

# TECHNOLOGY FOR RURAL DEVELOPMENT

VOLUME 1

PRODUCTION  
ORIENTED &  
EMPLOYMENT  
GENERATING  
TECHNOLOGIES

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COUNCIL OF SCIENTIFIC AND  
INDUSTRIAL RESEARCH  
NEW DELHI-110001  
OCTOBER, 1983

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## FOREWORD

In the 17th century, foreign merchants who came to India usually complained that India was a bottom-less pit in which all the gold and silver they brought, disappeared. This was because the product of Indian industry was sought for in many countries abroad. The foreign products, on the other hand, could not compete with the Indian products in the home market.

Gradually, situation began to change. Modern science and technology brought about an industrial revolution in the West and Indian technology could not keep pace with these developments. It became obvious that dichotomy was not possible between the skills available in the cities and those in the rural markets. The two became totally inter-dependent on one another.

And yet in a country like ours, the bulk of the people living in rural areas was denied its share of the advantages of science and technology. While the country cannot progress without industrialisation on a massive scale, it is becoming clear that apart from agriculture, S&T can serve as a tool to improve the quality of life of the villagers.

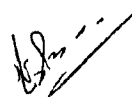
The agents of change, by virtue of their aims and objectives and with the active participation of scientific community, can catalyse the use of S&T complementaries in the sphere of rural development which should help in achieving rapid and successful results. This needs educating and opening the minds of rural people towards the benefits of S&T. Different media can be used for this purpose in bridging the communication and information gap through audio-visuals, training and demonstration.

I am glad to note that scientists of CSIR have joined hands in this task and the techniques, tools and technologies developed by them can be adopted by people staying in rural and backward areas. The main raw materials of many of these technologies are available there. The present publication is an effort to convey the message of application of science and technology to prospective users and clients.

These technologies generally aim at optimum and scientific utilisation of local raw material and resources for generation of gainful employment. The publication meets the objectives of our Prime Minister's 20 Point Programme and will help in setting up industries in those districts where none exists.

I would, however, like to add that to help the scientists better, even their best promoters and users of these technologies should provide the necessary feedback. Similarly, for scientists, technologists and engineers, it will require an increasing awareness of rural realities and needs and increased efforts on their part to meet them.

I am specially impressed by the tabular presentation of this publication as at one place it provides a quick view of technologies under different heads and their claims from various angles of utilization. This will, I am sure, serve as a ready reckoner to all those who are engaged in taking the fruits of S&T to rural areas for employment generation and human resources development and especially to those who are looking forward to new entrepreneurship/projects and improved skills. The publication, I hope, will be useful as basic material for the Council for Advancement of Rural Technology (CART) in the Ministry of Rural Development, Government of India and the emerging State Councils of Science & Technology.



S. Nurul Hasan  
Vice-President  
Council of Scientific & Industrial  
Research (CSIR)

## P R E F A C E

There is, perhaps, no area of human activity which cannot benefit from science and technology (S&T). This potent source has, however, not been fully tapped for the socio-economic development of people in rural areas especially in creating gainful employment. There is thus a need for undertaking a judicious application of S&T in an integrated manner coupling natural and human resources with modern techniques and technologies and to demonstrate these to the rural population at their door-steps. This calls for identification of needs and expectations of people and the matching technologies and their promotion according to their ability to absorb them in different agro-climatic and ecological zones in the country.

Scientists of CSIR laboratories have developed many technologies which have direct and indirect relevance to rural development. A compendium of such technologies was first published in 1978 under the title "CSIR in the service of rural society". This was warmly welcomed by different sectors. Since then, there has been a constant demand for information on those technologies which have a direct bearing on generation of gainful employment in rural and backward areas. In view of this and the national objective of eradication of poverty and of employment generation in rural and backward areas, an attempt has been made to prepare such a publication. Most of the technologies discussed here either have been successfully commercialized or are in various stages of utilisation.

This publication aims at providing relevant data pertaining to selected technologies developed by different CSIR laboratories with economic and production objectives specially

- to optimise utilisation of local raw materials and resources;
- to help in production of value added products near the source;
- to help in economic utilization of byproducts and recycling of wastes; and
- to project new and modern technologies for self-employment.

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#### List of Abbreviations used

gal	-	gallon(s)
ha	-	hectare(s)
hp	-	horse power
hr	-	hour(s)
kg	-	kilogram(s)
kl	-	kilolitre(s)
kW	-	kilowatt(s)
kWh	-	kilowatt(s) per hour
q	-	quintal(s)
Rs	-	Rupees
t	-	tonne(s)
W	-	watt(s)
yr	-	year(s)

## TRANSPLANTATION OF TECHNOLOGY

When we talk of technology we immediately think of its relevance to industrialization, but technology is indispensable also to agriculture and allied activities that constitute the main occupation of the bulk of Indian people living in rural areas. Perhaps the greatest contribution of science and technology to rural development has been through modernisation of agricultural methods. It has been experienced that science and technology, if allowed to interact with other rural activities (including para-agricultural and non-farm), can lead to generation of opportunities for new and gainful employment in rural and backward areas.

