soil &Climate:** Well drained soil with normal fertility is ideal for cultivation. Tropical, sub-tropical and rainy season with 22-28 c. and humidity 75-80 is best for cultivation.	**CIMAP**

	Propagation: Seed requirement through nursery is 500 gm seed/ha. Nursery may be raised 25-30 days before transplanting. **Agripractices:**10-15 ton well decomposed manure or 5 ton vermi-compost, 40:40 kg phosphorus and potash applied in last ploughing, 80 kg Nitrogen applied in 3 parts at regular interval of 20 days. 1st irrigation is applied immediately after planting and subsequent irrigations as and when required. **Yield:**Herb yield 200-250 q/ha, oil yield-100-125 kg/ha **For Further Information, Please Contact:** The Director, Central Institute of Medicinal &Aromatic Plants, Institute of Himalayan Bioresource Technology.	
	**5.2.11 GHRIT KUMARI** **Product/Process:** Agrotechnology for Aloe-vera. **Varieties/Use:** CIM-Sheetal. It is used in cosmetics and aroma industry and also for making juice & gel. **Suitable Region in India:** Tropical and sub-tropical zone best UP, Bihar, Punjab, Haryana, Rajasthan and Himachal Pradesh. **Soil &Climate:** it is best to cultivate in soil where pH range is from 6.5-8.5, sandy loam to loam. Tropical and sub-tropical zone best. **Propagation:** By the small plants (Plantlets) which are found around the main plants with plant height of 15-20 cm is best for its propagation. **Agripractices:**After 2 deep ploughing, plantelets should be transplant with the spacing of 50X40 cm during rainy season. 15-20-ton compost or 7.5-ton vermicomposting and 25 kgh nitrogen, 50 kg phosphorus 50 kg potash per year/ha required for Aloe-vera. Irrigate immediately after transplanting. later on apply irrigation as and when required. After 10-12 months from transplanting crop is ready for cutting the lower leaves at and interval of 45 days cut the leaves 3-4 times in a year. **Yield:** Fresh leaves 50-60 ton/ha. Fresh leaves form which we may get 35-40% barbeleon juice **For Further Information, Please Contact:** The Director, Central Institute of Medicinal &Aromatic Plants, Institute of Himalayan Bioresource Technology.	**CIMAP**

	**5.2.12 ISABGOL** **Product/Process:** Isabgol (Plantago ovata). **Varieties/Use:** Niharika and Mayuri. Husk used as laxative, dysentery, constipation, chronic diarrhea and seed used as fodder. **Suitable Region in India:** Temperate, sub-temperate, susceptible to fog and high humidity **Soil &Climate:** Sandy loam to loamy soil with proper drainage Temperate, sub-temperate, susceptibel to fog and high humidity. **Propagation:** Through seeds, direct sowing. **Agripractices:** Through seed in the month of Oct-Nov at spacing of 30 cm in row and broadcasting too. 10-15 tons decomposed compost or 5 tons of vermicomposting. NPK @ 20:25:25 kg/ha. Total P &K applied as basal while N is applied in 3 splits. After 20-25 days, first irrigation required and irrigate the crop as per requirement. **Yield:** after 4-5 months or prior to shattering of seed. After harvesting, process the seed for separation of husk and seeds. Seeds production 10-12q/ha **For Further Information, Please Contact:** The Director, Central Institute of Medicinal &Aromatic Plants, Institute of Himalayan Bioresource Technology.	**CIMAP**
	**5.2.13 SENNA** **Product/Process:** Agro technology of Cassia angustifolia. **Varieties/Use:** Va. Sona Foliage and leaves used in Unani and Ayurvedic system of medicine for constipation and dysentery problems. The main active ingredient of the plant is sennosides which is found in leaves and pod shells. **Suitable Region in India:** **Soil &Climate:** Loam and laterite soil with pH value upto 7.0-8.0 land should be well drained. Dry summer with moderate temperature is the actual requirement of the crop. **Propagation:**By seeds @ 30 kg /ha (Un-irrigated), 15 kg/ha (irrigated). **Agripractices:** Through seed in the month of Oct-Nov at spacing of 30 cm in row and broadcasting too. 10-15 tons decomposed compost or 5 tons of	**CIMAP**

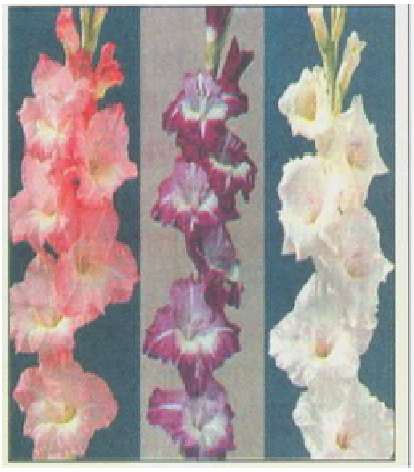
	vermicompost. NPK @ 20:25:25 kg/ha. Total P &K applied as basal while N is applied in 3 splits. After 20-25 days, first irrigation required and irrigate the crop as per requirement in North India, Feb-March and in South India, Sep-Oct or Feb-March (Irrigated) seeds should be sown at 30 cm spacing in 1.5 cm deep furrow. 100:20: 24-30 kg/ha, nitrogen, phosphorus and potash. Apply full quantity of potash and phosphorus and half quantity of nitrogen during field preparation and half quantity of nitrogen in two equal split doses after plucking of leaves. Irrigate as per need, 2-3 irrigation needed.2 weeding would be sufficient after planting. **Yield:** Leaves 8-10 quintals in irrigated, 5-9 quintals in non-irrigated, Pod4-5 quintals in irrigated and 2-3 quintal in non-irrigated condition per ha. **For Further Information, Please Contact:** The Director, Central Institute of Medicinal &Aromatic Plants, Institute of Himalayan Bioresource Technology.	
	**5.2.14 SATAVARI** **Product/Process:**Agro technology of Asparagus racemosus. **Varieties/Use:**variety CIM-Shakti. Roots used as general tonic, increase in lactation, etc. **Suitable Region in India:** UP, Bihar, Punjab, Rajasthan, Maharashtra, MP. **Soil &Climate:**Tropical and sub-tropical climate with 50 to 100 cm rainfall and 10 40 centigrade is best for this crop, well drainage, sandy loam, soil is suitable for asparagus. **Propagation:** Through seeds. 2.5-3.0 kg/ha time of nursery sowing is May in nursery bed. Transplanting may be started after 80 days from sowing. **Agripractices:** At last stage of ploughing mix 20-25 ton well decomposed manure with 80:60:150 kg nitrogen, phosphorus, potash for one ha. In winter, irrigation required after one month however, in summer, at interval of 20-25 days, irrigation is required. harvesting has to begin after 18 0r 30 months from planting in the month of Dec. and Jan. **Yield:** 6 Ton dried root. **For Further Information, Please Contact:** The Director, Central Institute of Medicinal &Aromatic Plants, Institute of Himalayan	**CIMAP**

	Bioresource Technology.	
	**5.2.15 MEDICINAL YAM** **Product/Process:** Agro technology for medicinal yams (Dioscorea compos ita and D. floribunda). **Varieties/Use:** S2-58. The rhizomes are important source of diosgenin, which is used as raw material for synthesis of progesterone, corti some and other steroidal drugs. **Suitable Region in India:** North East region, W. Bengal, Maharashtra, Karnataka, J&K, UP, MP, Arunachal Pradesh at altitude up to 1500 mean sea level. **Soil & Climate:**Annual rainfall 85-160cm, tropical/subtropical and humid climate, porous sandy loam soils. **Propagation:**30,500 plants/ha by rooted tuber during March-June, spacing 45x60 cm. **Agripractices:** Harvest: after 3 yr. during Dec.-January; irrigation: 6-7/yr. Supporting system required. Fertilizer: N300, P150, K150 kg/ha in 2 split doses. **Yield:** Third year: 45-60 t dry tubers of D. composite/30-40 t dry tubers of D. floribunda. **For Further Information, Please Contact:** The Director, Indian Institute of Integrative Medicine, Jammu North-East Institute of Science and Technology, Jorhat.	**IIIM**
	**5.2.16 ASPARAGUS** **Product/Process:** Agro technology for asparagus (Asparagus officinalis L.). **Varieties/Use:**SL-831 and SL-831-96. Used for medicinal purpose and as canned vegetable. **Suitable Region in India:** Temperate region and selected areas in the plains. **Soil & Climate:** Fertile, sandy loam soil, preferably cool environment. **Propagation:** Through seeds/tissue culture; planting period: March and Oct-Nov; planting material: 14000/plants/ha. **Agripractices:** Harvest: March to June and Oct-Nov; life span: 10-15 yr., irrigation: 4 to 5; fertilizer: N60 kg, P100kg, K80 kg, FYM 20tlha. **Yield:** Third yr onwards: 2.0-3.5 t/ha. **For Further Information, Please Contact:**	**IIIM**

	The Director, Regional Research Laboratory, Jammu.	
	**5.2.17 SHATAVARI** **Product/Process:** Agro technology for Shatavari, also known as Sam many Sataware (Asparagus racemosus Willd). **Varieties/Use:** JL-962. The plant is used for medicinal purpose in the treatment of dysentery and urinary disorders and for healing wounds. It is also a valuable ornamental plant. **Suitable Region in India:** Subtropical and tropical areas. **Soil & Climate:** Sandy loams, tropical climate. **Propagation:** Planting by seeds and crown division. **Agripractices:** Harvest period: January; life span: biennial; irrigation: 6; fertilizer: N60 kg, P80 kg and K40 kg/ha. **Yield:** 6-18 t from 12,18 and 24 months' crop. **For Further Information, Please Contact:** The Director, Indian Institute of Integrative Medicine, Jammu.	**IIIM**

5.3 FLORAL PLANTS

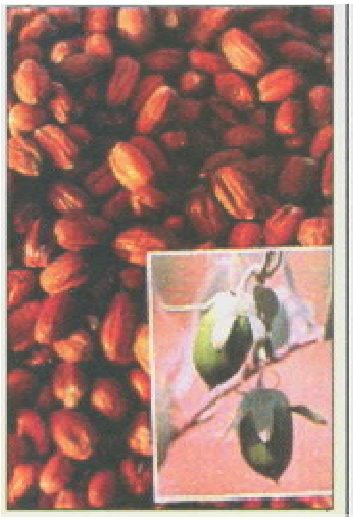
	**5.3.1 DAMASK ROSE** **Product/Process:** Agro technology for Damask rose (Rosa damascena Mill). i Production of high value processed products viz. rose oil, concrete, absolute, rose water in different grades, gulkand, and dry flowers. ii. Mini distillation unit for 10 kg flowers/batch suitable for 0.25-0.4 ha lands. **Varieties/Use:** Jwala, Himroz, Noorjehan. Rose products are used in high value cosmetics, perfumery, food, pharmaceutical industry, tobacco and pan masala, etc. **Suitable Region in India:**Jwala and Noorjehan are suitable for sub-tropical northern plains, mid hills and mild temperate regions up to 1200 m altitude. Himroz variety is suitable for mild temperate to cold temperate regions 1200-2500 mean sea level altitude. **Soil &Climate:** Wide range of soils e.g. sandy loam to clay loam). It does well in deep rich loamy soil. **Propagation:**Through stem cuttings, water-shoots and seeds. The rooted cuttings are transplanted during monsoon while winter is ideal for establishment in the field. **Agripractices:** Irrigation is necessary during dry periods. Fertilizer: N: 120-150, P: 60-90, K: 40-50 *kg/ha/yr.* Harvest: in northern plans during March April and in the hills during May. Economic life: 15-20 yr. **Yield:** Fresh flowers: 3.5 - 5.0 Vha; Oil recovery: 0.025-0.030%; Oil yield: 0.75 - 1.5 kg/ha; Rose concrete: 0.35-0.45%; Rose absolute: 0.15-0.20%; Rose water: AAA 1800-2000 Uha and AA grade 3,500-4,000 Uha. **For Further Information, Please Contact:** The Director, Central Institute of Medicinal &Aromatic Plants, Institute of Himalayan Bioresource Technology.	**CIMAP**
	**5.3.2 LILY** **Product/Process:** Agro technology for Lily: Asia Hybrid (Lilium sp.). **Varieties/Use:** Ten varieties; Useful for cut flower and bulb production. **Suitable Region in India:** Foothills of Himalaya	**IHBT**

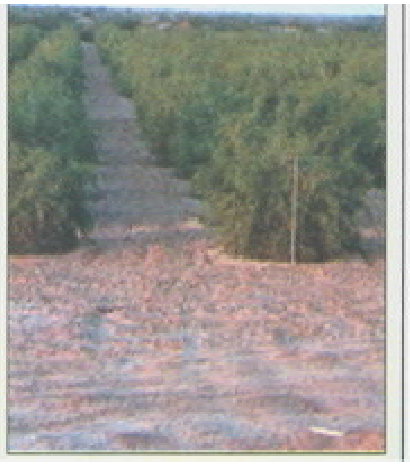
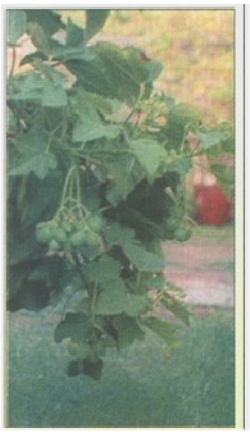
	and other areas having mild summer and prolonged winter. **Soil & Climate:** Sandy loam soil. The day temp. should be less than 20-25^{Q}C and the night temp. around 10-15^{Q}C. **Propagation:** Lilies are planted: in the western Himalaya round the year except monsoon period, in the plains during Oct.-Nov. Propagation is through sprouted bulbs. The bulbs can also be multiplied through scale segments. The micro bulbs attain plant able size within a year. With the new techniques, the rate of multiplication is much faster than the traditional propagation practice. **Agripractices:** It is grown under shading nets. The plant requires frequent irrigation but no water stagnation. In summers, water is required up to 10 *Um^{2}/ day*. Two doses of calcium nitrate are incorporated @ 100 kg/ha. Support is essential to keep the plants erect. Flowers are harvested 3-4 months after planting when unopened buds show distinct coloration. **Yield:** 1st year: 1.5 lakh spikes + 1.5 lakh bulbs/ha. 2nd year: 3 lakh spikes/ha **For Further Information, Please Contact:** The Director, Institute of Himalayan Bioresource Technology, National Botanical Research Institute.	
	**5.3.3 GLADIOLUS** **Product/Process:** Agro technology for Gladiolus flowers. **Varieties/Use:** Twenty varieties, used for cut flower and plant material production. **Suitable Region in India:** Foothills of Himalaya, northern plains. **Soil & Climate:** Sandy loam soil. The day temperature should be approx. 25-30^{Q}C and the night temperature around 15-20QC. **Propagation:** Gladiolus is grown: in the foothills of Himalaya almost round the year, in the sub-tropical plains in northern India, during winters; propagation through corms and cormels, 1.5-2.00 lakh corms required/ha. Cormels are used for production of corms. **Agripractices:**In plains, the sprouted corms of 3-5 cm dia are planted in Sept-Oct. and in the hills round the year. Before plantation, the soil is sterilized and FYM, super phosphate and Muriate of Potash are incorporated. CAN is used as nitrogen source. The plants flower 2-3 months	**IHBT**

	after sprouting. Harvesting stage of flowers is determined by the distance of market. **Yield:** 1st year: 1.0 lakh spikes & 1.5 lakh corms/ha 2nd year: 3 lakh spikes and 3 lakh corms/ha. **For Further Information, Please Contact:** The Director, Institute of Himalayan Bioresource Technology.	
	**5.3.4 TULIP** **Product/Process:** Agro technology for Garden Tulip (Tulipa gesnerana) under open field condition. **Varieties/Use:** Ten varieties, useful for cut flower and bulb production. **Suitable Region in India:** Foothills of Himalayas and other areas with prolonged chilly winter. **Soil & Climate:** Sandy loam soil. The day temperature should be less than 20^{Q}C and the night temperature may be as low as OQC. **Propagation:** Through bulbs, 1.5 lakh bulbs required/ha. **Agripractices:** The bulbs are properly forced by providing a cold temperature treatment. This treatment and its duration influence the flowering to be in December or February. Remunerative life: 2 yr. **Yield:** 1.5 lakh cut flowers/ha **For Further Information, Please Contact:** The Director, Institute of Himalayan Bioresource Technology.	**IHBT**
	**5.3.5 MARIGOLD** **Product/Process:** Agro technology for wild marigold (Tagetes minuta Linn) flowers. **Varieties/Use:** Improved selection for production of Tagetes oil and Tagetes absolute. The petals are also used in extraction of xanthophyll pigment, additive in poultry feed, and formulations for housefly/ cockroach repellents. **Suitable Region in India:** HP, J&K, Hills of UP, foothills of Himalaya and Shivalik ranges. **Soil & Climate:** Can be cultivated even under partial shades of vegetation and wide range of soils; sandy loam to clay soil with pH 5.5 to 8.0 is ideal. Mild temperate & sub-tropical climatic conditions are most suitable. **Propagation:** An annual plant propagated by	**IHBT**

	seeds as well as seedlings. **Agripractices:**Crop period is from June to October in hilly regions. Seed is sown in June and crop harvested in mid-October and distillation continued till late November. A good drainage system is essential. Fertilizer: 120:60:60 kg/ha of N: P: K. **Yield:** 20-25 t fresh flowers, yielding 40-50 kg oil/ha by steam distillation. **For Further Information, Please Contact:** The Director, Institute of Himalayan Bioresource Technology, National Botanical Research Institute.	
	**5.3.6 CALLA LILY** **Product/Process:** **Varieties/Use:** Him Sumukh and Him Shweta. **Suitable Region in India:**Low and mid hill regions of Himalayas. **Soil & Climate:** Sandy loam soil. The temperature range should be 15-25 deg C. **Propagation:** Through division of rhizomes (Him Shweta) and tubers (Him Sumukh). **Agripractices**: It is grown under shading nets. The plant requires frequent irrigation but no water stagnation. Two doses of NPK (12:32:16) are incorporated @ 100 kg/ha. Him Shweta flowers during spring season (February-April) and Him Sumukh during summer (May-June). **Yield:** 20000-25000 cut flowers /500 sqm **For Further Information, Please Contact:** The Director, Institute of Himalayan Bioresource Technology.	**IHBT**

5.4 OTHER ECONOMIC PLANTS

	**5.4.1 JOJOBA** **Product/Process:** Agro technology for Jojoba (Simmondsia chinensis) **Varieties/Use:** The seeds contain 45-55% premium industrial oil, which is an ideal lubricant for high speed, high temperature machines and a substitute to sperm whale oil. It is also used as base in cosmetics, detergents, pharmaceuticals, in floor polishing waxes and in candles with a long burning time. **Suitable Region in India:** Rajasthan, Saurasthra & Kutch in Gujarat, western Haryana and Punjab, southwest UP, coastal Orissa, A.P., Tamil Nadu, semi-arid laterite soils in Karnataka. **Soil & Climate:** This hardy desert shrub withstands extreme temperatures from - 5 to 54^{Q}C and grows on variety of soils from porous rocks to sandy loams and acidic to slight alkaline wastelands but not suitable in wet marshy conditions. **Propagation:** Through seedlings, rooted cuttings or tissue culture plantlets. The nursery is raised in October and March. **Agripractices:** Light irrigation in first 2 yr. Mature plants survives even without water. For a good harvest, irrigation is desirable during flowering and seed ripening stage. Gypsum is applied @ 1 t/ha. **Yield:** If propagated through cuttings, a plant yields 50 g seed in 4th year. After 10^{th} year the seed yield is 1 kg/plant or 2.5 t/ha till 100 yr. **For Further Information, Please Contact:** The Director, Central Salt & Marine Chemicals Research Institute.	**CSMCRI**

	**5.4.2 PILU** **Product/Process:** Agro technology for Pilu or Kharijal (Salvadora persica) in saline wastelands. **Varieties/Use:** The seeds contain 30 to 35% valuable industrial oil, which is a substitute to coconut oil for making quality soaps/ detergents. The stem is used in dental care, the leaf and tender shoots are eaten as salad and also used as camel fodder. **Suitable Region in India:** Kutch (Gujarat), saline soils in arid and semi-arid zones of Maharashtra, Andhra Pradesh and Tamil Nadu. **Soil & Climate:** Being a drought, tolerant tree, it grows on coastal sand dunes, marginal to high saline wastelands with or without water logging, ravines and saline/alkaline dry zones. It is also suitable for growing as wind-breaks for protecting farm habitations, gardens etc. **Propagation:** The tree readily regenerates from seed and coppices well, but the growth is slow. For commercial planting, 3 yr. old nursery seedlings are used. **Agripractices:** During initial 3 yr., it requires marginal irrigation. Subsequently minimum lifesaving irrigation is needed. It can also be irrigated with saline water. The plant flowers during November and seeds mature during April. **Yield:** Seeds 3.5 t/ha after 8 yr. The plant has a life up to 100 yr. **For Further Information, Please Contact:** The Director, Central Salt & Marine Chemicals Research Institute.	**CSMCRI**
	**5.4.3 JATROPHA CURCAS** **Product/Process:** Agro technology for Physic nut (Jatropha curcas L.), also known as 'Jungle arandi', 'Ratanjyot', 'Jamalghota' or 'Bagbherenda'. **Varieties/Use:** The seed oil, called 'Curcas oil' is industrially valuable as biofuel, illuminant oil and used in soap/candle making. This biodiesel is free from lead, Sulphur and halogens and can be used as blending component with diesel fuel. Conventional diesel engine can be operated with this oil. **Suitable Region in India:** Tropical wastelands including Andaman & Nicobar Islands.	**CSMCRI**

	Soil & Climate: Hardy plant grows under wide range of temperature, soil, pH and rainfall. It is well adapted to arid and semi-arid conditions. **Propagation:** By seeds or cuttings. **Agripractices:** Flowers in hot and rainy season, sets fruit in winter; fertilizer and moisture demands are low; productive period: 30 yr. **Yield:** 6th yr. onwards 4,000 kg under rain fed & 12,000 kg/ ha/yr. under irrigated conditions. The seed yields about 35% oil. **For Further Information, Please Contact:** The Director, Central Salt &Marine Chemicals Research Institute.	
	**5.4.4 SEAWEED** **Product/Process:** Cultivation of seaweed viz. Gracilaria edulis. **Varieties/Use:** In production of agar. **Salient Feature of Process/Technology:** Gracilaria is grown in lagoons and open sheltered calm waters. The cultivation is done by vegetative propagation starting from fragments. Single Rope Floating Raft technique has been developed wherein the main structure is a 30 m long polypropylene rope of 10 mm dia. The rope is attached to 2 wooden stakes and kept afloat with synthetic floats. Each raft is kept afloat by means of 25-30 floats. The cultivation rope is hung with the floating rope while ten fragments of the weed are inserted in each rope. The distance between two rafts is kept at 2 m. The weed grows fast and the pure material thus produced fetches a high price. There is a great market demand for this weed. Its cultivation generates income and employment for the women and fishermen. **Status of Commercialization:**so far 1500 people got trained for this alga cultivation. **Minimum Economic Unit Size:** 10 rafts. **Equipment and Machinery:** Polypropylene ropes, raft system. **Raw Materials:** Weed (Gracilaria edulis) for propagation. **For Further Information, Please Contact:** The Director, Central Salt & Marine Chemicals Research Institute.	**CSMCRI**
	5.4.5 SEAWEED	**CSMCRI**

	**Product/Process:** Cultivation of seaweed viz. Gracilaria debilis. **Application/Use:** In production of superior quality agar. **Salient Feature of Process/Technology:** "Gracilaria debilis is grown in lagoons and inter-tidal region of sea. The cultivation is done by Bamboo Raft culture method through vegetative propagation. Freshweight seedlings (13–25 g) were inserted into polypropylenerope at 5 cm intervals by nylon thread. Each rope had20 propagules with a total fresh weight of 260–500 g rope−1. A raft with 17 such ropes had initial seedlingdensity of 4.42–8.5 kg fresh wt. All the rafts were covered by fishnet from the lower side to prevent grazing and reducematerial loss due to detachment from the seeded ropes. Thewhole assembly was anchored with 6-mm polypropylene ropes and natural stone (approx. 25 kg wt.). **Status of Commercialization:**So far 1500 people got trained for this alga cultivation. **Propagation:** Vegetative propagation. **Agripractices:** Harvest is ready after every 45 days. No need of fertilizers. They grow naturally. In a year 6-7 harvest cycle is possible. The produced biomass had a market rate at Rs45/kg.dry.wt **Yield:** 30-35 kg.fr. wt. can be produced from single raft and 3.5kg.dry wt. is possible from single raft. 13-15% commercial agar yield with 600-900 g/cm2 gel strength is possible from produced biomass. **For Further Information, Please Contact:** The Director, Central Salt & Marine Chemicals Research Institute.	
	**5.4.6 SEAWEED** **Product/Process:** Cultivation of seaweed viz. Kappaphycus alvarezii. **Application/Use:** In production of carragenan and liquid plant growth stimulant. **Salient Feature of Process/Technology:** The commercial cultivation of K. alvarezii has been taking place in Tamil Nadu for the past 15 years. **Soil and Climate:** Nearly 2500 people got trained in farming and 650 are involved in commercial farming **Propagation:** Vegetative propagation. **Agripractices:** Harvest can be made in 45 days	**CSMCRI**

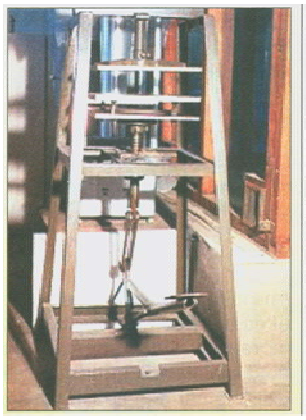
	and 7 harvests can be made in a single year **Yield:** 250 - 300 kg fresh biomass can be harvested from single raft and about 25 - 30 tons' dry material will be produced per hectare per cycle **For Further Information, Please Contact:** The Director, Central Salt & Marine Chemicals Research Institute.	
	**5.4.7 SEAWEED** **Product/Process:** Cultivation of seaweed viz. Gelidiella acerosa **Varieties/Use:** In production of bacteriological agar. **Suitable region in India:** Gelidiella acerosa has been cultivated using hanging stone raft method. **Soil and Climate:** Nearly 1500 people got trained in farming. **Propagation:** Vegetative propagation. **Agripractices:** Harvest can be made after 90 days and 3 harvests can be made in a single year **Yield:** 6 - 8 kg fresh biomass can be harvested from single raft and about 4-5 tons' dry material will be produced per hector per cycle.**For Further Information, Please Contact:** The Director, Central Salt & Marine Chemicals Research Institute.	**CSMCRI**
	**5.4.8 SEAWEED SAP** **Product/Process:** Liquid seaweed sap as crop bio stimulant and carrageenan production technology from fresh Kappaphycus alvarezii. **Varieties/Use:** (a)Kappaphycus seaweed sap is a very good crop bio stimulant capable of enhancing crop yields by 11-37% over and above the recommended dose of fertilizers. (b) Caraggenan: It has several industrial uses such as in thickeners, ice-creams etc. **Suitable region in India:** Kappaphycus seaweed sap has been tested across 20 states of India with good performance. Seaweed can be grown in Tamilnadu and Gujarat. **Soil and Climate:**The seaweed sap performs as a crop bio stimulant performs well in varied agro-ecological zones, viz., hilly cold regions, semi-arid to arid tropical regions. **Propagation:** Kappaphycus seaweed cultivation technique standardized by CSIR-CSMCRI	**CSMCRI**

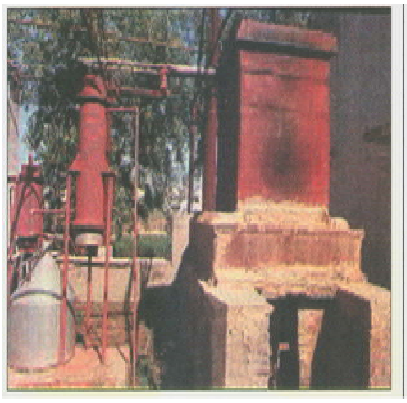
	(Macroalgal group, of CSIR-CSMCRI). **Agripractices:** Agripractices using seaweed sap as an organic bio stimulant has been developed for several crops such as rice, wheat, maize, black gram, green gram, soybean, sesame, potato, sugarcane, tomato, pea, cabbage etc. **Yield:** Crop Yield increase by 11-36% over and above the regular agro-practices in different crops **For Further Information, Please Contact:** The Director, Central Salt & Marine Chemicals Research Institute.	
	**5.4.9 TEA HUSBANDRY** **Product/Process:** Agro technology package for China hybrid or chinar tea cultivation in the hills through mechanized skiffing and harvesting operations. Manufacture of quality black orthodox and green tea. **Varieties/Use:** Tea industry having china hybrid or chi nary tea plantations in hilly areas. **Suitable Region in India:** The improved technology provides nearly 4 times yield. Skiffing and harvesting of tea leaf are done by mechanized system. The cost of plucking as compared to conventional hand plucking is brought down to 60% by one-man operated machine and to 40% by two-man operated machine. **Soil & Climate:** Commercialized in Himachal Pradesh and Uttar Pradesh hills. **Propagation:** Tea farm of 5 ha; teas manufacture: 40,000 kg/yr. **Agripractices:** Tea plucking machines and sprayers. **Yield:** Agrochemicals, farm machinery and equipment. **For Further Information, Please Contact:** The Director, Institute of Himalayan Bio Resource Technology.	**IHBT**
	5.4.10 BAMBOO NURSERY **Product/Process:** Agro technology for rooted bamboo plants ready for transplantation. **Varieties/Use:** Bamboo is the fast growing multipurpose plant species used in a variety of applications like building construction, water conduits,	**IHBT**

	scaffoldings, bridges, mats, floor/ partition tiles; as food, handicrafts, steel substitute in concrete and handicrafts etc. **Suitable Region in India:** For micro-propagation, land with assured irrigation is necessary for raising nursery. For tissue culture work, additional investments on lab and building are required. **Soil & Climate:** Bamboo is normally propagated by offsets, which include a rhizome and part of the aerial culm. The new technique uses aerial branch cuttings. Protocols have been standardized for mass multiplication using nodal explants of field-grown bamboo through tissue culture. The macro-cuttings provide 80-85% success rate. **Propagation:**Macro propagation: Common garden tools. Micro propagation: autoclave, laminar/culture-hood, working bench, racks with lights. **For Further Information, Please Contact:** The Director, Institute of Himalayan Bio resource Technology.	
	**5.4.11 GERBERA** **Product/Process:** **Varieties/Use:** Him Saumya, Him Gaurav, Him Aabha, Him Apoorva, Him Keerti, Him Glow and Him Peace. **Suitable Region in India:** Low and mid hill regions of Himalayas and adjoining plains. **Soil & Climate:** Sandy loam soil. The temperature range should be 20-30 deg C. High production under protected cultivation. **Propagation:**Through tissue culture and division of suckers. **Agripractices:** It is grown under polyhouse condition. The plant requires frequent irrigation but no water stagnation. In summers, water is required up to 10 L/m2/day. Use of balanced fertilizer NPK (19:19:19) @ 20 gms/litre at fortnightly interval is required. Flowers are harvested at the time of anthesis. **Yield:** 60000-72000 cut flowers/500 sqm **For Further Information, Please Contact:** The Director, Institute of Himalayan Bio resource Technology.	**IHBT**

	**5.4.12 HIMSTEVIA (A CLONAL CULTIVAR OF STEVIA) RAISED THROUGH TISSUE CULTURE TO ESTABLISH STEVIA CULTIVATION** **Product/Process:** **Varieties/Use:** HIMSTEVIA. **Suitable Region in India:** Tropical and sub-tropical region of India. **Soil & Climate:** Sandy loam soil. The temperature range should be 18-40 deg C. **Propagation:**Through cuttings, division of suckers and tissue culture. **Agripractices:**Rooted cuttings are transplanted in the field during March/April. First irrigation is given immediately after transplanting. Transplanting is done in furrows or flat beds at a spacing of 45 x 45 cm. on an average 100-120 kg N, 40-50 hg P2O5 and 50-60 kg K2O should be applied per hectare. Harvesting is done after 90 days of transplanting. Subsequently harvest is taken after 50-65 days of the first harvest. **Yield:** In the first year, average fresh biomass yield of 2.0-2.5 ton/ha is obtained; Subsequently an average dry leaf yield of stevia is 30-35 q/ha/year. **For Further Information, Please Contact:** The Director, Institute of Himalayan Bioresource Technology.	**IHBT**

5.5 MISCELLANEOUS

	**5.5.1 HERBAL MOSQUITO REPELLENT COIL** **Product/Process:** Manufacture of herbal coils. **Application/Use:** To repel mosquitoes. **Salient Feature of Process/Technology:** The herbal raw materials e.g. binders, smouldering agent and adjuncts are ground into fine powder. The constituent powder is kneaded thoroughly with water base and then compacted and pouched. Coils are dried. The coil burns slowly, emanating fumes which drive away mosquitoes. A coil lasts for 6 - 8 hr. The fume/smoke is not harmful. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 1000 coils/day. **Indicative Investment:** Rs.3 lakhs. **Equipment and Machinery:** Foot /hand press, coil press, hammer mill, sieves, weighing machine. **Raw Materials:** Herbal material, binder, smouldering agent, adjuncts. **For Further Information, Please Contact:** The Director, Central Food Technological Research Institute.	**CFTRI**
	**5.5.2 TECHNOLOGY FOR SPIRULINA PRODUCTION** **Product/Process:** Process for the production of nutritious alga - Spirulina. **Application/Use:** Feed development. **Salient Feature of Process/Technology:** Selected strains of Spirulina are used for cultivation in large cement pots and small manually/mechanically in a pond and growth is monitored by the addition of nutrient and fresh clean water routinely. After achieving maximum cell density, biomass is harvested by filtration, washed with fresh water and sun-dried. The dry flakes thus obtained are crushed to obtain powder for feed development. **Status of Commercialization:** Ready for Commercialization. **Minimum Equipment Size**: 1 tpa **Indicative Investment:** Rs.2 lakhs. **Equipment and Machinery:** Cement tanks of 1 sq. m., filtration unit, drying trays, balance, pH meter, electric heater / gas burners.	**CFTRI**