Transplantation of technology involves selection of appropriate technology from various alternatives to meet the needs of a specific target group, making it adaptable and providing the necessary support services. In the rural context such a technology has been termed as Rural Technology. In this publication, it covers rural-based economic and production-oriented activities where application of CSIR technologies may meet some of the national objectives – eradication of poverty, increased economic opportunities, gainful employment, balanced growth and social justice. Here, basically, science and technology have to be related to the people, their needs, resources, skills and cultural environment. The corresponding structure of technology development and replication would need a different approach. While in some cases it would need examination of the suitability and applicability of the already available tools, equipment, techniques and development of new alternative technologies wherever necessary, in other cases it may need the use of advanced technologies.

The Sixth Five Year Plan (1980-1985) stipulates that “rural technology should not be taken to mean primitive technology or technology of yesterday. A determined effort is needed to take modern science and technology to the rural areas so that it is brought well within the material, financial and skill resources of rural people. Therefore, while searching for and improving upon such technologies which increase employment opportunities for our people, it will be simplistic and dangerous to confine indigenous efforts to relatively simple technology for rural needs and depend on import of technology in high-technology areas. We have also to ensure an approximate mix of small, medium and large-scale technologies, in a manner consistent with our long-term interests”.

The other way of transplanting technologies could be to make the best use of existing resources to generate wealth and assets. This approach demands greater decentralisation of the application of modern technologies in rural and backward areas and calls for such policy measures as price and wage regulation and provision of employment for rural women, as these also determine the choice and operation of technology.

Transplantation of technology calls for generating scientific temper among the rural people, preparing them to accept new ideas, and inculcating in them a faith and confidence in their resourcefulness and ingenuity in adopting appropriate technology. This requires an integrated approach involving promotion of specialized programmes coupled with demonstration, training and post-training services. In many cases, technology may have to be developed in a package form.

This publication is in response to a felt need. It was suggested that CSIR may provide information on technologies having scope for application in rural areas and which have been developed up to a reasonable scale for easy transfer and utilization. It was with this objective in view that the work on identification of production-oriented and employment-generating technologies suitable for utilisation and commercialization in rural and backward areas was undertaken. Care has been taken to include only those technologies which do not incur high capital cost per unit of output and have a good scope of adaptability in rural areas. These technologies are either already in production, at various stages of commercialization or have been worked out up to a reasonably developed stage in the laboratory. Thus these technologies have a reasonable degree of provability behind them and also conform to some of the objectives enunciated in 20-Point Programme (January 1982) and Technology Policy Statement (January 1983) of the Government of India\*.

This publication should, therefore, be taken as a Technology-Shelf containing selected items deployable in different areas of economic and productive activities.

A key element in successful technology utilization is the comprehensive knowledge of the various aspects involved, such as quality and quantity of raw materials required, their seasonal availability or otherwise, collection and storage, energy source and requirement, needs and availability of finance, credit, skill, manpower and management, and marketing. Hard technology itself is just one of the components of these aspects. It would, therefore, be advisable that even for technologies with an investment below rupees one lakh (Rs.1,00,000), a study of economic viability of the project should be made especially in relation to cost of production and marketability of the end product. The risk of failure could be minimised by

continuous vigilance and observation of market behaviour and judicious decisions for the disposal of a product in semi-finished or finished form. Efforts could also be made for a fraternal trading arrangement with some established industries or marketing agency. In the management of such products possibilities should be explored to establish a relationship between different categories of beneficiaries – the producer of raw materials, the processor or entrepreneur, the market and the ultimate consumer, so that the benefits of science and technology are derived by all. In some cases, it may be of advantage to organise an institution to manage the project. According to the nature of the project, financial institutions, banks and insurance companies may also be associated from the beginning for providing finances and insurance cover.

In promoting these technologies the capacity for employing people directly should not be taken as a yardstick for their overall employment potential in isolation from other considerations. The performance of these technologies in generating production under rural conditions is perhaps more important than total wealth and assets produced. In many cases, the indirect impact and advantages could be quantified to complement socio-economic benefits. Like other economic and production-oriented projects, operation of many of the rural technologies discussed in this publication would need a reliable supply of raw materials and other specified inputs. This would, therefore, need a control over multiplication and indiscriminate replication of such technologies in a region. The technologies promoted should also be in harmony with the general level of competence of technology users. We must remember, though, that technology alone will not prove effective in bringing about transformation unless there is a simultaneous progress in the education of rural people. Here, education should precede the transplantation of technology programme and the objective should be 'technology as a complement to the development of humans in rural areas'.