	Raw Materials: Fertilizers and inorganic carbon source. **For Further Information, Please Contact:** The Director, Central Food Technological Research Institute.	
	**5.5.3 DISTILLATION SYSTEM FOR ESSENTIAL OILS** **Product/Process:** Design of improved stills & field distillation units for distillation of aromatic grasses, mints, rose, geranium, kewra etc. Distillation stills in various capacities are designed for specific locations/ applications and also set up as turnkey project. **Application/Use:** Distillation of essential oil. **Salient Feature of Process/Technology:** Low cost, energy efficient, easy to operate distillation units. **Status of Commercialization:** Commercialized **Minimum Economic Unit Size:** For aromatic grasses, cap. 1 t per batch: Rs.2.5 lakh. For rose and geranium, cap 150 to 200 kg per batch: Rs. 5.0 lakh **Equipment and Machinery:** Distillation unit, furnace as per CSIR design, provisions for continuous water supply, shed. **Raw Materials:** Aromatic flowers/flowers/foliage. **For Further Information, Please Contact:** The Director, Central Institute of Medicinal & Aromatic Plants, Institute of Himalayan Bioresource Technology, North-East Institute of Science and Technology, Jorhat.	**CIMAP**
	**5.5.4 INCENSE STICKS FROM OFFERED FLOWER IN RELIGIOUS PLACES** **Product/Process:** Making of incense sticks by using flower-waste and herbages offered to deities in religious shrines (Temples/Dargahs) etc. **Application/Use:** The technology of making incense sticks using floral waste shall be helpful in overcoming the problem due to such solid waste that cause soil and water pollution when thrown in holy rivers or on roads. Moreover, it is also useful for empowering rural women as a cottage industry enterprise for income generation. **Salient Feature of Process/Technology:** • This technology and know-how is simple in operation and would yield in the recycling of	**CIMAP**

	biological resource (flower-waste) into useful products (incense agarbatti) of aesthetic value. • The technology can also be applied to flower biomass left after hydro-distillation of their aromatic oils. • The resultant products are eco-friendly and safe to use with no adverse side effects on human health. • The technology is at ready to adopt stage for rural women and other small scale start-up aspirants. **Status of Commercialization:** Commercialized **Minimum Economic Unit Size:** **Equipment and Machinery:** A grinder and Tray dryer with wooden small stools and steel vessels are required. The total cost of equipment's and miscellaneous items are approx. Rs. 1,00,000 (One Lac only) for a small manufacturing unit comprising of 15-20 rural women. **Raw Materials:** Waste flowers collected from temples/Dargan, distillation waste, and other herbages offered at religious places will be used as a raw material with a cheap binder (Jigat powder) and bamboo sticks. Since the waste materials (Flowers / herbages) will be collected from places of worships they are likely to cause any cost. Only collection and processing charges are applicable. The agarbatti made from above mentioned materials may cost approximate RS. 40 t0 50 per kg (Approx.1500 Nos). **For Further Information, Please Contact:** The Director, Central Institute of Medicinal & Aromatic Plants, Institute of Himalayan Bioresource Technology, North-East Institute of Science and Technology, Jorhat.	
	5.5.5 MENTHOL PRODUCTION **Product/Process:** Process for production of menthol bolder crystals, liquid menthol, methane and terpenes from oil of Menthol mint (Mentha arvensis). **Application/Use:** Pharmaceutical preparations, food flavours, cosmetics, perfumes etc. **Salient Feature of Process/Technology:** The process involves the progressive chilling of mentha oil resulting in the separation of 63-65% menthol in crystalline form. The crystals are further processed to obtain bolder crystals. The left over dementholised oil is hydrolysed and	**CIMAP**

	fractionated. Terpenes, menthone (90-93% purity) and liquid menthol are separated. Menthol crystals are further recovered thereby improving the overall yield and economics. **Status of Commercialization:**Technology in production. **Minimum Economic Unit Size:** 15 tpa **Indicative Investment:** Rs.15 lakh **Equipment and Machinery:** Hydrolysis unit, fractionating column, separators, vacuum pump, boiler, chiller, centrifuge. **Raw Materials:** Mint oil, alkali, solvent, acid. **For Further Information, Please Contact:** The Director, Central Institute of Medicinal & Aromatic Plants, Institute of Himalayan Bioresource Technology, North-East Institute of Science and Technology, Jorhat.	
	**5.5.6 NATURAL ROSE WATER** **Product/Process:** Utilization of post-offered waste rose flowers from religious temples and dargahs etc. for production of natural rose water. **Application/Use:** • Presently, all of the rose flowers being offered at religious places like temples, dargahs etc. are thrown away and left to rot and add to soil / water pollution. • Natural rose water made from offered flowers/leaves will have a religious sanctity and can be used as flavoring agents in food & drinks for human consumption. • The rose water can be also being used by small and large scale entrepreneurs and industries that are associated with production of skin-care products like toners, facial cleansers, shampoos, baby creams, aromatic bath soaps and aromatherapy. **Salient Feature of Process/Technology:** • Natural Rose water has a good demand in comparison to the synthetic rose water, which is made using harmful chemicals. • Natural rose water is pure and has no chemicals; making it non-toxic and safe for use in flavoring, cosmetics, pharmaceutics etc. • Based on CSIR-CIMAP knowhow and superior technical features of the distillation units and processing parameters rose water produced by CSIR-CIMAP technology have better aroma and safer quality. **Status of Commercialization:**Commercialized.	**CIMAP**

	Minimum Economic Unit Size: **Indicative Investment:**Rs.35,000 to 5 lakh depending on the capacity & configuration. **Equipment and Machinery:** Hydrolysis unit, fractionating column, separators, vacuum pump, boiler, chiller, centrifuge.The equipment / distillation units are based on CSIR-CIMAP knowhow, designs and specifications. The units can be fabricated as per requirement of the intended capacity. **Raw Materials:** Since the major raw material shall be the post offered flowers from the temples, dargahs etc., the cost of raw material will be negligible. **For Further Information, Please Contact:** The Director, Central Institute of Medicinal & Aromatic Plants, Institute of Himalayan Bioresource Technology, North-East Institute of Science and Technology, Jorhat.	
	**5.5.7 DISTILLATION SYSTEM FOR ESSENTIAL OILS** **Product/Process:** Design of improved stills & field distillation units for distillation of aromatic grasses, mints, rose, geranium, kewra etc. Distillation stills in various capacities are designed for specific locations/ applications and also set up as turnkey project. **Application/Use:** Distillation of essential oil. **Salient Feature of Process/Technology:** Low cost, energy efficient, easy to operate distillation units. **Status of Commercialization:** Commercialized **Minimum Economic Unit Size:** For aromatic grasses, cap. 1 t per batch: Rs.2.5 lakh For rose and geranium, cap 150 to 200 kg per batch: Rs.5.0 lakh **Equipment and Machinery:** Distillation unit, furnace as per CSIR design, provisions for continuous water supply, shed. **Raw Materials:** Aromatic flowers/flowers/foliage. **For Further Information, Please Contact:** The Director, Central Institute of Medicinal & Aromatic Plants, Institute of Himalayan Bioresource Technology, North-East Institute of Science and Technology, Jorhat.	**IHBT**

	**5.5.8 LOW COST GREENHOUSE** **Product/Process:** Construction of low cost polyhouse using bamboo as the structural material. **Application/Use:** Cultivation of high value flowers/ plants by small farmers. **Salient Feature of Process/Technology:** For cultivation of quality flowers and high value crops, greenhouse conditions are ideal. In this case, bamboo has been used as a structural material for construction of the greenhouse. The flowering plants get the protection from rain, hails, excessive low temperature, disease and insect infestation. **Status of Commercialization:**The technology is being used by the small flower growers in Himachal Pradesh. **Minimum Economic Unit Size:** 30 m2 (10m x 3m) **Indicative Investment:** Rs.200/m2 of floor area **Raw Materials:**Bamboo, UV stabilized polythene sheets of 150-200-micron thickness, HOPE pipes, nails, paint. **For Further Information, Please Contact:** The Director, Institute of Himalayan Bioresource Technology.	**IHBT**
 	**5.5.9 MINI ESSENTIAL OIL DISTILLATION APPARATUS** **Product/Process:** Process for manufacture Oil Distillation Apparatus. **Application/Use:** For producing essential oils and perfumed waters like rose water, ajowain and basil water on small scale. Also useful for training and education. **Salient Feature of Process/Technology:** An indigenously designed, portable, cost effective eco-friendly, easy to handle, more stable and durable small house hold distillation apparatus, which can distill lighter and heavier essential oil. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 25 Land 50 U/day **Indicative Investment:** Rs.0.175 lakh (25 L) and Rs.0.28 lakh (50 L). **Equipment and Machinery:** SS-304 and Borosil glass, essential oil distillation unit, for heating LPG	**IHBT**

	burner, direct heating with agro-waste, kerosene/diesel burner, electrically heating and by steam injection. **Raw Materials:** Medicinal & Aromatic Plant materials like Rose, Lavender, Geranium. **For Further Information, Please Contact:** The Director, Institute of Himalayan Bioresource Technology.	
	5.5.10 MENTHOL PRODUCTION **Product/Process:** Process for production of menthol bolder crystals, liquid menthol, methane and terpenes from oil of Menthol mint (Mentha arvensis). **Application/Use:** Pharmaceutical preparations, food flavours, cosmetics, perfumes etc. **Salient Feature of Process/Technology:** The process involves the progressive chilling of mentha oil resulting in the separation of 63-65% menthol in crystalline form. The crystals are further processed to obtain bolder crystals. The left over dementholised oil is hydrolysed and fractionated. Terpenes, menthone (90-93% purity) and liquid menthol are separated. Menthol crystals are further recovered thereby improving the overall yield and economics. **Status of Commercialization:** Technology in production. **Minimum Economic Unit Size:** 15 tpa **Indicative Investment:** Rs.15 lakhs **Equipment and Machinery:** Hydrolysis unit, fractionating column, separators, vacuum pump, boiler, chiller, centrifuge. **Raw Materials:** Mint oil, alkali, solvent, and acid. **For Further Information, Please Contact:** The Director,Central Institute of Medicinal & Aromatic Plants, Indian Institute of Integrative Medicine, Jammu.	**IIIM**
	**5.5.11 GLADIOLUS CULTIVATION TECHNOLOGIES** **Product/Process:** Cut flowers of Gladiolu. **Application/Use:** Agricultural field. **Salient Feature of Process/Technology:** Gladiolus: cut-flowers are very popular in India and have been commercialized at a very large scale. CSIR-NBRI has standardized the agro-technology for commercial cultivation under sub-	**NBRI**

	tropical conditions. **Status of Commercialization:**The agro-technology has been passed on to the progressive farmers under rural development programme. **Minimum Economic Unit Size:** **Indicative investment:** Total Expenditure is Approx. Rs.2,82,406.00 for one acre **Raw Materials:** Plant material, fertilizers, irrigation etc. **For Further Information, Please Contact:** The Director, National Botanical Research Institute.	
	**5.5.12 CHRYSANTHEMUM CULTIVATION TECHNOLOGIES** **Product/Process:** Cut flowers of Chrysanthemum. **Application/Use:** Agricultural field. **Salient Feature of Process/Technology:** **Chrysanthemum:**The flowers occur in various forms (daisy-like, decorative, pompons or buttons) and many colors (yellow, white, purple & red). CSIR-NBRI has developed several cultivars for horticultural purposes. Important for production of cut-flower and bedding purpose. **Status of Commercialization:**The agro-technology has been passed on to the progressive farmers under rural development programme. **Minimum Economic Unit Size:** **Indicative investment:** Total Expenditure is Approx. Rs.2,82,406.00 for one acre **Raw Materials:** Plant material, fertilizers, irrigation etc. **For Further Information, Please Contact:** The Director, National Botanical Research Institute.	**NBRI**
	**5.5.13 DRY FLOWER TECHNOLOGY** **Product/Process:** Artistic greeting cards, wall plates, landscapes, three dimensional interior decorative items, etc. **Application/Use:** Dehydration of foliage & flowers adds value; is of ornamental value & provides opportunity for self-employment as there is huge demand for creative products. **Salient Feature of Process/Technology:**	**NBRI**

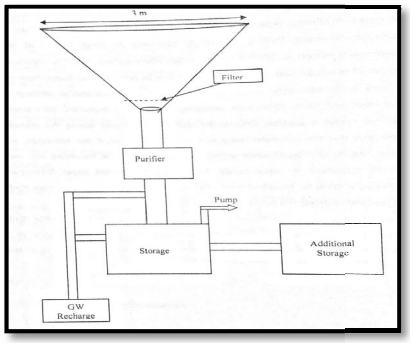
	Use of flowers and foliage as raw material. Plant material retains its natural shape and color for long period of time. Dried material can be used for making creative greeting cards, pictures etc. **Status of Commercialization:** Transferred through training programs. **Minimum Economic Unit Size:** **Indicative investment:** Total Cost of the Project is Rs.90,000 **Equipment:** Hot air oven. **Raw Materials:** Leaves and flowers of annual and perennial ornamentals (herbs, shrubs, trees etc.), common weeds. **For Further Information, Please Contact:** The Director, National Botanical Research Institute.	
S  	**5.5.14 HERBAL GULAL AND DYES FOR RURAL ENTREPRENEURSHIP DEVELOPMENT** **Product/Process:** Herbal Gulal and colors for Rangoli **Application/Use:** Herbal gulal has soft, nontoxic and supple touch with good sticking capacities to skin. It is also perfumed with essential oils. There is no side effect of the herbal dye, whereas synthetic dry colors are prepared from toxic chemicals and may create eye irritation, allergies, skin damage, respiratory problems and may damage other vital organs. **Salient Feature of Process/Technology:** Safe natural dyes are used for the preparation of herbal gulal. No salts of Cr, Co, Ni, Pb are used. The resultant color powders thus prepared have good sticking capacity to skin and can be easily removed with a soft mop. These dry colors have cosmetic effect on skin too as they make face feel a bit soft. The natural dyes used for blending are extracted from regenerative plant resources and forest-agro wastes. **Status of Commercialization:** Commercialized (Licensed to many companies) **Minimum Economic Unit Size:** **Indicative investment:** It has initial investment of Rs.10 -11 Lakhs. This technology is good for small entrepreneur also. **Equipment:** Grinder, Blender cum Evaporator, Pulveriser, Solvent extraction unit, oven, packing machine. **Raw Materials:** Starch as bulking substances,	**NBRI**

	thickening & binding agent Guar Gum / food hydrocolloids, natural dye from plants. **For Further Information, Please Contact:** The Director, National Botanical Research Institute.	
	**5.5.15 BIOTECH APPROACH FOR RECLAIMING MINED LANDS** **Product/Process:** Process for fast rejuvenation of degraded mined lands through an integrated biotechnological approach. **Application/Use:** Reclamation and restoration of mined lands/ waste lands. **Salient Feature of Process/Technology:** The fertility and productivity of degraded mined lands/waste lands can be restored fast through an integrated biotechnological approach which includes application of selected biofertilisers, organic manure and planting multipurpose silvae. This approach ensures establishment of microflora and biogeochemical cycles within a short span, which otherwise takes centuries. Italso provides forest produce for cottage industry and employment to contiguous population. **Status of Commercialization:** Commercialized **Minimum Economic Unit Size:** 1 ha land. **Indicative Investment:** Rs.1.5 lakh **Raw Materials:** Biofertilisers, plant saplings, organic waste, land for nursery development. **For Further Information, Please Contact:** The Director, National Environmental Engineering Research Institute.	**NEERI**
	**5.5.16 WATER HYACINTH: CELLULASE PRODUCTION** **Product/Process:** Process for production of cellulose enzyme from water hyacinth and utilization of residue as soil fertilizer. **Application/Use:** Cellulase enzyme is used in food processing (brewing, clarification of wine/fruit juices), paper and pulp industry (lignocellulosic products) etc. **Salient Feature of Process/Technology:** Water hyacinth is construed as a nuisance weed, which infests the lakes. It is a misplaced resource that can be used for making high value products like cellulase enzyme. The process for manufacture of enzyme comprises of drying of weed, pulverizing, inoculating with a spore suspension of Trichoderma reesei, incubation,	**NEERI**

	extraction of enzyme, its purification and spray drying. The residue left after fermentation is utilized as a soil fertilizer. **Status of Commercialization:** Production at pilot plant scale. **Minimum Economic Unit Size:** 100 kg water hyacinth/day. **Equipment and Machinery:** Solid state fermentation facility and laboratory facility. **Raw Materials:** Water hyacinth, nutrient media, Trichoderma reesei culture. **For Further Information, Please Contact:** The Director, National Environmental Engineering Research Institute.	
	**5.5.17 MASS SCALE SPIRULINA PROTEIN PRODUCTION AND FOOD SUPPLEMENTATION FOR COMMON MEN AT PAANCHGAON, NAGPUR.** **Product/Process:** Spirulina health supplement and protein/energy chocolate. After due testing, it will be processed for FDA approval and filing patent. **Application/Use:** 1. Nutritional status of rural malnourished population can be benefitted through Spirulina dietary supplements. 2. Employment/ Entrepreneurship generation in rural areas through know-how dissemination on high density Spirulina cultivation process, which can enhance financial status of rural population. **Salient Feature of Process/Technology:** • Spirulina is reported to contain protein, energy, fat, enzymes, vitamins, antioxidants and pigments. • The protein content of Spirulina is especially high, varying between 50% and 60% of its dry weight, and comprises almost all amino acids, including the essential ones. • Additionally, it is very rich in beta carotene (Vitamin A precursor), iron, vitamin B12, gamma-linolenic acid and other micronutrients. • Its supplementation in food will certainly improve nutrition as well as immunity against disease and ageing related problems. • Therefore, supplementation of food with Spirulina can be helpful to fight the problems of malnourished population of rural area at Panchgaon, Nagpur. **Propagation**: 350 gms of Spirulina Biomass can	**NEERI**

	be obtained from 700L medium after 20 days of cultivation in Zarrouks Medium. **Agripracticies:** Sufficient water, salt and agitation with sunlight are required to obtained large scale Spirulina Biomass. **Yield:** Spirulina Biomass and Energy chocolates. **For Further Information, Please Contact:** The Director, National Environmental Engineering Research Institute.	
	**5.5.18 HERBAL DEODORANT DETERGENT** **Product/Process:** Process for manufacture of liquid de-odorant cleaner. **Application/Use:**Cleaning, disinfection & deodorization of kitchen, toilet, living room, office, hospital, etc. **Salient Feature of Process/Technology:** It is a water dispersible emulsion, based on natural essential oils. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 100 Day. **Indicative Investment:** Rs.1.25 lakh. **Equipment and Machinery:** Emulsifier, hot plate, storage vessel, bottles. **Raw Materials:** Natural essential oils, other chemicals. **For Further Information, Please Contact:** The Director, North-East Institute of Science and Technology, Jorhat.	**NEIST**
	**5.5.19 MOSQUITO REPELLENT CANDLE** **Product/Process:** Process to manufacture Mosquito Repellent Candle. **Application/Use:** The candle is effective in repelling mosquitoes and as well as produces subtle fragrance while burning. **Salient Feature of Process/Technology:** □ Effective for repelling mosquitoes. □ Safe to use. □ Can be used in indoor and outdoor conditions. □ Three in one product for providing light, fragrance and repelling mosquitoes. **Status of Commercialization:** Transferred to two parties. **Minimum Economic Unit Size:** 1.5 tpd (boards). **Indicative Investment:** Rs.50 lakh **Equipment and Machinery:** Candle making	**NEIST**

	mould. **Raw Materials:** Plant hydrodistilates. **For Further Information, Please Contact:** The Director, North-East Institute of Scienc and Technology , Jorhat.	
	**5.5.20 MOSQUITO REPELLENT HERBAL INCENSE STICKS** **Product/Process:** Process to manufacture Mosquito Repellent Herbal Incense sticks. **Application/Use:**To repel mosquitoes from house **Salient Feature of Process/Technology:** Eco-friendly, herbal and effective formulation. **Status of Commercialization:** Transferred to 4 parties. **Minimum Economic Unit Size:** **Indicative Investment:** **Equipment and Machinery:** Grinder, sets of agarbatti making machines. **Raw Materials:** Ground powder of over-ground plant of different plant species. **For Further Information, Please Contact:** The Director, North-East Institute of Scienc and Technology , Jorhat.	**NEIST**
	**5.5.21 SOLID DISPERSIBLE DEODORANT** **Product/Process:** Technology for production of Solid Dispersible Deodorant. **Application/Use:** Cleaning the floor, tiles, table top & to be use as germ killer, freshener & mosquito repellent. **Salient Feature of Process/Technology:** Use of eco- friendly raw materials and chemicals. No sophisticated machineries are required. A Hydraulic press (manual or automatic) will be required with moulds of required size and shape. No highly skilled manpower is required. No by-product and toxic gas generates. **Status of Commercialization:** In commercial production. **Minimum Economic Unit Size:** 1200 Tablet/day **Indicative Investment:** Rs.5. 00 Lakhs **Equipment and Machinery:** Hydraulic press (manual or automatic) with moulds of required size, mixing machine & weighing balance, Jar, measuring cylinder. **Raw Materials:** One Inorganic Powdered Material, Binder, Surfactant, Essential oil& Disinfectant. **For Further Information, Please Contact:**	**NEIST**

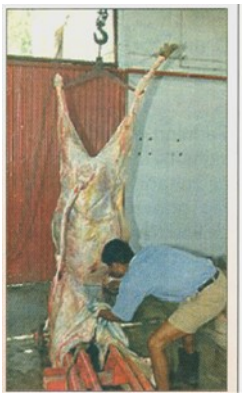
	The Director, North-East Institute of Scienc and Technology , Jorhat.	
	**5.5.22 OPEN-FIELD RAINWATER SHARVESTING SYSTEM** **Product/Process:** Harvesting of rainwater over an open field, road side, schools etc. **Application/Use:** Rain water harvesting surface, water storage, pump (optional), solar light purifier (optional). **Salient Feature of Process/Technology:** It is a cost-effective (approximately 50-60%) rain water harvesting structure especially ideally for rural areas. **Status of Commercialization:** Under development. **Minimum Economic Unit Size:** Rs.2.5 Lakhs **Indicative Investment:** Rs.25 Lakh **Equipment and Machinery:** Harvesting surface, water storage tank, pump, solar water purifier **Raw Materials:** Local fabrication. **For Further Information, Please Contact:** The Director, National Institute of Science Technology and Development Studies.	**NISTADS**

6. COTTAGE INDUSTRIES

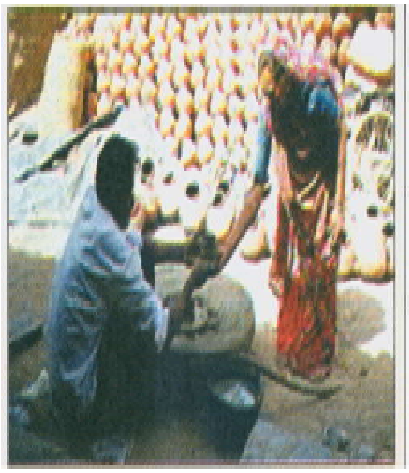
6.1 LEATHER PROCESSING:

  Comparison of old & new process V.T.Leather and Director, CLRI & Scientists inspect the leather  	**6.1.1 IMPROVED RURAL TANNING TECHNOLOGIES FOR TANNING OF HIDES AND SKINS** **Product/Process:** Process for Tanning of hides and skins for making footwear/goods. **Application/Use:** Footwear and Leather goods industry (Household Tanning Unit). **Salient Feature of Process/Technology:** Traditional process with improved techniques – Environmental friendly. **Status of Commercialization:** Commercialized **Minimum Economic Unit Size:** 10-12 hides per day. **Indicative Investment:** Approx. Rs.10 lakh (including shed and land) for processing about 10-12 hides per day). **Equipment and Machinery:** Water tubs, knife for fleshing/ unhairing, slickers, weighing balance, wooden beam, hand stackers, etc. **Raw Materials:** Raw hides and skins, Tanning materials, chemicals, etc. **For Further Information, Please Contact:** The Director, Central Leather Research Institute..	**CLRI**
	**6.1.2 STANDARDIZATION OF ETHNIC LEATHER FOOTWEAR (INCLUDES KOLHAPURI CHAPPALS)** **Product/Process:** Process for fabrication of shoe upper, shoe, chappals and sandals. **Application/Use:** Shoe upper for making full shoe, sandal and chappal. **Salient Feature of Process/Technology:** The process includes necessary steps for aesthetic look of the product, stress, strain characteristics of the material for specific use as well as the compatibility of upper outer material with bottoming material of higher durability. The manufacturing process involves cutting/clicking, upper closing, lasting and finishing. Inculcate the traditional artisans to acquire confidence building on creativity, Design and innovation concepts on developing footwear through adaptation of	**CLRI**

	technology from CLRI.Exploring newer methodologies and materials for the quality and productivity enhancements on rural technology of footwear. **Status of Commercialization:** Commercialized **Minimum Economic Unit Size:** 100 pairs/day with about 16 personnel. **Indicative Investment:** Rs.12 lakhs **Equipment and Machinery:** Clicking, skiving, sewing, lasting, sole attaching press, embroidery machines, hand tools etc. **Raw Materials:** Leather, synthetic material, soling material, adhesive, thread etc. **For Further Information, Please Contact:** The Director, Central Leather Research Institute.	
	**6.1.3 IMPROVED TOOL KITS FOR LEATHER ARTISANS** **Product/Process:** Improved tool kits for footwear artisans, flayers. **Application/Use:** Mitigation of drudgery, improvement in productivity and quality as well as additional value earnings by leather artisans. **Salient Feature of Process/Technology:** The tool kit for footwear artisans consists of 33 hand tools which include punch sets, cuddappa stone, oil stone, adjustable divider, rampi, slot punch, stitching awl, prick marking awl, oil can, adhesive container etc. All the tools are packed in aluminum box 30x15x10cm^3, weighing about 3.5 kg. A separate tool kit has also been developed for flayers. **Status of Commercialization:** Use of improved tools has been extensively demonstrated and these have been well accepted by the leather artisans. **Minimum Economic Unit Size:** One tool kit, details available from CSIR. **Indicative Investment:** Rs.4,000 **Raw Materials:** Common tools. **For FurtherInformation, Please Contact:** The Director, Central Leather Research Institute.	**CLRI**
	6.1.4 MANUFACTURE OF LIQUID TANNING EXTRACT **Product/Process:** Process for Preparation of a liquid vegetable tanning extract through scientific technology. **Application/Use:** Leather Industry - In tanning of hides and skins.	**CLRI**

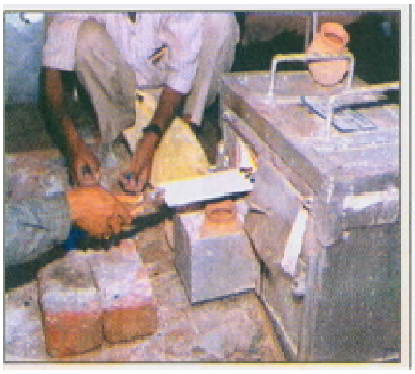
	Salient Feature of Process/Technology: In the manufacture of extracts, no chemical is used. On the other hand, tannins are extracted with water. The water is evaporated to get required concentration. Extracted materials can be used as fuel wood. There will not be any liquid pollution except for spillages which are minimum and do not involve any toxic chemicals. **Status of Commercialization:** Commercialized **Indicative Investment:** Approximately Rs.20 lakhs for a capacity of 3 tons/day liquid extract. **Equipment and Machinery:** Wooden vats, multiple effect evaporators (triple effect), storage tanks etc. **Raw Materials:** Vegetable tanning materials such as myrobalan, Avaram bark, Konnam bark, Kutch extract. **For Further Information, Please Contact:** The Director, Central Leather Research Institute.	
	**6.1.5 CARCASS UTILISATION** **Product/Process:** Process for integrated utilization of all tissues of fallen carcass for value added products. **Application/Use:** 351Meat meal and bone meal are used in animal/poultry/ pig/fish feed; tallow in soap industry; water effluents in sub surface irrigation for fruit crops and compost! vermicomposting of ruminal contents for raising ornamental plants. **Salient Feature of Process/Technology:** The process comprises collection of fallen carcass in a specially designed vehicle; transportation at low cost; flaying in a simplified manner; rendering and mincing; anaerobic treatment of effluents; composting/ vermicomposting of the ruminal and intestinal contents. This approach keeps the environment clean and green. **Status of Commercialization:** Commercialized **Minimum Economic Unit Size:** 3-4 carcasses/ day **Indicative Investment:** Rs.20 lakh **Equipment and Machinery:** Wet rendering cooker, meat mincer, drier and pulveriser. **Raw Materials:** Fallen animals (cattle, buffalo, goat, sheep etc.). **For Further Information, Please Contact:** The Director, Central Leather Research Institute, Central Mechanical Engineering Research Institute.	**CLRI, CMERI**

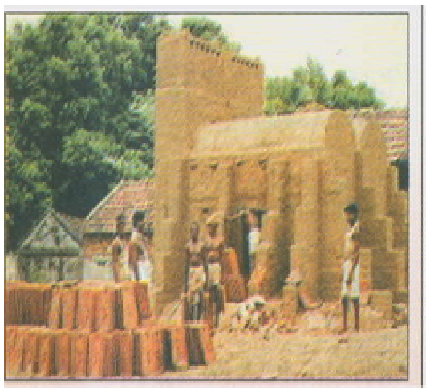
6.2 POTTERY

	**6.2.1 POTTERY ON WHEEL** **Product/Process:** Improved design of potter's wheel, kiln and process for traditional terracotta wares e.g. pitcher, planter, kunda, kulhar, plate, tableware, flower vase etc. **Application/Use:** Rural pottery: better quality and higher productivity through potter's wheel. **Salient Feature of Process/Technology:** The clay is blunged and lavigated through setting method to remove coarse grit etc. The slurry is de-watered and made into plastic mass. It is thrown over traditional/improved potter's wheel for shaping various articles. The articles are coated with specially prepared englobe, polished and fired in an improved up draught kiln. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 50 kg/day **Indicative Investment:** Rs.0.50 lakh **Equipment and Machinery:** Improved potter's wheel, wood-fired improved up draught kiln, set of sieves. **Raw Materials:** Locally available low grade common red clay. **For Further Information, Please Contact:** The Director, Central Glass &Ceramic Research Institute.	**CGCRI**
	**6.2.2 BLACK POTTERY** **Product/Process:** Process for production of black pottery ware: high strength, silvery decoration. **Application/Use:** Rural pottery. **Salient Feature of Process/Technology:** Locally available common clay is beneficiated and made into plastic mass along with fine sand, non-plastic clay etc. Articles are shaped over potter's wheel, dried, finished with englobe, hand decorated and fired under reducing conditions at 850^{Q}C in a wood-fired improved kiln. The strength of the articles is 300 kg/cm2 as compared to 72 kg/cm2 in the conventional products. **Status of Commercialization:** Commercialized **Minimum Economic Unit Size:** 20 kg/day	**CGCRI**

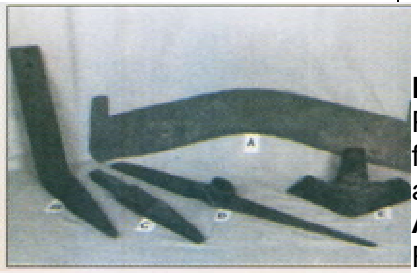
	Indicative Investment: Rs.0.60 lakh **Equipment and Machinery:** Set of sieves, improved potter's wheel, wood-fired kiln, etc. **Raw Materials:** Common clay, non-plastic clay, fine sand. **For Further Information, Please Contact:** The Director, Central Glass& Ceramic Research Institute.	
	**6.2.3 BLUE POTTERY** **Product/Process:** Manufacture of blue pottery art wares. **Application/Use:** Decorative novelty items. **Salient Feature of Process/Technology:** The blue pottery consists of a body predominantly made of quartz and glass cullet powder. In the traditional 'Jaipur technique', the articles undergo 20-25 unit operations during fabrication stage. The new technique involves application of englobe made of white glass powder and a glutinous paste of Maida on the body. Thereafter the lead-free glaze is applied. The articles are fired in the temp range of 700Q-800^{Q}C in a tandoor kiln using wood as fuel. **Status of Commercialization:** Ready for commercialization. **Minimum Economic Unit Size:** 25 kg/day **Indicative Investment:** Rs.2 to 3 lakh **Equipment and Machinery:** Tandoor kiln. **Raw Materials:** Quartz powder, glass powder, lead-less frit, binders, Maida. **Further Information, Please Contact:** The Director, Central Glass & Ceramic Research Institute.	**CGCRI**
	**6.2.4 WHITE STONEWARE CROCKERY** **Product/Process:** Process for production of white stoneware crockery, decorative items, electric kettle etc. **Application/Use:** Domestic use and electrical appliances. **Salient Feature of Process/Technology:** The process consists of grinding of quartz and feldspar in a ball mill. The slurry is mixed with clay, sieved, filter pressed and deflocculated. Items are fabricated by slip casting in plaster of Paris moulds. The cast pieces are finished and dried. The articles are single fired at temp. 1150^{Q}-1250^{Q}C and glaze finished. This process provides better quality with low production cost	**CGCRI**

	and less rejections. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 0.2 tpd **Indicative Investment:** Rs.25 lakh **Equipment and Machinery:** Ball mil, blunger, agitator, magnet, filter press, press machine, jigger jolley, shuttle kiln, compressor, etc. **Raw Materials:** China clay, ball clay, calcined quartz, potash feldspar, calcite/marble, zircon, barium carbonate, zinc oxide, ceramic stain, plaster of Paris etc. **For Further Information, Please Contact.:** The Director, Central Glass &Ceramic Research Institute.	
	**6.2.5 GLAZED TERRACOTTA CROCKERY AND HANDICRAFTS** **Product/Process:** Process to manufacture high strength glazed terracotta crockery, figurine and handicraft items. **Application/Use:** Decoration and utility wares. **Salient Feature of Process/Technology:** Manufacture of glazed terracotta figurines and crockery items is a traditional handicraft in India. The improved process facilitates production through scientific processing of beneficiated local clay and it's blending with ball clay, quartz, feldspar and use of fuel efficient kiln. It enables potters to produce a wider range of products varying from crockery to novelty items with higher productivity, thereby creating more remunerative opportunities. **Status of Commercialization:** Commercialized **Minimum Economic Unit Size:** 30 kg/day. **Indicative Investment:** Rs.10 lakh **Equipment and Machinery:** Ball mill, pug mill, blunger, agitator, filter press, potter wheel, jigger jolley, shuttle kiln/electric kiln etc. **Raw Materials:** Locally available common plastic clay, feldspar, ball clay, dolomite, quartz. **For further Information, Please Contact:** The Director, Central Glass & Ceramic Research Institute.	**CGCRI**