These are, therefore, some of the crucial considerations in transplanting technologies. However, certain compromises could be made according to local situations.

This publication is presented in a somewhat nonconventional form to enable planners, policy makers, promoters of development schemes, financial institutions, government departments, change-agents, social voluntary organizations, consulting firms and other such institutions to have a quick look and use this as a handy reference book. The technologies are listed in a tabular form under suitably classified heads and further details about these could be obtained from concerned

national laboratories (addresses given in appendix) or the Technology Utilisation Division, CSIR, Rafi Marg, New Delhi-110001.

**\* 20-Point Programme**

- 1) *Rural development and employment*
- 2) *Increased efficiency, capability, utilization and generation of internal resources,*

**Technology Policy Statement (TPS)**

- 1) *Rural development and employment generation*
- 2) *Efficiency and productivity*

## AGRO-BASED TECHNOLOGIES

Agricultural products and by-products form raw materials for many industries, which include processing of raw grain into consumable cereals, manufacture of industrial products and utilisation of by-products and wastes.

The technologies presented here imply the decentralised growth of cottage and small scale units near the source of such agro-materials like cereals, pulses, fruits, vegetables, spices, etc. These technologies are characterised by advantages like utilisation of locally available raw materials, ease of operation by semi-skilled workers, production of value added products, generation of assets and gainful employment opportunities.

## AGRO-BASED TECHNOLOGIES

S.NO.	TECHNOLOGY/TECHNIQUE(LABORATORY)	MAIN FEED STOCK/RAW MATERIAL	STATUS/SCALE OF TECHNOLOGY	COST/CAPACITY OF PLANT	ENERGY SOURCE/ REQUIREMENT	EMPLOY- MENT POTENTIAL	UTILISATION STATUS (NUMBER OF PARTIES)	
							RELEASED TO	IN PRODUCTION
1.	Anti-fungal paste (CFTRI,Mysore)	Banana,high polymerisation diluent accelerator, fungicide, food colour	Available (cottage)	Rs.15,000/30 kg. per day	Electricity 6 kW/day	4	-	-
2.	Castor oil, dehydrated (RRL,Hyderabad)	Castor seeds	In production (small)	Rs.4,00,000/500kg per day	Electricity 300 kW/day	20	4	2
3.	Cocoa mass,refined, Cocoa powder (CFTRI,Mysore)	Cocoa beans	In production (small)	Rs.5,33,000/0.25t beans per day	Electricity 350 kW/day Water 800 litres/day	11	4	1
4.	Coconut,desiccated (CFTRI,Mysore)	Coconuts	Available (small)	Rs.1,45,000/1000 coconuts per day	Electricity 75 kW/day Water 6,000 gal/day	45	-	-
5.	Coconut water, bottling of, (RRL,Trivandrum)	Ripe coconuts	Released (small)	Rs.14,10,000/ 1000 litres of coconut water per day	Electricity 41 kW/day Light diesel oil 14 litres/day	10	1	-
6.	Coconut oil and defatted gratings (RRL, Trivandrum)	Fully matured coconuts	Released (small)	Rs.1,10,000/2000 coconuts per day	Electricity 400 kW/day	18	3	-
7.	Cotton,chemical (RRL,Hyderabad)	Cotton linters	In production (small)	Rs.30,00,000/ 4.5 t per day	Electricity 3,000 kW/day	50	1	1



S.NO.	TECHNOLOGY/TECHNIQUE (LABORATORY)	MAIN FEED STOCK/RAW MATERIAL	STATUS/SCALE OF TECHNOLOGY	COST/CAPACITY OF PLANT	ENERGY SOURCE/ REQUIREMENT	EMPLOY- MENT POTEN- TIAL	UTILISATION STATUS (NUMBER OF PARTIES)	
							RELEASED TO	IN PRODUCTION
8.	Food,weaning malted (for infants) (CFTRI,Mysore)	Ragi and green gram	In production (small)	Rs.4,00,000/ t per day	Electricity 85 kW/day Fuel oil 120 litres/day Water 20,000 litres/day	40	3	2
9.	Food colours, plant based (CFTRI, Mysore)	Turmeric, Kokum,Beetroot, etc.	Available (small)	Rs.15,00,000/ 2.8 t of raw material per day	Electricity 350 kW/day Water 12,000 litres/day Oil 400 litres/day	20	-	-
10.	Fruits & Vegetables, dehydration of (CFTRI,Mysore)	Fruits & vegetables	In use (small)	Rs.7,18,000/ 500 Kg per day	Electricity 200 kW/day Water 15,000 litres/day	54	Several	Several
11.	Grapes, sun dried (CFTRI, Mysore)	Grapes, preservative	In production (cottage)	Rs.3,000/100 Kg per day	Solar	Self Employment	1	1
12.	Liquid fruits (CFTRI,Mysore)	Apple,banana, guava,grape, etc.	In production (small)	Rs.1,00,000/1000 bottles (200 ml) per day	Electricity 25 kW/day Water 2,500 litres/day	8	10	1
13.	Maize mill including destoner (CFTRI,Mysore)	Maize	Destoner in production (small)	Rs.2,00,000/ 400 kg of maize grain per hour	Electricity 304 unit/day	8	46	3
14.	Papain (CFTRI,Mysore)	Papaya latex	In production (small)	Rs.1,50,000/ 25 kg of latex per day	Electricity 135 kW/day	39	12	2
15.	Papain, crystalline and concentrate (RRL, Hyderabad)	Papaya latex	In production (small)	Rs.9,00,000/ 500 g of crystalline and 500 kg of concentrate per annum	Electricity 700 kW/day	28	4	1