	**6.2.6 BONE CHINA PORCELAIN** **Product/Process:** Process for manufacture of Bone china porcelain articles e.g. decorative tableware, crockery and novelty items. **Application/Use:** Domestic use as well as in hotels for decorative purpose. **Salient Feature of Process/Technology:** The raw materials, viz. china clay, potash, feldspar, bone ash etc. are finely ground and then casting slip is prepared with help of electrolytes. Articles are cast in plaster of Paris moulds, dried and biscuited at 1250^{Q}C. These are glazed and fired at 11 OOQC in an electric/gas fired kiln. The articles are super white, translucent and of high strength. **Status of Commercialization:** Commercialized **Minimum Economic Unit Size:** 25 kg/day **Indicative Investment:** Rs.15 lakhs. **Equipment and Machinery:** Pot mill, ball mill, plaster of Paris moulds, electric/gas fired kiln etc. **Raw Materials:** China clay (white burning), potash, feldspar, bone ash, frit, plaster of Paris, etc. **For Further Information, Please Contact:** The Director, Central Glass & Ceramic Research Institute.	**CGCRI**
	**6.2.7 ENVIRONMENT FRIENDLY GAS FIRED KILN FOR GLASS BEADS** **Product/Process:** Process for making environment friendly gas fired kiln for producing glass beads. **Application/Use:** Kiln for making glass beads. **Salient Feature of Process/Technology:** This environment friendly gas fired kilns has 2 pots capacity i.e. 2 artisans can work at a time. The kiln is ceramic fiber and ceramic board lined, metal clad along with gas firing system, thus the life of the kiln has increased several times in comparison to the traditional kiln and require less maintenance. The kiln attains higher working temperature quickly. No soot, ash or dust particle are deposited on the product. Kiln is portable and extremely safe for the artisans and yield better quality products at competitive rates. There is more than 50% fuel saving in comparison to traditional kiln.	**CGCRI**

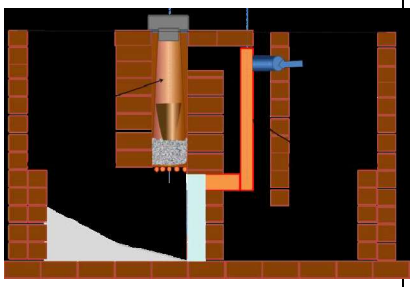
	Status of Commercialization: Commercialized **Minimum Economic Unit Size:** 5 Kilns per day. **Indicative Investment:** Rs.2lakh. **Equipment and Machinery:** Electric welding set, Manual iron sheet cutting machine, motorized drilling machine, Mechanical tools. **Raw Materials:**GI sheets, ms angle iron, Nut bolt, Pressure gauge, Heating torch, Burner, Regulator, High pressure rubber pipe, Ceramic fiber blanket, Ceramic fiber board, Refractory glass melting pot. **For Further Information, Please Contact:** The Director, Central Glass &Ceramic Research Institute.	
	**6.2.8 QUEEN POTTERY KILN** **Product/Process:** Design and construction of kiln for firing pottery items. **Application/Use:** This kiln sinters all kinds of terracotta e.g. handicrafts, domestic articles and roof tiles, etc.; uses low grade coal at a higher temperature resulting in conservation of energy as well as quality improvement. It replaces the use of wood by raw coal and saves 60% fuel. **Salient Feature of Process/Technology:** The kiln can be operated by coal or wood in similar fashion as traditional biomass kilns. A uniform temperature of $900^{Q}C$ is attained in the kiln. Quality of terracotta is superior and breakage is minimized. The sintering period and fuel consumption are 60% less than in the traditional method. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 2.5 m2 to 12 m^3. **Indicative Investment:** Rs.7000 to Rs.25000 **Equipment and Machinery:** Civil construction **Raw Materials:** Red brick, clay, sand, iron grate. **For Further Information, Please Contact:** The Director, Institute of Minerals and Materials Technology, Bhubaneswar.	**IMMT**

6.3 METAL WORKING

	**6.3.1 IRON SMELTING IN SMALL FURNACE** **Product/Process:** A technology package of low carbon iron making for the fabrication of agricultural/ domestic/value added products. **Application/Use:** For black smith and iron smelter artisans. **Salient Feature of Process/Technology:** The technology package for the production of iron 20-25 kg/heat of low carbon content, similar in quality as of traditional iron, ranges 0.06-to 0.15 wt. % carbon. Indigenously designed vertical furnace using locally available material of 3.5 to 4 feet height is used for iron making directly from iron bearing ore. The agro-waste charcoal/charcoal is used as a fuel/reducing agent. The iron bloom is nearly 99 % pure and is excellent corrosion resistant. It is a potential material for medicinal use, value added cultural items like nail, lamp, deity, monuments etc and functional items such as tools for agricultural &domestic use, structural and marine engineering for links & anchors applications. The process is environmental benign utilizes renewable source of energy. Small pockets of iron ore deposits of low and high grade can be utilized for iron extraction which are not economical viable for commercial miming. Low cost of production ranges Rs.20-23/kg iron bloom. **Status of Commercialisation:** Commercialised. **Minimum Economic Unit Size:** 20 - 25 Kg / day. **Indicative Investment:** Rs.0.20 lakh. **Equipment and Machinery:** Custom built hood, tools and tackles as per CSIR design. **Raw Materials:** Iron ore, agro -waste charcoal/charcoal and flux. **For Further Information, Please Contact:** The Director, Advanced Materials and processes Research Institute, Bhopal.	**AMPRI**
	**6.3.2 IMPROVED AGRICULTURAL/ DOMESTIC TOOLS** **Product/Process:** Package of improved technologies for the fabrication of improved quality of tools for domestic and agricultural purposes. **Application/Use:** For use of black smith artisans and fabricators to make tillage tool, harvesting tool, sowing tool and horticultural tool having better performance	**AMPRI**

	qualities. **Salient Feature of Process/Technology:** The kit comprises a tailor made small manually controlled electric hammer mill, 1.5 to 2 HP, (optional requirements), tools and tackles. Simple heat-treating procedure for improving the quality of the products using conventional steel and appropriate steel in a simple especially designed charcoal/non-coking coal fired pit furnace. Technology package is cost effective and fuel saving by 20% - 30%. Productivity is improved by 2- 3 times depends on type of the article made. Tailor made improved process of Carburization exclusively for black smiths to improve the surface properties of mild steel has been developed, which is flexible, does not need carburization box. Hardness may be acquired up to 600 VHN unto a depth of 0.5 mm. The process is more economical, energy and material efficient, commercial viable and is applicable to any intricate shape. **Status of Commercialisation:** Commercialised. **Minimum Economic Unit Size:** 50 articles/day. **Indicative Investment:** Rs.10,000 to 35,000. **Equipment and Machinery:** Tools and tackles, and hot & cold working hammer machine. **Raw Materials:** Steel and coal. **For Further Information, Please Contact:** The Director, Advanced Materials and processes Research Institute, Bhopal.	
	**6.3.3 BELL-METAL DOKRA ARTIFACTS** **Product/Process:** A package of improved techniques/tools for making bell metal Dokra craft. **Application/Use:** For craftsmen. **Salient Feature of Process/Technology:** Dokra craft is the oldest art of bell metal founding of idols and decorative articles in wax modelling using the Lost Wax technique. The new technology package provides continuous metal founding, effects better control over melting conditions and metal fluidity. Productivity is 4 times with better lustre on articles. A simple wax threading machine along with a kit consisting of tools and tackles for melting and casting have been developed. Improved furnace working on raw charcoal substantially reduces fuel cost. **Status of Commercialisation:** Being adopted by tribal artisans in Bastar (MP), Bankura and Burdwan districts of West Bengal. **Minimum Economic Unit Size:** 50 articles/day.	**AMPRI**

	Indicative Investment: Rs.0.20 lakh **Equipment and Machinery:** Wax threading machine, tools and tackles as per CSIR design. **Raw Materials:** Bell metal, bees wax. **For Further Information, Please Contact:** The Director, National Institute of Science Technology & Development Studies, Advanced Mateials and processes Research Institute, Bhopal, Institute of Minerals and Materials Technology, Bhubaneswar.	
	**6.3.4 GOLD PLATING SOLUTION** **Product/Process:** Process for making decorative gold plating solution concentrate (20g qoldd.). **Application/Use:** Decorative gold polishing of low cost jewellery e.g. ear rings, bangles and other ornaments made of nickel-plated/high copper alloy/brass **Salient Feature of Process/Technology:** Gold is anodically dissolved to produce concentrate of potassium gold cyanide, which is treated with chemicals to prepare concentrated plating solution. At the time of use, concentrate is diluted suitably for making the polishing solution, which produces semi bright gold deposits on articles, which are subsequently polished to a high luster. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 240 Uannum **Indicative Investment:** Rs.8 lakh. **Equipment and Machinery:** AC to DC rectifier, single phase. **Raw Materials:** Gold metal, chemicals **For Further Information, Please Contact:** The Director, Central Electrochemical Research Institute.	**CECRI**
	**6.3.5 WOOD COMBUSTOR FOR CARDAMOM DRIER** **Product/Process:** Machine for Cardamom Drier. **Application/Use:** Spices. **Salient Feature of Process/Technology:** It is a wood combustor for improvement of the traditional Large Cardamom (Spice) drier in Cardamom growing areas of Himalayan states and hilly areas of India. The combustor burns firewood completely in smokeless environment. It is fitted in tile traditional bhati (drier) for drying of large cardamom raw capsules. The combustor reduces	**IMMT**

	75% of wood consumption and curing period and also pollution, which improves the quality of the dried cardamom. Essential oil in the dried cardamom is increased due to efficient smokeless drying. The wood combustor is portable and detachable, which is simply pushed into the traditional cardamom bhati (drier) for burning of wood in smokeless environment. The combustor supplies clean &hot flue gas evenly to the layers of raw cardamom capsules over the bamboo mat for drying in a temperature range of 50^{Q}C to 150^{Q}C as per requirement. Method of drying of cardamom capsules is same as in traditional process for high acceptability among the farmers. **Status of Commercialisation:** Commercialised. **Minimum Economic Unit Size:** 100 machine/annum. **Indicative Investment:** Rs.1 lakh **Equipment and Machinery:** Welding machine, Shear cutting machine & hand tools. **Raw Materias:** Mild steel angle and sections. **For Further Information, Please Contact:** The Director, Institute of Minerals and Materials Technology, Bhubaneswar.	
	**6.3.6 ENERGY EFFICIENT COKE-BASED ECO-FRIENDLY BRASS MELTING FURNACE FOR BRAS AND BELL METAL ARTISANS** **Product/Process:** **Application/Use:** CSIR-NML has developed a cost effective, energy efficient and eco-friendly coke based brass melting furnace for manufacturing artifacts by the metal artisans. The traditional brass melting furnace used for manufacturing artifacts by the metal artisans are polluting, grossly inefficient with poor productivity. The CSIR-NML technology addresses all these issues and the drawback of the existing traditional brass melting furnaces. **Salient Feature of Process Technology:** The newly designed furnace has the advantages of: (i) Reduction in energy consumption by 20-40%, (ii) Reduction in melting cycle time by 20%, (iii) Increase of productivity by 25% (iv) Significant reduction in emission of toxic gasses and suspended particulate matter (SPM) to the atmosphere resulting in improvement in working environment as the operator/ artisan works at close proximity of the furnace	**NML**

	(v) Cooler working ambience (vi) Construction by using cheap and locally available materials (vii) Minimum alteration of traditional furnace practices for better acceptability. **Status of Commercialisation:** Ready for commercialisation. **Minimum Economic Unit Size:** **Indicative Investment:** **Equipment and Machinery:** **Raw Materials:** **For Further Information, Please Contact:** The Director, National Metallurgical Laboratory.	
	6.3.7 RURAL BLACKSMITHY PACKAGE **Product/Process:** Artisanal technology package comprising of: Simple melting technique for producing raw materials for blacksmiths with carbon levels; casting the molten metal into plates; hot forging of the cast high carbon steel plates; heat treatment of forged products; low-cost fuel efficient furnace; mechanical forging hammer; forging schedule and heat treatment schedule for high carbon steel products. **Application/Use:** Especially useful for practising blacksmiths in rural sector. It provides raw material flexibility, mechanised devices and cost reduction for production of quality tools and implements as per BIS specified hardness. **Salient Feature of Process/Technology:** No conventional energy required for melting operation; tailoring of desired carbon level in metal block; 2/3rdreduction in fuel; 50% flue utilisation; portable furnace; reduced drudgery in forging work; provides variable impact energy. **Status of Commercialisation:** Demonstrated to several field groups. **Minimum Economic Unit Size:** 2-3 kg batch melt, approx. Rs.50/kg (0.8% C steel). **Indicative Investment:** Rs.25,000/unit **Equipment and Machinery:** Mechanical hammer, fuel efficient furnace (fabrication), thermocouple & recorder. **Raw Materials:** Aluminium powder, cast iron chips & steel chips, exothermic sleeves for in-situ melting. **For Further Information, Please Contact:** The Director, National Metallurgical Laboratory.	**NML**

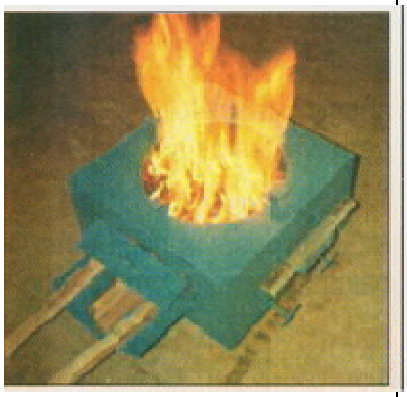
	**6.3.8 RURAL/TRIBAL IRONMAKING** **Product/Process:** Iron making process for producing very low carbon wrought iron using low grade iron ore and charcoal available in rural/tribal areas. **Application/Use:** For making implements like dagger, grass cutter, sickle, axe, small spade, hammer, fishing hook, arrow, spear, musical instrument etc. whicha re used by rural/tribal folks for their livelihood and defence. It can also be used for making handmade decorative items, like icons, door handles etc. which may have good foreign market. **Salient Feature of Process/Technology:** Cost effective for rural artisans; No electric power required; Capital investment almost negligble; Product is a purer form of iron; The product has very good corrosion resistence; Product is a suitable raw material for making wootz steel. **Status of Commercialisation:** Not yet commercialised; but there is an ample opportunity for commercialization. **Minimum Economic Unit Size:** 3-4 Kgs **Indicative Investment:** Rs.1.25 lakh for Cupola and pollution control system. **Equipment and Machinery:**Hand operated blower. **Raw Materials:** Low grade hematite ore(goethite/limonite)having good porosity; Sal wood, mahua, tamarind or jamun charcoal; Clay having good plasticity and refractoriness. **Fr Further Information, Please Contact:** The Director, National Metallurgical Laboratory.	**NML**
	**6.3.9 ANTI-TARNISHING LAQUER FOR BRASS AND COPPER** **Product/Process:** Process for casting of brassware. **Application/Use:** □ Prevention of tarnishing of brass & copper handicrafts. □ Preservation of copper and brass architectural works. □ Corrosion protection of copper & brass hardware items. □ Corrosion protection of copper condensers, heat exchangers. **Salient Feature of Process/Technology**:	**NML**

	Novel polymer based Lacquer formulation technologyPost treatment baking not required Lead (Pb) and Cadmium (Cd) free coating 20-30% less cost compared to market available lacquers High performance coating: Coating passes 500 hours of salt spray test (ASTM B 117) & 72 hours of flower of sulfur test (ASTM B 809) High coverage area: 18-20 m2/L. **Status of Commercialisation:** **Indicative Investment:** **Raw Materials:** **For Further Information, Please Contact:** The Director, National Metallurgical Laboratory.	

6.4 ENERGY

	**6.4.1 SOLAR WATER HEATER** **Product/Process:** Process for fabrication of solar water heaters: 3 models, viz. Domestic, Large size and low cost. **Application/Use:** For obtaining hot water in residential and institutional buildings. **Salient Feature of Process/Technology:** Domestic model: cap. 140 L, working on natural convection, water temperature 55oC during evening, 48-50oC during next morning. Large size: Cap. 600 L, working on forced convection, water temperature 55oC during evening, 48-50oC during next morning. Low cost: built-in storage for day time use, max. water temperature 65-70oC. **Status of Commercialization:**Commercialized. **Minimum Economic Unit Size:** It is efficient and economical as compared to conventional two-pipe system. Wet areas are planned around duct and require less space. **Indicative Investment:** **Equipment and Machinery:** Ordinary mechanical workshop facilities. **Raw Materials:** GI pipes / fittings, GI sheets, aluminum sheets, mineral / glass wool insulation and 4mm thick glass sheets. **For Further Information, Please Contact:** The Director, Central Building Research Institute.	**CBRI**
	**6.4.2 WOOD – FIRED CERAMIC-LINED COOKSTOVE** **Product/Process:** Process for fabricating ceramic-lined metal clad, wood-fired cook stove. **Application/Use:** Stove for cooking food. **Salient Feature of Process/Technology:** The essential components of this stove are ceramic/refractory liner of specific size, cast iron grate and the metal-clad structure. The ceramic liner is wrapped with a thin aluminum sheet of 42-52 SWG, and clad with metal. Three models are available viz. 'Sona-R', Sona-Super' having thermal efficiency around 45% and 'Shambhu' with thermal efficiency up to 50%. Temperature of the outer surface is around 60^{Q}C. The 'Sona-R' model has a unique provision for chapatti baking inside the Chula. **Status of Commercialization:** Commercialized **Minimum Economic Unit Size:** 100 chulhas/day	**CGCRI**

	Indicative Investment: Rs.7 lakh **Equipment and Machinery:**Aluminum moulds, vibrating machine, iron sheet cutting machine, curing tanks. **For Further Information, Please Contact:** The Director, Central Glass & Ceramic Research Institute.	
	**6.4.3 SOFTCOKE-FIRED COOKSTOVE** **Product/Process:** Process for manufacture of cook stoves working on soft coke. **Application/Use:** Domestic cooking purposes. **Salient Feature of Process/Technology:** Energy efficient & environment friendly cook stove. **Status of Commercialization:** Demonstrated to various artisans and households in different villages. **Minimum Economic Unit Size:** 100 stoves/day **Indicative Investment:** Rs.10 lakh **Equipment and Machinery:** Geolotine shear machine, sheet folding machine, saw machine, hacksaw, drilling machine, welding set etc. **Raw Materials:** ms sheet, ms rods. **For Further Information, Please Contact:** The Director, Central Institute of Mining and Fuel Research.	**CIMFR**
	6.4.4 DOMESTIC BRIQUETTE FUEL **Product/Process:** Process for making fuel briquettes from low-grade coal. **Application/Use:** As smokeless fuel for domestic use. **Salient Feature of Process/Technology:** Utilizes low-grade coal/washery by product. Product is water repellent, having good combustion characteristics. **Status of Commercialization:** Technology in production **Minimum Economic Unit Size:** 25 tpd for a battery limit plant. **indicativeInvestment:** Rs.25-30 lakh **Equipment and Machinery:** Crusher, briquetting press, mixer, screw feeder, bucket elevator, devolatilize. **Raw Materials:** Low grade caking/coking coal, washery by products, non-bituminous binders.	**CIMFR**

	For Further Information, Please Contact: The Director, Central Institute of Mining and Fuel Research.	
	**6.4.5 MULTI-FUEL POARTABLE COOKSTOVE** **Product/Process:** Manufacture of energy efficient multi-fuel Chula. **Application/Use:** For cooking in a smokeless condition using variety of fuels. **Salient Feature of Process/Technology:** All solid fuels like wood, twig, leaf, dung, agricultural waste, raw coal briquettes etc. can be burnt in this stove at high. thermal efficiency. Available in various models viz. Harsha, Harsha Community, and Jyotsana. Village blacksmiths can fabricate these stoves. About 50% fuel saving is achieved. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 50 stoves/day working 300 days/annum. **Indicative Investment:**Rs.2lakh, Cost of production: Harsha (family size: Rs.200, Community size: Rs.1000). **Equipment and Machinery:** Workshop facilities. **Raw Materials:** Mild steel plate. **For Further Information, Please Contact:** The Director, Institute of Minerals and Materials Technology, Bhubaneswar.	**IMMT**
	**6.4.6 MULTI PURPOSE BIOMASS DRIER** **Product/Process:** Process for production of Multi-Purpose Biomass Drier **Application/Use:** For drying and heating of various agriculture products, food and industrial materials in a clean environment within a temperature range of 50^{Q}C to 200^{Q}C through burning biomass **Salient Feature of Process/Technology:** Heating is indirect and smoke and hot gases do not come in contact with the drying materials. It is suitable for drying of noodles, vermicellies, potato chips, vegetables, papa, badi, spices like zinger, onion, garlic, cardamom etc., cereal & pulses, parboiled rice, fish, meat, industrial products, textiles, baking of paint (heat paint) over auto-mobile and furniture etc. Average wood consumption for drying is @ 3.3 kg/hr. The drier maintains a uniform temperature with high thermal efficiency. About 60% to 70% of energy cost and	**IMMT**

	drying period are reduced with compared over electric heated drier. **Status of** commercializati**on:** Commercialized. **Minimum Economic Unit Size:** 10,000 units/Year **Indicative Investment:** Rs.1 lakh **Equipment and Machinery:** Welding and drilling machines, hand tools required for production. Mild Steel Angle and Sheet, Plywood and Thermo Cole and GI Plate. **For Furthr Information, Please Contact:** The Director, Institute of Minerals and Materials Technology, Bhubaneswar.	
	**6.4.7 ENERGY EFFICIENT LOW COST BAKERY OVEN** **Product/Process:** Machine for Bakery Oven. **Application/Use:** It is a wood fired bakery oven suitable for tiny bakery unit and households. **Salient Feature of Process/Technology:** The oven is low cost and portable in use. The oven bakes bread (loaf) and other confectionaries in a uniform temperature burning biomass, without use of electricity or gas/oil. The oven obtains the required temperature of baking within 15 minutes after ignition and consumes less fuel, for which it reduces 60% baking cost over the traditional bakery oven. It bakes more than 32 pieces of loaf (400 g each) consuming 6kg firewood in an hour by one person. It is equipped with a combustor for burning fuel, an oven and chimney, which are connected each other, Biomass burns completely in the combustor and hot flue gas travels to the oven through the suction effect of the chimney. The device functions in down draft principle, for which a uniform temperature in the oven is easily maintained for baking various confectioneries. The smoke and pollution are greatly reduced due to complete combustion of fuels in the combustor by primary &secondary air streams. **Status of Commercialization:** Commercialized. **Indicative Investment:** Rs.0.10 lakh **Equipment and Machinery:** Welding and drill machine, hand tools for fabrication. Raw Materials: Mild steel sheet and sections and GI sheet. **For Further Information, Please Contact:** The Director, Institute of Minerals and Materials Technology, Bhubaneswar.	**IMMT**

	**6.4.8 SPENT WASH (ALCOHOL DISTILLERY EFFLUENT) VALORIZATION TECHNOLOGY** **Product/Process:** ZLD compliant technology to utilize alcohol distillery spent wash for recovery of potash (fertilizer), organics (cattle feed ingredient) & water (to be recycled in process). **Application/Use:** Technology for management & valorization of alcohol distillery effluent . **Salient Feature of Process/Technology:** Spent wash, effluent from alcohol distilleries, is slightly viscous, dark brown colored liquid with unpleasant odor and very high pollutant loading. This effluent, if allowed to discharge into surface water / river untreated, will cause severe damage to the ecosystem, including destruction of flora & fauna. Going forward, this problem is likely to worsen, particularly in view of rising demand of fuel ethanol.Currently in-vogue protocols (viz., ferti-irigation, bio-methanation, composting etc.) operate on the premises of getting rid of the problem (spent wash). However, spent wash contains appreciable amount of potassium – an important agri-nutrient. CSIR-CSMCRI's spent wash management technology enables remunerative utilization of spent wash through recovery of value added products (potash fertilizer, organics for feed / fuel application) along with water (for recycling) while ensuring compliance with regulatory Zero Liquid Discharge norms. **Status of Commercialization:** In January, 2018, the process know-how was licensed to M/s Aurangabad Distillery Ltd., Maharashtra. The plant - attached to 60 klpd distillery - is expected to be operational by December, 2018. **Minimum Economic Unit Size:** Process plant catering to about 30 klpd distillery. **Indicative Investment:** ₹35 crores (approx., for plant suitable for 60 klpd distillery). **Equipment and Machinery:** Generic chemical plant equipment, viz., reactors, filters evaporators etc. **Raw Materials:** Spent wash, nitric acid, sulphuric acid, lime, magnesia etc. **For Further Information, Please Contact:** The Director, Central Salt &Marine Chemicals Research Institute.	**CSMCRI**

	**6.4.9 SOLAR DISTILLATION UNIT FOR POTABLE WATER IN REMOTE LOCATIONS** **Product/Process:** HOUSEHOLD SOLAR STILL (3m2) **Application/Use:** 1.400 LPD solar still units to provide potable water from brine to solar salt workers at Institute ESF 2. 30 LPD solar distillation plants with solar PV lights BSF Triple Junction post, Haraminala at Indo-Pak border 3.15-17 LPD solar distillation plant integrated with solar PV lights Kavaratti Island, Lakshadweep **Salient Feature of Process/Technology:** Scarcity of potable water for drinking and cooking is a challenge confronting people in remote locations such as coastal areas and small islands. Many of these locations are blessed with abundant sunshine and there is merit in affordable low-tech solutions such as desalination in a solar still, a device that enables evaporation and subsequent condensation of water in an enclosed unit assisted by solar radiation. The improvements of design include. I) Incorporating reflectors in V-trough alignment along the North-South edges of the still. ii)Incorporating steps or partitions in the basin. **Status of Commercialization:**Know-how licensed, but not yet commercialized. **Minimum Economic Unit Size:** 10-15LPD from any kind of feed water. **Indicative Investment:** Rs.25000.00/m2 **Equipment and Machinery:** Hardware like glass, SS, anodized aluminum sheet, PVC tanks and pipes etc. **Raw Materials:** Spent wash, nitric acid, sulphuric acid, lime, magnesia etc. **For Further Information, Please Contact:** The Director, Central Salt &Marine Chemicals Research Institute.	**CSMCRI**
	6.4.10 Solar thermal dryer for improvement of livelihood of fishing communities **Product/Process:** 0.6TPD solar fish dryer at Sagar Island, Sunderbans, West Bengal. **Application/Use:** Solar dryer technology is simple and therefore easily adaptable by the community and food	**CSMC RI**




processing sector. It is not only an alternative to dwindling resources, but can also eliminate spoilage problems and impart controlled drying.

Salient Feature of Process/Technology:

1. An entirely solar PV powered system for off-grid locations.
2. Solar PV powered dehumidifier for night time drying to obtain better throughput.
3. A completely dismantlable system to take care of incoming storms/cyclones.
4. Extra racks inside the solar dryer for excess throughput.
5. 90 % UV cut-off, so that better color retention is obtained, and better price is fetched.

Status of Commercialization: Not yet commercialized. Installed through a consultancy project awarded by an NGO.

Minimum Economic Unit Size: 0.5-0.6 TPD fresh fish in 36 m2 area.

Indicative Investment: 10 -12 Lakh

Equipment and Machinery: Hardware like MS frames, UV protecting sheet, PV panels, battery, inverter, charge controller, dehumidifier, Dc heater, chimney, MS racks.

Raw Materials:

For Further Information, Please Contact:

The Director, Central Salt &Marine Chemicals Research Institute.

6.4.11 ANAEROBIC GAS LIFT REACTOR (AGR)

Product/Process:

A High rate biomethanation technology to treat organic solid waste for the generation of biogas and bio manure.

Application/Use:

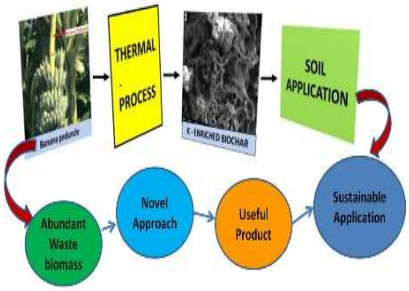
Treatment of organic waste for the generation of compost.

- Treatment of organic solid waste for the generation of biogas and bio manure.
- Scale operation: 250 kg to 10 tons per day.

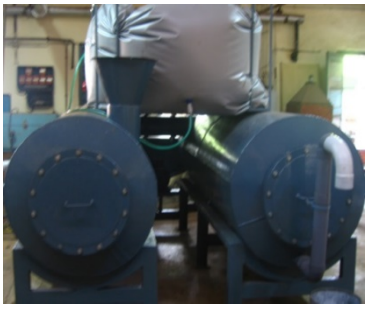
Salient Feature of Process/Technology:

- Low Hydraulic Residence time (HRT).
- High Volatile Solids Loading Rate (VSLR).
- High methane yield.
- End to end solution for solid waste management.
- Incorporated with best features of high rate anaerobic digester.
- Could be designed for the treatment of 250 kg to 10 tons of organic solid waste per day
- Encompasses novel pre and post processing mechanisms.

	• Advanced digester design: higher biogas production, nutrient rich organic fertilizer generation, low foot print area, semi-automatic plant operation • Low Hydraulic Residence time (HRT) • High Volatile Solids Loading Rate (VSLR) • High methane yield • End to end solution for solid waste management • Incorporated with best features of high rate anaerobic digester. • Could be designed for the treatment of 500 kg to 10 tons of organic solid waste per day • Encompasses novel pre and post processing mechanisms. • Advanced digester design: higher biogas production, nutrient rich organic fertilizer generation, low foot print area, semi-automatic plant operation. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 250 kg/day to 10 tons/day. **Indicative Investment:** Rs.17.5 Lakh to 250 lakh **Equipment and Machinery:** Major equipment: Anaerobic digester with accessories, biogas generator with accessories. **Minor equipment:**Waste crusher/shredder, conveyor arrangement for loading waste into crusher, process pumps, biogas scrubber, biogas balloon, biogas compressor, biogas pressure tank, biogas flare unit/gas blower, accessories etc. **Capital Cost:** INR 35 lakhs for 1 TPD capacity and INR 275 lakhs for 10 TPD capacity. **Raw Materials:** • Raw materials: segregated wastes like food waste, OFMSW, poultry litter, cattle manure, seri culture waste etc. • Organic solid waste is available free of cost at source • Nutrient and micronutrients: Rs.25 per ton **For Further Information, Please Contact:** The Director, Indian Institute of Chemical Technology.	