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							RELEASED TO	IN PRODUCTION
16.	Pectin, peel oil, and calcium citrate (CFTRI, Mysore)	Lime(citrus <u>aurentifolia</u> )	In production (small)	Rs.16,00,000/ 4 t of lime per day yielding i) Cal.citrate 24 t ii) Pectin 15 t iii) Oil 1800 litres	Electricity 350 kW/day Steam 7t/day Water 50,000 litres/day	73	4	1
17.	Potato chips, dehydrated (CFTRI, Mysore)	Potato	In production (cottage)	Rs.15,000/50kg chips per day	Solar (Sun drying)	4	Several	Several
18.	Potato chips, fried (CFTRI, Mysore)	Potato, refined groundnut oil	In production (cottage) (small)	Rs.7,000/20 kg chips per day Rs.2,00,000/ 500 Kg chips per day	Negligible Electricity 100 kW/day Water 25,000 litres/day Fuel Oil 600 t/day	3 7	1	1
19.	Pulse mill, modern (CFTRI, Mysore)	Pulses	In production (small)	Rs.3,00,000/ 8 t pulses per day	Electricity 680 units/day Water 350 litres/day	12	8	2
20.	Raisins (NBRI, Lucknow)	'Pusa' seedless grapes	Available (small)	Rs.80,000/30-40kg of raisins per day	Electricity 5 kW/day	5	-	-
21.	Rice mill, mini (CFTRI, Mysore)	Paddy (Rough Rice)	Plant in production (small)	Rs.50,000/ 500 kg of paddy per hour	Electricity 65 kW/day	5	43	2
22.	Sesame seed, dehulling of, (CFTRI, Mysore)	Sesame seeds	Released (small)	Rs:20,00,000/ 5 t seeds per day	Electricity 450 kW/day Steam 16 t/day Water 50,000 gal/day.	35	1	-
23.	Walnuts, processing of (CFTRI, Mysore)	Green walnuts	Machine in use (cottage)	Rs.25,000/t per day	Electricity 300 kW/day	10	Several	Several

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							RELEASED TO	IN PRODUCTION
24.	Wax emulsion, for increasing shelf life of fruits and vegetables (CFTRI,Mysore)	Fruits and vegetables, emulsifiers, fungicides, and wax	In production (cottage)	Rs.10,000/20 litres per day	Electricity 5 kw/day	4	3	1
25.	Wheat milling (CFTRI,Mysore)	Wheat	Released (cottage)	Rs.35,000 - 40,000/300 kg wheat per day (R house chift)	Electricity 25 kw/day	4	11	-

## SPICE-BASED TECHNOLOGIES

Spices occupy the pride of place in Indian culinary. Many spices are also used for medicinal and other homestead uses. Concentrated spice products are increasingly used by the food industries for adding flavour, aroma, colour and taste to foods. Production of natural food colours from spices, viz. red colour from chillies, assumes significance in view of the opinion against the use of synthetic colours in food. A process for producing spice oils used for giving extra flavour to meat products has also been developed. For preparing this, some of the 'rejects' obtained during grading of species like cardamom or pepper can also find use. Products such as high quality spice oleoresins and oils, dehydrated green pepper with its characteristic flavour and colour, etc., are some other products which have brought added economic gains to the producers. Science and technology has thus helped in increased work opportunity and income.

## SPICE-BASED TECHNOLOGIES

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							RELEASED TO	IN PRODUCTION
26.	Asafoetida (Hing), powder/tablets (CFTRI,Mysore)	Asafoetida (oleogum resin obtained from root of Ferale plants)	In production (small)	Rs.1,10,000/ 200 kg resin per day	Electricity 160 kW/day	12	1	1
27.	Chilli, drying of (CFTRI,Mysore)	Chillies	In use (small)	Rs.61,000/130 kg per day	Solar Water 1,500 litres/day	50	1	1
28.	Chilli oleoresin, high pungent fraction and colour of (RRL,Trivandrum)	Dried chillies	Released (small)	Rs.22,00,000/t chillies per day	Electricity 475 kW/day Light diesel oil 70 litres/day	30	3	-
29.	Garlic powder (CFTRI,Mysore)	Garlic bulbs	In production (small)	Rs.1,30,000/ 225 kg powder per day	Electricity 500 kW/day Water. 5,000 litres/day	25	17	3
30.	Ginger,drying & powdering of (CFTRI,Mysore)	Ginger	In use (small)	Rs.3,80,000/ 1.2 t of raw ginger per day	Electricity 1,500 kW/day	7	Several	Several
31.	Mustard powder (CFTRI,Mysore)	Mustard seeds	In production (small)	Rs.3,45,000/ 500 kg mustard seeds per day	Electricity 150 kW/day Steam 1 t/day Water 5,000 litres/day	8	3	1
32.	Pepper,green, canning and bottling of (RRL,Trivandrum)	Fresh green pepper	In production (small)	Rs.9,50,000/ 60 t per annum (60 working days)	Electricity 30 kW/day Light diesel oil 120 litres/day Water 5,000 litres/day	16	5	5

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							RELEASED TO	IN PRODUCTION
33.	Pepper, green, dehydrated (CFTRI, Mysore)	Fresh green pepper	In production (small)	Rs.3,28,000/t pepper per day (150 working days)	Electricity 1,20,000 kW/annum Coal 20 t/annum	18	23	4
34.	Pepper, green, dry packed (RRL, Trivandrum)	Fresh green pepper	Released (small)	Rs.1,55,000/15 t per annum	Electricity 5,000 kW/annum	6	2	-
35.	Pepper, powder (white) from black pepper (RRL, Trivandrum)	Dry black pepper	Released (small)	Rs.6,30,000/300 kg of black pepper per day (8 hours shift)	Electricity 185 kW/day Light diesel oil 100 litres/day	12	1	-
36.	Spice oleoresins (CFTRI, Mysore)	Pepper, ginger turmeric, chillies, etc.	In production (small)	Rs.12,00,000/t of raw material per day	Electricity 180 kW/day Fuel oil 350 litres/day Water 8,000 litres/day	27	26	7
37.	Spice oil (CFTRI, Mysore)	Cardamom, pepper and ginger	In production (small)	Rs.2,50,000/500 kg per day (100 working days)	Electricity 300 kW/day	10	7	2
38.	Turmeric, curing and polishing of (CFTRI, Mysore)	Turmeric fingers	In use (small)	Rs.90,000/500 kg raw material per day	Electricity 300 kW/day	10	Several	Several

## MUSHROOM CULTIVATION AND PROCESSING

Mushroom cultivation in a predominantly vegetarian and undernourished country like India is very important as these edible fungi contains 26-42 per cent protein (dry weight basis) with an excellent composition of amino acids, minerals and vitamins. Moreover, the protein quality is such that much of it is digestible. Cultivation of mushrooms has become popular among housewives, not only to enrich diet, but also to supplement the family income. A number of varieties suitable for cultivation in different agro-climatic zones have been developed. These include for example, button mushroom (*Agaricus bisporus*) and dhingiri (*Pleurotus sajorcaju*) which can be grown easily by rural people. The dhingiri variety gets ready for harvest within 20-25 days in a thatched hut under moderate conditions of temperature (21-28°C) and relative humidity (55-75 per cent). Thus mushrooms can be grown practically throughout the year by adjusting different varieties at different times of the year. However, cultivation is not encouraged during rainy season as chances of infection are high.

The main requirement in mushroom cultivation is the appropriate culture or seed. A ramified mycelium kept alive in pure conditions is used as seed (spawn). This is available on demand from RRL (Jammu), NBRI (Lucknow), RRL (Jorhat) and CFTRI (Mysore). These laboratories organise training programmes on mushroom cultivation.