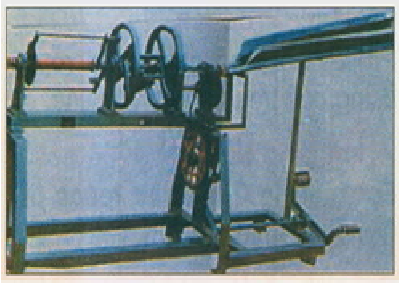
	**6.4.12 POTASH ENRICHED BIOCHAR FROM WASTE BIOMASS** **Product/Process:** Potassium enriched biochar. **Application/Use:** Organic fertilizer -soil application and agro-waste management. **Salient Feature of Process/Technology:** Carbonaceous, alkaline and potassium enriched (> 10 %) biochar. **Status of Commercialization:** not yet commercialized. **Minimum Economic Unit Size:** 100 kg to > 1 ton/day dry biomass pyrolysis unit. **Indicative investment:** 20 lakhs and above. **Equipment and machinery:** Pyrolysis unit and other supporting equipment's like oven drier, cutter and grinder, packaging equipment's etc. **Raw materials:** Banana peduncle waste biomass **For Further Information, Please Contact:** The Director, Institute of Minerals and Materials Technology, Bhubaneswar.	**IMMT**
	**6.4.13 NEERDHUR: MULTI-FUEL DOMESTIC IMPROVED COOKSTOVE (NATURAL DRAFT)** **Product/Process:** Product. **Application/Use:** The product can be used for domestic household cooking, roasting, frying, grilling, water boiling with multiple fuels e.g. coal, charcoal, firewood, woodchips, biomass briquettes, crop waste, rice rusk, agriculture waste, forest waste.Offers improved efficiency and lower emissions. **Salient Feature of Process/Technology:** 1.NEERDHUR cook stoves is approved by MNRE, GoI on the basis of performance evaluations conducted by ICS Test Center and after satisfying stipulated performance criteria to meet the newly developed cook-stove emission standards by Bureau of Indian Standards (BIS 2013). 2. NEERDHUR is certified to show a thermal efficiency of 33.33% with emission levels as CO: 3.78 g/MJd, TPM: 340.10 mg/MJd at a power output of 1.70KW. 3. NEERDHUR is among the best cook stoves in terms of thermal efficiency under the 2KW domestic natural draft biomass stoves. **Status of Commercialization:** Commercialized. Know-how on Improved Cook stove "NEERDHUR" technology has been successfully demonstrated in 4. villages across 2 states, namely Mohagaon,	**NEERI**

	Gothangoan in Nagpur district, Savroli-Palghar, Mumbai and Chunakhali, Kolkata. Field trials and IEC has also been done in the above stated villages. □ Total number of States covered: 4 (10 villages) □ Total Households Benefitted: 800 + □ Total Beneficiaries: 4000+ **Indicative Investment:** One-time implementation cost in general @ 60 lakhs/ha excluding land cost. **Equipment and Machinery:** 1. Sheet and Rod cutters 2. Sheet Rollers 3. Arc-Welding or Riveting Machine 4. Drilling Machine 5. Common workshop facilities for a moderate volume production **Raw Materials:** 1. Stainless Steel Sheets 2. Galvanized Iron Sheets 3. Ceramic Wool 4. Mild steel Rods 5. Refractory Cemen **For Further Information, Please Contact:** The Director, National Environmental Engineering Research Institute.	
	**6.4.14 DEVELOPMENT AND DEMONSTRATION OF LOW COST FUEL FROM AGRICULTURAL WASTE** **Product/Process:** **Application/Use:** It provides renewable energy for cooking and heating purposes to rural households who lack access to modern sources of energy. **Salient Feature of Process/Technology:** Briquetting machine: Easy to operate and handle, one-time investment along with zero maintenance; Briquettes: Uniform in size and quality, Better handling characteristics such as easy to handle, store and transport and enhanced calorific value and helps in waste management by changing waste to wealth. **Yield:** Plate cutters, Lathe machine for threading, General workshop facilities for the production of briquetting machine. Mild steel material; Readily available and inexpensive agricultural wastes such as rice husk, groundnut, saw dust, cow dung, dried leaves etc. **For Further Information, Please Contact:** The Director, National Environmental Engineering Research Institute.	**NEERI**

	**6.4.15 COMPACT KITCHEN WASTE DIGESTER CUM BIOGAS PLANT** **Product/Process:** **Application/Use:** Kitchen waste disposal at house hold and recovering biogas and manure from organic wastes **Salient Feature of Process/ Technology:** 1) Compact size 2) Does not need water 3) High biogas yield with high methane content 4) It can treat all organic wastes 5) Low slurry out, that can be directly used as manure. 6) Hygienic way of waste disposal at site and avoids waste collection and centralized treatment system **Status of Commercialization:** Commercialized **Minimum Economic Unit Size:** 3kg/day **Indicative Investment:**Rs.25,000 **Equipment and Machinery:** Digester with accessories and gas holder. Digester can be made out of MS, PVC or FRP. **Raw Materials:** Kitchen waste (organic) **For Further Information, Please Contact:** The Director, National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram.	**NIIST**
	**6.4.16 HIGH SOLID TREATING COMPACT DIGESTER CUM BIOGAS PLANT** **Product/Process:** **Application/Use:** Recovering biogas and manure from organic wastes from houses to commercial units. **Salient Feature of Process/Technology:** 1. Compact size 2. Needs no water along with organic waste (high solid loading). 3. Can treat any food waste (egg shell, lemon, onion, etc.) 4. Yield more biogas with high methane content. 5. No mosquito breeding problem 6. Less slurry out that can be used directly as manure. **Status of Commercialization:** Technology already transferred to three companies (non-exclusively). **Minimum Economic Unit Size:** **Indicative Investment:**3 lakhs for a 2 M3 capacity unit **Equipment and Machinery:** "The digester (MS or	**NIIST**

	PVC make) associated mechanical mixing and control units, biogas booster etc." **Raw Materials:** Organic waste is the raw material **For Further Information, Please Contact:** The Director, National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram.	

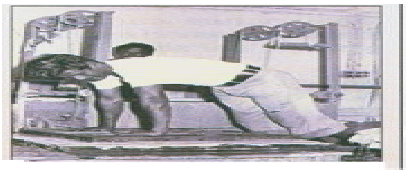
6.5 FIBRES

	**6.5.1 SISAL FIBRE HANDICRAFTS** **Product/Process:** Processing of sisal fiber into various handicrafts. **Application/Use:** Used as a substitute for jute in the preparation of handicrafts. **Salient Feature of Process/Technology:** Sisal leaves are cut and fiber extracted through a Raspador machine. It is washed in water and dried in the sun. The fiber is then beaten to remove undesired particles. The dry fiber is used for making braids, which are dyed and made into attractive handicrafts. **Status of Commercialization:** Commercialised **Minimum Economic Unit Size:** 50 kg/day **Indicative Investment:** Rs.1.00 lakh **Equipment and Machinery:** Raspador machine **Raw Materials:** Sisal fiber, dyes, adhesive and decorative materials. **For Further Information, Please Contact:** The Director, Advanced Materials and Processes Research Institute, Bhopal.	**AMPRI**
	**6.5.2 NATURAL FIBRE YARN** **Product/Process:** Process for manufacture of spun rope, 'sutli' and 'baan' from plant based fibers like jute, mesta, flax, hemp, sabai grass, wild grasses, coir etc. **Application/Use:** Miscellaneous applications e.g. fastening string for parcels, charpoy matting, etc. **Salient Feature of Process/Technology:** The yarn is spun using sewing machine parts. The main drive of the machine uses standard bicycle components. The machine is operated by sitting on a stool by simple pedaling as in a table model sewing machine. A village bicycle mechanic can repair/maintain it. No electric power is required. However, the moving parts need periodic lubrication. Two persons can make 5-10 kg yarn/hr. with the use of a machine. **Status of Commercialization:** Commercialised. **Indicative Investment:** Rs.0.15 lakh **Equipment and Machinery:** 'Universal' fiber yarn making machine available from CSIR licensee. Raw Materials: Jute/mestalflaxlhemp/wild grass/sabai grass/coir.	**CMERI**

	For Further Information, Please Contact: The Director, Central Mechanical Engineering Research Institute.	
	**6.5.3 BANANA FIBRE AND PRODUCTS** **Product/Process:** Process for extraction of fiber from banana pseudo-stem and production of utility items. **Application/Use:** Coarse woven fabrics e.g. hessian, sacks, ropes, twines, sand bags, tents, webbing, canvas and screens, kit bags, tool bags, luggage covers. Banana fiber can also be blended with wool, cotton and flak for making blankets, carpets and rags. **Salient Feature of Process/Technology:** The process involves splitting of the banana pseudo-stem into strips, digestion in open vats, washing and drying. The fiber is converted into various utility items using traditional techniques. **Status of Commercialization:**Ready for commercialization. **Minimum Economic Unit Size:** Fiber 0.5 tpd **Indicative Investment:**Rs.5.00 lakh **Equipment and Machinery:** Two rolls crusher, open vat, drying chamber, weighing balance, cutting and slitting equipment. **Raw Materials:** Banana pseudo stems, chemicals **For Further Information, Please Contact:** The Director, North-East Institute of Science and Technology, Jorhat.	**NEIST**
	**6.5.4 BLOSM** **Product/Process:** Manufacture composite panel material, named as 'Blosm", from banana leaf sheath/trunk. **Application/Use:** As substitute for wood-based panel materials in building industry. **Salient Feature of Process/Technology:** Process involves mat making from banana leaf sheath veneers/ strands, binder application and consolidation under heat and pressure. The product quality is equivalent to that of plywood. The process is adaptable by plywood manufacturing units. **Status of Commercialization:** Under commercialization. **For Further Information, Please Contact:** The Director, National Institute for Interdisciplinary	**NIIST**

	Science and Technology, Thiruvananthapuram.	
	**6.5.5 CLEAN BIOPROCESS FOR EXTRACTING NATURAL FIBRE FROM WASTE AGRO RESIDUES** **Product/Process:** **Application/Use:** The bioprocess can be used for recovering natural fiber from waste agro residues like banana pseudo stem, pine apple leaf, coconut husk, etc. **Salient Feature of Process/Technology:** Zero discharge bioprocessNo chemical usage Good quality fiber yieldGeneration of biogas as added advantage. **Status of Commercialization:** **Minimum Economic Unit Size:** **Indicative Investment:** **Equipment and Machinery:** Capital cost for putting the plant the cost depends on the scale. **Raw Materials:** waste agro residue is the raw material. **For Further Information, Please Contact:** The Director, National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram.	**NIIST**

6.6 STATIONERY

	6.6.1 SYNTHETIC STATIONERY ADHESIVE **Product/Process:** Manufacture of adhesives from synthetic polymers. **Application/Use:** For bonding: paper-paper, paper-glass & paper-leather. **Salient Feature of Process/Technology:** Synthetic vinyl polymer of medium molecular weight is dissolved in deionized water in a specific formulation. **Status of Commercialization:** Commercialized **Minimum Economic Unit Size:** 50 kg/day (8 hr.) **Indicative Investment:** Rs.3lakh. **Equipment and Machinery:** Glass & SS equipment. **Raw Materials:** Synthetic vinyl polymer, humefactant, formaldehyde, etc. **For Further Information, Please Contact:** The Director, Indian Institute of Chemical Technology.	**IICT**
	6.6.2 ADHESIVE FOR CORRUGATED BOXES **Product/Process:** Manufacture of gum adhesive for corrugated boxes: liquid, powder. **Application/Use:** For making corrugated boxes used in packaging. **Salient Feature of Process/Technology:** Liquid adhesive are prepared in a ms kettle with direct/indirect heating along with stirring. Powder gums are prepared by homogeneous mixing. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 100 kg/batch/day **Indicative Investment:** Rs.1.5 lakh. **Equipment and Machinery:** Reaction kettle with indigenously available accessories. **Raw Materials:** Starch, white dextrin, yellow dextrin, borax, formaldehyde, caustic soda. **For Further Information, Please Contact:** The Director, Indian Institute of Chemical Technology.	**IICT**
	**6.6.3 HAND MADE PAPER** **Product/Process:** Manufacture of handmade paper/sheet. **Application/Use:** Drawing paper, water marked paper, certificate	**IIIM**

	paper, fancy and decorative papers, greeting and invitation cards, paperboards and carry bags. **Salient Feature of Process/ Technology:** Process involves preparation of pulp from waste papers and rags, blending and stockpreparation, wet sheet making, pressing, sun drying, calendaring, cutting and conversion into different end use items. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 200 kg/day **Indicative Investment:** Rs.25 lakhs. **Equipment and Machinery**: Hydropulper, beater, handsheet making vats, screw press, calendering unit, cutting machine, storage vessels, weighing balance, water tank etc. **Raw Materials:** Agro-cellulosic fibers e.g. jute, straw, banana stem, cannabis; cotton rags, hosiery waste, tailor cuttings, hessian waste; waste paper, dyes, pigments and sizing chemicals. **For Further Information, Please Contact:** The Director, Indian Institute of Integrative Medicine, Jammu, North-East Institute of Scienc and Technology , Jorhat.	
	**6.6.4 LOW-DUST CHALK** **Product/Process:** Production of low dust chalk pencil. **Application/Use:** Educational aid for writing on black boards. **Salient Feature of Process/Technology:** Chalk pencils are manufactured from mixtures of plaster of Paris, French chalk and clay by making a paste of the mix and casting in suitable molds. These are dried and packed. Low dust chalk pencils have advantage of mitigating silicosis for chalk users, particularly the teachers. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 200 boxes/day. **Indicative Investment:** Rs.0.50 lakh **Equipment and Machinery:** Moulds for chalk pencil, mixing trays, paper boards and carton etc. **Raw Materials:** Plaster of Paris, French chalk, clay, binder. **For Further Information, Please Contact:** The Director, North-East Institute of Scienc and Technology , Jorhat.	**NEIST**

	**6.6.5 COLOURED WAX CRAYONS** **Product/Process:** Manufacture of colored wax crayons. **Application/Use:** Educational aid for drawings and color sketches. **Salient Feature of Process/Technology:** Process involves melting of wax with appropriate dye/pigment, addition of filler to the molten was, casting in required shapes & sizes, wrapping and packing in cardboard boxes. **Status of Commercialization:** Commercialized. **Minimum Economic Unit Size:** 150-200 boxes/day. **Indicative Investment:** Rs.0.6 lakh **Equipment and Machinery:** Vessels, moulds of different shapes and sizes **Raw Materials:** Wax, pigment, filer material. **For Further Information, Please Contact:** The Director, North-East Institute of Scienc and Technology, Jorhat.	**NEIST**
	**6.6.6 WOOD CARE** **Product/Process:** Technology for production of Wood Care. **Application/Use:** Enhance the durability and strength of bamboo and wood & wood /bamboo products. **Salient Feature of Process/Technology:** □ Use of eco- friendly raw materials & chemicals. □ Low cost technology and can be adopted as cottage scale level in rural areas. □ No sophisticated equipment's and machineries involved. □ No highly skilled labors required. □ No bye products generate during manufacturing process. **Status of Commercialization:** In commercial production. **Minimum Economic Unit Size:** 100 L/day **Indicative Investment:** 7. 50 Lakhs **Equipment and Machinery:** Soxhlet apparatus, Electrical stirrer with speed control& Miscellaneous equipment's. **Raw Materials:** i. Plant extracts, ii. One Vegetable non edible oil & Emulsifying agent **For Further Information, Please Contact:** The Director, North-East Institute of Scienc and Technology , Jorhat.	**NEIST**

6.7 MISCELLANEOUS

6.7.1 BIOPLATES FOR LEAF CUP MACHINE

CFTRI

Product/Process:
Casting of plates and cups from arecas sheath.
Application/Use:
Production of plates/cups for serving of food.
Salient Feature of Process/Technology:
Traditionally plant residues such as areca sheaths have been used in India for forming into different shapes such as plates, cups and saucers etc. for serving of food. The sheaths are trimmed to a uniform size of 300- mm diameter and conditioned in water for 30-60 sec. The trimmed sheaths are passed under an of water jet spray while on a conveyor belt. The surface cleaned leaves are received in the gap between the die set. That is electrically heated to a temperature of 130 - 150^{Q}C. The Sheaths are pressed in the die, at the end of the operation the die moves down and the formed plate/ cup is lifted and discharged manually.
Status ofCommercialization: Ready for commercialization.
Indicative Investment: Rs.1.5 lakh.
Equipment and Machinery: Continuous casting machine - Design drawings available from CFTRI.
Raw Materials: Plant leaves like banana, beautia, bauhinia, arecanut sheath, pseudostem of banana.
For Further Information, Please Contact:
The Director, Central Food Technological Research Institute.

6.7.2 ORNAMENTAL FISH AQUARIUM

IIIM

Product/Process:
Process for rearing ornamental fishes and making aquarium.
Application/Use:
Interior decoration.
Salient Feature of Process/Technology:
Fish aquarium brings home the joy of a new pet into the family and introduction of a new form of life. The aquarium does not require much space or expensive maintenance. Ornamental fishes are reared in cement tank or plastic pool or in glass aquarium. These are placed in a transparent water container with arrangements for aerator, light, thermostat etc.
Status of Commercialization: Commercialized
Minimum Economic Unit Size: 20

	aquariums/day **Indicative Investment:** Rs.0.60 lakh **Equipment and Machinery:** Cement/plastic water tanks. **Raw Materials:** Ornamental fish fingerlings, glass/plastic aquarium containers, adhesive, net, aerator, filter, thermostat, light bulb. **For Further Information, Please Contact:** The Director, Indian Institute of Integrative Medicine, Jammu.	
	6.7.3 RICE BRAN WAX **Product/Process:** Process for upgradation of crude rice bran wax. **Application/Use:** Used in paper, candles, moulded novelties, electric insulation, polishes, cosmetics, printing ink, lubricants, adhesives, chewing gum, vegetable coating and pharmaceuticals. **Salient Feature of Process/Technology:** The process consists of selective removal of triglycerides, fatty acids resinous matter and other undesirable components using suitable organic compounds. **Status of Commercialization:** Commercialized **Minimum Economic Unit Size:** 0.5 tpd crude rice bran wax. **Indicative Investment:** Rs.25 lakh **Equipment and Machinery:** No special equipment required. The reaction vessels are indigenously available. **Raw Materials:** Crude wax from rice bran processing. **For Further Information, Please Contact:** The Director, Indian Institute of Chemical Technology.	**IICT**
	6.7.4 LONG DECAY PHOSPHOR **Product/Process:** Process for processing of Phosphorous powder. **Application/Use:** Photoluminescence escape routes and rescue guidance system, warning signs and accident prevention signs, Machinery markings, Producing special effects in Night festivals/bars/discotheques, Electric switches, Consumer goods, Toys, Sports equipment, Enamels and ceramic tiles, Bank notes. **Salient Feature of Process/Technology:** This is a coating of a special luminescent material called Long Decay Phosphor. This has a property	**NPL**