## MUSHROOM CULTIVATION AND PROCESSING

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							RELEASED TO	IN PRODUCTION
39.	Mushroom,cultiva- tion of (NBRI, Lucknow)	1) <u>Volvariella</u> <u>sp.</u> ) spawn and paddy straw	Released (cottage)	Rs.15/bed for cultivation of 3 kg mushroom	-	Self- Employment	Several	-
		2) Button ( <u>Agari- cus bisporus</u> ) spawn,wheat straw,sawdust and wheat bran	-do-	Rs.20-25/tray for cultivation of 3 kg mushroom (period about 60 days)	-	-do-	-do-	-
		3) Dhingri ( <u>Pleurotus</u> <u>sajorcaju</u> ) spawn and paddy straw	-do-	Rs.15/tray for cultivation of 3 kg mushroom (period about 30 days)	-	-do-	-do-	-
		4) <u>Pleurotus</u> <u>flabbelatus</u> ) spawn, paddy straw,oat meal and polythene bags.	-do-	-do-	-	-do-	-do-	-
40.	Mushroom,preser- vation of, by canning, dehy- dration, pickling and soup manufacture (RRL, Jammu)	Fresh mushroom	Released (small)	Rs.2,75,000/ 450 kg. fresh mushroom for 180 days	Electricity 20 hp Water 2 kl/day	24	Several	-
41.	Mushroom, dehydration of (RRL,Jammu)	Fresh mushroom	Released (cottage)	Rs.12,000/ 180 kg fresh mushroom per day	Solar,Wood & Coal marginal	4	Several	-



S.NO.	TECHNOLOGY/TECHNIQUE (LABORATORY)	MAIN FEED STOCK/RAW MATERIAL	STATUS/SCALE OF TECHNOLOGY	COST/CAPACITY OF PLANT	ENERGY SOURCE/ REQUIREMENT	EMPLOY- UTILISATION STATUS (NUMBER OF PARTIES)	
						POTENTIAL	RELEASED TO IN PRODUCTION
42.	Mushroom, cultivation* and processing of (CFTRI, Mysore)	Master spawn, nutrients, paddy straw and packaging material	In use (cottage)	Rs.50,000/50 kg fresh mushroom per day	Electricity 5 units/day Water 1,000 litres/day Fire wood 20 kg/day	Self Employment	1 1

\* Pleurotus sajorcaju variety of mushroom can be cultivated and harvested within 20-25 days in thatched hut under moderate conditions of 20-28°C temperature and relative humidity of 55-75 per cent. It can be grown for 6-8 months in a year at an estimated cost of Rs. 5/kg of mushroom.

## FERMENTATION-BASED TECHNOLOGIES

Fermentation is the earliest known process of converting one organic substance into another by micro-organisms or enzymes of vegetable or animal origin. The techniques have been employed since ancient times in the production of curd, cheese, vinegar and alcoholic beverages and in food-seasoning. Modern fermentation technology has, however, been used for manufacture of a variety of products. Some of these developed by CSIR laboratories are citric acid, ethanol, vitamins, baker's yeast, wines, cider, fermented beverages, etc.

Great potential for promotion of fermentation industries exists in rural areas where substrates like rice, maize, potato, tapioca, malt barley, cashew apple, toddy, grapes, pineapple, molasses, etc. are available. There are some technologies which have possibility of application and promotion in rural areas for fermentation industries.

## FERMENTATION-BASED TECHNOLOGIES

S.NO.	TECHNOLOGY/TECHNIQUE(LABORATORY)	MAIN FEED STOCK/RAW MATERIAL	STATUS/SCALE OF TECHNOLOGY	COST/CAPACITY OF PLANT	ENERGY SOURCE/ REQUIREMENT	EMPLOYMENT POTENTIAL	UTILISATION STATUS (NUMBER OF PARTIES)	
							RELEASED TO	IN PRODUCTION
43.	Amylo-glucosidase (CFTRI, Mysore)	Strain of <u>A. niger</u> wheat bran	In production (small)	Being estimated	-	-	3	2
44.	Curd, ready mix for quick setting of, (CFTRI, Mysore)	Chemicals	Released (cottage)	Cost of mix works out to be 35 paise for making curd out of 1 litre of milk	-	-	1	-
45.	Microbial rennet (CFTRI, Mysore)	Strain of rhizopus	Released (small)	Being estimated	-	-	1	-
46.	Orange, comminuted beverage base (CFTRI, Mysore)	Mandarin oranges	Released (small)	2.8 t oranges per day	Electricity 100 kW/day Steam 1 t/day	10	1	-
47.	Pectic enzyme (CFTRI, Mysore)	<u>Aspergillin</u> , wheat bran	In production (small)	Rs. 4,60,000/35 litres concentrate per day	Electricity 300 kW/day Coal 0.05 t/day Water 30,000 litres/day	12	4	2
48.	Vinegar from pineapple waste, or any sugary material (CFTRI, Mysore)	Pineapple peels, corncobs, nutrients, bottles, etc.	In production (cottage)	Rs. 30,000/t per day.	Water 5,000 litres/day	Self Employment	1	1

## FOREST-BASED TECHNOLOGIES

Forests, with the proposed afforestation programmes, are inexhaustible source of raw materials for a variety of industries — pulp, paper and boards, aromatic and medicinal products, rosin and turpentine, non-edible oilseeds and the most important timbers and fuel. The economics of production, however, depends on the location of user industries. There are certain industries which could be appropriately located close to the forest areas and can be managed there by the local people. Such industries could utilise the un-used forest products like pine needles, waste-wood, etc., for production of value-added products like boards, packing cases, etc. The flowers and seeds can also be used for manufacture of industrial products like essential oils, gums and non-edible oils. The processes developed in CSIR laboratories and expertise available can thus be advantageously utilised for promotion of such production units.