	to store the room light. This Stored energy is released in the form of visible light after room light has been switched off for several hours. So it can be used as light source for signs. **Status of Commercialization:** Ready for commercialization. **For Further Information, Please Contact:** The Director, National Physical Laboratory.	
	6.7.5 MAGICAL HEAT PACK (REUSABLE) **Product/Process:** Heat Pack for pain removal. **Application/Use:** This can be used by athletes, patients, travelers suffering from joint pain, back pain also by any personnel placed in high altitude. **Salient Feature of Process/Technology:** A super cooled aqueous solution of an inorganic hydrated salt is placed in PVC pouch containing a trigger which acts as an activator for the crystalline and dissipation of heat and can be effectively used as warmer. It can be made reusable by putting in hot water and also by putting it in micro-oven. This reusable heat packs are especially useful in rural sector because they provide heat without the necessity of electricity, and also when the villagers are mobile. In the hilly areas also where it is very cold and no electric supply is available, this technology could be very useful to keep body warm. To activate the heat pack, the clip inside the pouch is to be clicked. Heat reaction will spread from the clip throughout the pack. The time period of the pack system stays hot will vary on the climatic condition. **Status of Commercialization:** Ready for commercialization. **For Further Information, Please Contact:** The Director, National Physical Laboratory.	**NPL**
	6.7.6 ILLIZAROV CARBON COMPOSITE RINGS **Product/Process:** Illizarov carbon composite rings. **Application/Use:** For orthopedic applications such as correction of bone deformities. **Salient Feature of Process/Technology:** Illizarov method involves assembly of metal rings using wires across the fractured/deformed areas without any surgical trauma. This is followed by gradual compression or destruction resulting in	**NPL**

	the removal of deformities/union of fracture. This technique is also used for lengthening of bones to as much as 6 to 8 inches. The high point of this method is that all along the patients remain mobile. Normally and particularly in India Orthopedic surgeons use stainless rings which has some serious drawbacks in treating polio patients particularly, due its heavy weight, opaqueness to X-rays (thus coming in the way of monitoring of bone healing process) and plastic deformation of stainless steel rings at higher loads. The proposed Illizarov carbon composite rings will be 1/4th (25%) in weight in comparison to the conventional stainless steel rings. **Status of Commercialization:** Ready for commercialization. **For Further Information, Please Contact:** The Director, National Physical Laboratory.	
	6.7.7 LOW COST PELTIER BASED REFRIGERATOR **Product/Process:** Peltier based refrigerator. **Application/Use:** This cooler/refrigerator provides a cost-effective technological solution for storage of perishable food stuff, including, milk products, fruits, vegetables and access to cold drinking water. **Salient Feature of Process/Technology:** 1.) This technology of cooler/ refrigerator is based on solid state Peltier device and runs without compressor and hence it is cost-effective, maintenance-free and has a very long life. 2.) This unit does not require grid power and can be powered by a ~60W solar panel or a battery. 3.) This cooler/refrigerator provides a cost-effective technological solution for storage of perishable food stuff, including, milk products, fruits, vegetables and access to cold drinking water. **Status of Commercialization:** Technology has been transferred to M/s Joy Trading company, Paschim Vihar, New Delhi-63. **For Further Information, Please Contact:** The Director, National Physical Laboratory.	**NPL**
	6.7.8 RECYCLING OF PLASTIC WASTE FOR TILES **Product/Process:** Plastic tiles. **Application/Use:**	**NPL**

	This technology provides a solution for solid waste management problem and promote waste-to-usable technology program, a much-needed impetus to India's recycling industry. **Salient Feature of Process/Technology:** Plastic recycling is growing in India and the market is huge. It is essential to save the recyclable waste material from going to the waste processing and disposal sites and using up landfill space. Salvaging it at source for recycling could make profitable use of such material. This will save national resource and also save the cost and efforts to dispose of such waste. **Status of Commercialization:** Technology has been transferred to 1) M/s Shayna Eco field India Pt. Ltd. having its corporate office at A-163, Jeewan Nagar, Ashram, Delhi - 110014 2) M/s Addin Infra Pvt Ltd, Ahmedabad, Gujarat 3) M/s. Vyzag Bio Energy Fuel Private Limited, Flat No 822, Lansum Greens, Madhavadhara, Visakhapatnam-530007; (Andhra Pradesh) **For Further Information, Please Contact:** The Director, National Physical Laboratory.	

7.1INFORMATION TECHNOLOGY

	**7.1.1 IOT ENABLED SMART SOLAR TREE** **Product/Process:** IoT enabled Smart Solar Tree. **Application/Use:** Smart cities, Decentralized Power Generation, Agricultural land, border security and gram panchayats. **Salient Feature of Process/Technology:** 1kW and 3 kW solar tree designs optimized for a particular geographical location; Integrated lighting and cell phone charging; IoT enabled sensors for electrical performance monitoring; IoT enabled sensors for distributed sensing of environmental parameters (Temp, humidity, CO2, PM 2.5, PM 10 etc.; Integrated smart cameras for surveillance; IoT enabled solar tree has applications ranging from decentralized power generation applications, agriculture lands security borders, smart cities and ev charging stations. **Status of Commercialization:**Transferred and ready for commercialization. **Minimum Economic Unit Size:** **Indicative Investment:** **Equipment and Machinery:** **Raw Materials:** **For Further Information, Please Contact:** The Director, Central Electronics Engineering Research Institute.	**CEERI**
s 	**7.1.2 SOLAR PVT CO-GENERATION SYSTEM** **Product/Process:** Solar PVT Co-generation system **Application/Use:** Suitable for domestic and industrial applications. **Salient Feature of Process/Technology:** Engineering Solar Photovoltaic and Thermal Co-generation, Simultaneous generation of electrical and thermal energy in a single system; More than 100 GW solar roof top. **Status of Commercialization:** Transferred and ready for commercialization **Minimum Economic Unit Size:** 8 m² **Indicative Investment:** **Equipment and Machinery:** **Raw Materials:** **For Further Information, Please Contact:** The Director, Central Electronics Engineering Research Institute.	**CEERI**

7.1.3 EHEALTH CENTRES - IMPACT ON HUMAN DISEASES DIAGNOSIS, TREATMENT AND PREVENTIVE CARE.

IGIB

Product/Process: Mobile Health Care.

Application/Use:

Rapidly deployable integrated primary health solution with telemedicine capacity and e-workflow. The foremost limitation is a real shortage of healthcare providers coupled with inequitable concentration of resources, both in manpower as well as infrastructure. Three fourth of the rural Indian population has access to just one-third of the country's available hospital beds. Those living in remote pockets typically have to travel more than five kilometers to access healthcare. This is amplified by an inability to monitor the utilization of the little that is available and diversion of funds earmarked for health infrastructure creation and provider absenteeism is well-known. The general lack of objective health data makes informed or targeted disease prevention difficult, especially in the context of limited resources.

Salient Feature of Process/Technology:

Cloud Software link-Telemedicine: Integrated solution for provision of healthcare that harnesses together the infrastructure-creation advantages of cargo containers; the capability of telemedicine to enable high-quality healthcare access; operational transparency of a cloud-based electronic workflow; and automated analysis of data for various levels of decision support.

Status of Commercialization:80 such e HC deployed in country as on date.

Minimum Economic Unit Size: Half container of e HC.

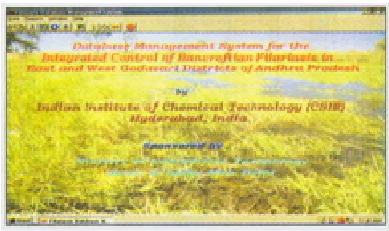
Indicative Investment: Approx. 25 lakhs per half container.

Equipment and Machinery: Telemedicine, Spirometry vital sizes glucose

Raw Materials: Shipping containers, Miscellaneous health care equipment's.

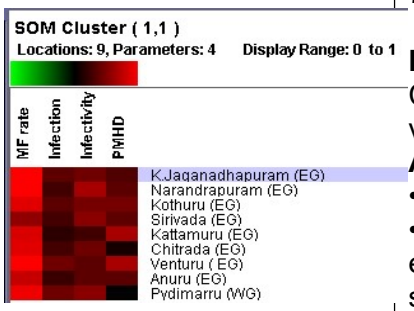
For Further Information, Please Contact:

The Director, Institute of Genomics and Integrative Biology.

	**7.1.4 DATABASE MANAGEMENT SYSTEM FOR INTEGRATED CONTROL OF BANCROFTIAN FILARIASIS IN RURAL AREAS** **Product/Process:** Innovative software. **Application/Use:** For integrated control of Bancroftian Filariasis in the rural endemic areas of East and West Godavari Districts of A. P. **Salient Feature of Process/Technology:** The database is created with "VISUAL BASIC" as front end and "MICROSOFT ACCESS" as back end so as to enable new entries also. **Status of Commercialization:** Ready for commercialization. **Indicative Investment:** Rs.10 lakhs. **Equipment and Machinery:** Simple hardware, PC, software including Visual Basic 6.0, MS Access and Printer. **Raw Materials:** Area wise Socio-economic details (18 parameters), Crystal reports, Epidemiological &Entomological details of Filariasis/Mosquito species. **For Further Information, Please Contact:** The Director, Indian Institute of Chemical Technology.	**IICT**
	**7.1.5 FORECAST MODEL OF VECTOR-BORNE DISEASES** **Product/Process:** Forecasting software model. **Application/Use:** To predict outbreak of vector borne diseases like Malaria, Japanese encephalitis etc. in rural endemic areas. Salient Feature of **Process/Technology:** The software is written using Java language, so it is platform-free, versatile and can be used on most of the computers. The software has automatic alerting system and ability to take necessary control measures. The information can be sent to the concerned authorities also through Internet or virtual private network with an ordinary dial-up connection. **Status of Commercialization:** Ready for commercialization. **Indicative Investment:** Rs.10 lakhs. **Equipment and Machinery:** Simple hardware, PC, software, Java compatible system, Modem and printer. **Raw Materials:** Area wise Monthly data on average rainfall, humidity, maximum/ minimum temperatures, crop practices, irrigation facilities, vector density,	**IICT**

	number of positive cases during last 6-8 years and any other parameter relevant to prevalence of the disease. **For Further Information, Please Contact:** The Director, Indian Institute of Chemical Technology.	
	**7.1.6 SAMADHAN KENDRA** **Product/Process:** Text Graphics & Audio software for the farmers. **Application/Use:** To provide information about Agriculture, Health schemes, and other need based information required by the village populace. **Salient Feature of Process/Technology:** The database is created with "JAVA" as front end and "MICROSOFT ACCESS" as back end so as to enable new entries also. **Status of Commercialization:** Ready for commercialization. **Indicative Investment:** Rs.10 lakhs. **Equipment and Machinery:**Simple hardware, PC, software including Java compatible system, printer, modem, and Internet. **Raw Materials:**Village wise details about Agriculture/Agriculture offices, Pest infestation on the crops grown, Availability of medicines in the Public Health Centers, Dealers selling pesticides, seeds and farm equipment's. Details of Central/State Government Agriculture/Health schemes. **For Further Information, Please Contact:** The Director, Indian Institute of Chemical Technology.	**IICT**
	7.1.7 ESTABLISHMENT OF RURAL PHEROMONE LURES MAKING CENTRES [RPLMC] FOR CROP PROTECTION USING PAT **Product/Process:** **Application/Use:** • Center can be used for the making of Pheromone lures as per the requirement of farmers depends of the field crop/specific pest lures as per crop sessions i.e., like Rice - Yellow Stem Borer (YSB), Vegetable - Brinjal shoot and fruit borer (BSFB), Sugarcane - inter node borer (SINB), Fruit - Diamond Back Moth (DBM), Cotton - American bollworm and Groundnut - leaf miner (GLM) etc. • Pheromone lures making center will facilitate farmers to obtain genuine pheromone lures as per	**IICT**

	their requirement at affordable costs. **Salient Feature of Process/Technology:** Pheromones in pest control alternative to pesticides/ gm crop-cotton. Most useful IPM strategy for pest monitoring and management is Pheromone Application Technology. This is farmer friendly technology in the following ways. • Depends on the insect catches in pheromone. traps Pesticide application can be regulated i.e., when to spray, dose of the pesticide. • Even pest can be controlled without pesticide spray by using PAT with mass trapping method. Highly compatible with other control options including predators. Easy mode of application and safe to the applicator. Reduce pesticide application and improve health conditions of farming community. Increase the value of agro produce 25 -30% **Status of Commercialization:** Ready for commercialization. **Minimum Economic Unit Size:** **Indicative Investment:** Rs.15 to 20 lakhs **Equipment and Machinery:** • Analytical balance • Soxhlets extractors • Distillation set ups • Isomantles • Micro pipettes • Deep freezer (-30oC) • Hot air oven • Lure making trays **Raw Materials:** 1. Pheromone Component: The center can purchase the pheromone components from the market which is presently highly dependent on imported chemicals. This will be more expensive. Instead, the center can initially obtain pheromone blends of important insect pests from Indian Institute of Chemical Technology on cost to cost basis. Since IICT is an R&D institute it can supply pheromone components up to certain extent at no loss and no profit basis. However, the center and the farmers will be benefitted by the cost effectiveness and the quality assurance of the pheromone chemicals IICT can provide synthetic pheromones. 2. Dispenser: Very common and easily available in the market. **For Further Information, Please Contact:** The Director, Indian Institute of Chemical Technology.	

	**7.1.8 SELF ORGANIZING MAPS (SOM)** **Product/Process:** Cluster technology for minimizing the outbreaks of vectors and vector borne diseases in India. **Application/Use:** • SOM used for prioritization of epidemic regions. • The endemic clusters can be visualized on spatial environment for easy understanding of disease hot spots. • This clustering technique enables the health officials to prioritize the diseases endemic zones and plan their control operations so as to minimize the mortality and morbidity occurring due to the onset of vector borne diseases. **Salient Feature of Process/Technology:** The character that distinguishes the SOM net from the other cluster algorithms is that not only similar inputs are associated to the same cell but also neighborhood cells contain similar types of documents. This property together with the easy visualization makes the SOM map a useful tool for visualization and clustering of large amount of data sets. The technology will prioritize the control parameters to reduce the outbreak of diseases. **Status of Commercialization:** Not yet commercialized **Minimum Economic Unit Size:** **Indicative Investment:** Rs.35,000/- for 100 LPH, Rs.3,00,000/- for 500 LPH & Rs.6 Lacs for 1000 LPH capacity. **Equipment and Machinery:** Desktop with basic configuration **Raw Materials:** Epidemiological and entomological data of mosquito borne diseases. **For Further Information, Please Contact:** The Director, Indian Institute of Chemical Technology.	**IICT**
	**7.1.9 WATER-EFFICIENT AUTOMATED SMART IRRIGATION SYSTEM** **Product/Process:** Water-efficient Automated Smart Irrigation System (WASIS) prototype at TRL-7 **Application/Use:** Retrofit/integrate with existing irrigation system to enhance water use efficiency, decrease production cost and increase crop production. **Salient Feature of Process/Technology:** It is water-efficient, automated, smart (has intelligence about soil moisture requirements of	**NISTADS**

	crops), customizable, easy to operate and cost effective. **Status of Commercialization:** Would be ready for commercialization with development of different variants for different user's/ demand types. **Minimum Economic Unit Size:** Rs.2 lakh **Indicative Investment:** Rs.30 Lakh **Equipment and Machinery:** An integrated system with components such as soil moisture sensors, data logger, solar power based power supply system for backup/ continuous operation of sensors/motors, irrigation system (drips, motors/pumps, pipe layout and other accessories), rain gauge, data acquisition system and remote communication, server (computer/cloud for data interfacing with the data acquisition system). **Raw Materials:**Local fabrication. **For Further forma ion, Please Contact:** The Director, National Institute of Science Technology & Development Studies.	
	**7.1.10 AYUR VATIKA, AN HERBAL VERTICAL GARDEN COMBINING A FUNCTIONAL PROTOTYPE AND WEB-BASED INFORMATICS.** **Product/Process:** Herbal Vertical Garden combining a functional prototype and web-based informatics. **Application/Use:** To create awareness on the role of herbs in health and nutrition. **Salient Feature of Process/Technology:** The prototype of the vertical garden with informatics has been established at CSIR-NISTADS. **Status of Commercialization:** In process. **Minimum Economic Unit Size:** About Rs.1 lakh **Indicative Investment:** Rs.15 Lakh **Equipment and Machinery:** Herbal vertical garden. **Raw Materials:** Herbs with automated irrigation system. **For Further Information, Please Contact:** The Director, National Institute of Science Technology & Development Studies.	**NISTADS**

8.1 WASTE MANAGEMENT

	**8.1.1BEYOND DUMPING: NEW STRATEGIES FOR RECOVERY OF PRESERVATIVE SALT FROM RAW-HIDE SKIN SALT AND RO – REJECT WASTE SALT** **Product/Process:** Beyond dumping: New strategies for recovery of preservative salt from Raw-hide skin salt and RO – reject waste salt. **Application/Use:** The recovered salt was recycled and reused in tanning process. It reduces environmental pollution issue. An economically viable technique. **Salient Feature of Process/Technology:** • Do not need any special setups/ equipment's • It is an economical process for the recovery of preservative salt from raw-hide and RO reject waste mixed salts. • Chemical treatment method provides an added advantage of total recovery of salt from the remaining solution and hence zero waste generation. This technology can be used in leather industry. **Status of Commercialization:** Yet to be commercialized. Two industries are ready to take the technology for the implementation. **Minimum Economic Unit Size:** 500 L **Indicative Investment:** 5 lakhs **Equipment and Machinery:** Mixing tank (2 Lakhs) **Raw Materials:** Raw-hide salt and RO reject salt **For Further Information, Please Contact:** The Director, Central Electrochemical Research Institute.	**CECRI**