## FOREST-BASED TECHNOLOGIES

S.NO.	TECHNOLOGY/TECHNIQUE(LABORATORY)	MAIN FEED STOCK/RAW MATERIAL	STATUS/SCALE OF TECHNOLOGY	COST/CAPACITY OF PLANT	ENERGY SOURCE/ REQUIREMENT	EMPLOYMENT POTENTIAL	UTILISATION STATUS (NUMBER OF PARTIES)	
							RELEASED TO	IN PRODUCTION
49.	Board, fibre, for packing purposes (RRL, Jammu)	Pine needles	Released (small)	Rs.25,00,000/ 4.8 t raw material per day	Electricity 250 hp Coal 1 t/day	50 direct 100 indirect	5	-
50.	Board, paper (RRL, Jammu)	Paddy/wheat straw, bagasse, pine needles, etc.	In production (small)	Rs.8,00,000/ 2.5 t per day	Electricity 120 hp Coal 1 t/day Water 150 kl/day	16	8	4
51.	Board, straw (RRL, Hyderabad)	Waste paper, grass and straw	In production (small)	Rs.3,00,000/ 500 kg of board per day	Electricity 500 kW/day Water 250 kl/day	12	Several	Several
52.	Cedarwood oil (RRL, Jammu)	<u>Cedrus deodara</u>	In production (small)	Rs.2,50,000/ 20 kg per day	Electricity 5 hp Coal/fuel wood 100 t/annum	10	10	3
53.	Gum from 'dhaincha' (sesbania <u>bispinosa</u> ) (IARI, Lucknow)	Dhaincha seeds	Available (small)	Rs. 2,50,000/t seed per day	Electricity 20 kW/day	50	-	-
54.	Pine wool (RRL, Jammu)	Pine needles	Released (small)	Rs.3,80,000/ 1.6 t dry needles per day	Electricity 50 hp Coal 100 t/annum	16	4	-
55.	Resin, distillation of, and hardened rosin, production of (RRL, Jammu)	Chir-resin	In Production (small)	Rs. 5,00,000/t per day of resin distillation and Rs. 10,00,000/t per day of hardened rosin	Electricity 15 hp Coal 100 t/annum.	20	5	3
56.	Tamarind powder (CFTRI, Mysore)	Tamarind pulp	In production (small)	Rs.3,00,000/ 500 kg per day	Electricity 450 kW/day Water 7,000 litres/day	25	17	5

## POULTRY-BASED TECHNOLOGIES

The poultry industry, which provides eggs and broilers, has benefited well from the results of research both for breeding of improved stocks and processing of eggs and poultry meat. Poultry-based technologies basically include techniques for advantageous utilisation of poultry products. These cover processing and preservation of chicken meat and eggs as well as formulation and quality control of poultry feed. Storage of poultry products for a longer time, particularly in the hot climate prevalent in India, has been investigated. Simple equipment has also been devised for use by small-scale poultry farmer to prepare ready-to-cook broilers. Formulations have been standardised for products such as chicken curry, chicken sausage, chicken sticks and 'tandoori' chicken. Technologies have also been developed for producing egg powder for ready and convenient use; egg coating oil to double the storage life of eggs and maintain their quality; egg washing powder to remove dirt and microbial load from egg surfaces and egg albumen flakes for use in offset printing, leather tanning and as adhesives in crown cap manufacture.

## POULTRY-BASED TECHNOLOGIES

S.NO.	TECHNOLOGY/TECHNIQUE(LABORATORY)	MAIN FEED STOCK/RAW MATERIAL	STATUS/SCALE OF TECHNOLOGY	COST/CAPACITY OF PLANT	ENERGY SOURCE/ REQUIREMENT	EMPLOYMENT POTENTIAL	UTILISATION STATUS (NUMBER OF PARTIES)	
							RELEASED TO	IN PRODUCTION
57.	Broilers,dressing of (CFTRI,Mysore)	Broiler chicken	In use Poultry dressing gadgets developed (cottage)	Rs. 30,000/ 150-200 birds per day	Electricity 10 kW/day Water 2,000 litres/day	10	Several	Several
58.	Egg albumen flakes (CFTRI,Mysore)	Egg	In production (small)	Rs.4,00,000/ 40 kg flakes per day	Electricity 100 kW/day Water 10,000 litres/day	8	8	1
59.	Egg coating oil (CFTRI, Mysore)	Petroleum product, preservatives	Released (small)	Rs. 1,00,000/ 1000 litres per day	Electricity 40 kW/day	6	3	-
60.	Egg shell powder (CFTRI,Mysore)	Egg shells	In production (small)	Rs.60,000/ 100 kg per day	Electricity 60 kW/day Water 4,000 litres/day	7	1	1
61.	Egg washing powder (CFTRI,Mysore)	Detergent	Released (Cottage)	Rs.2,000/ 10,000-15,000 eggs per day	Electricity 30 kW/day Water 2,000 litres/day	4	2	-
62.	Poultry feed (CFTRI,Mysore)	Cereals, millets, oil seed cakes and molasses	In production (small)	Rs.3,70,000/ 9 t feed per day	Electricity 90 kW/day	10	5	1

## MARINE-BASED TECHNOLOGIES

**Fish-based technologies :** CSIR technologies in this area aim at generating additional food resources from aquaculture and fish industry including improved techniques of processing, preservation, packaging, storage, distribution and gainful utilisation of low market value fishes. Methods of freeze drying of shrimps and fish meal and good quality oil from sardine have been standardised. The CFTRI process on pre-treatment of fishes with a curing mixture followed by sun-drying or mechanical drying of mackerel has helped increase the storage life of fish to about seven months without impairing its quality. The technologies from CFTRI, Mysore and RRL, Bhubaneswar enable economic utilisation of low grade fishes and fishery waste in the manufacture of fish meal, which forms a proteinous supplement in livestock and poultry feeds. In view of the increasing demand for fish meal and oil, there is scope for promoting such production units in coastal areas.

RRL, Jammu has successfully introduced five well acclimatized freshwater fish varieties, never grown earlier in the Jammu region. The Laboratory was the first to start production and supply of fish seeds for table varieties, viz. Rohu, Catla and Mrigal in Jammu & Kashmir State. In association with the State Government and co-operation of the village people, some rural ponds and lakes have been stocked with fingerlings of these fishes providing an additional source of income to the fishermen.

NIO, Goa has expanded fisheries resources in the waters of Goa, Konkan, Gujarat and Kerala which has helped fishermen to reap a rich harvest of fishes and prawns in coastal waters. Improvements have been made in the traditional technique of paddy-cum-prawn culture. The technology pertains to improvisation of traditional practices involving high stocking density and short term culture of *Pencus indicus* in 25 metre square plastic netting enclosures in a paddy-cum-prawn pond. With the improved technology, the yield of prawn increased to 1,750 kg as against 800 kg per ha/year in traditional practices. Here, the stocking density is maintained at 20 prawns per square metre and the feed used is groundnut oil cake. It has been also possible to take two harvests a year.



**Other Marine-based technologies :** The long and extensive sea coast of the country is a rich source of varied marine plants, seaweeds and fishes. The importance of seaweeds as cattle feed, manure, human food, and gelforming substances like agar-agar and algin and of late as a source of energy has been well recognised in the country's economic development. CSMCRI, Bhavnagar has developed technologies for seaweed products such as agar-agar, sodium alginate, alginic acid and alginates.

Another significant contribution of CSMCRI is the utilization of sea-water and sand dunes for cultivation of food and economic crops of importance. The Institute has successfully cultivated bajra, onion and jajoba (an oil-bearing plant) in sand dunes.

Sea-farming involving the application of the principle of animal husbandry to the marine environment is a new area for coastal rural development. This has created a potential for generating additional work opportunity, income and employment. Although exploitation of sea resources has traditions well-rooted in the past, it is only recently that sea farming or mariculture has been considered as a potential area for development and growth. To this end, NIO, Goa has undertaken R&D work in different aspects of mariculture covering sea-weeds, shell-fishes and finfishes. The culture of bivalves (mussels, oysters and clams) has given the most promising result so far. Rope culture of green mussels resulted in a high yield of 480 tonnes per hectare a year. Experiments have shown the possibility of getting three crops of mussels a year with the rate of return as high as about 80 per cent on a low initial investment. The culture of the grain edible oyster *Crassostrea gryphoides* when grown either on suspended ropes, trays or sandwich nets has shown a cut of 40 per cent time on large scale production. NIO has also developed technology for culturing agarophytes and alginophytes on coir nets in the coastal region.

CSMCRI has developed techniques for the cultivation of enteromorpha, an economically important algal seaweed in intertidal belts of the coast as well as in artificial ponds on land. The plants cultivated on nets produce biomass of 900-1718 g fresh weight per square metre area of the net in 6-8 weeks during winter season. Three crops can be produced in a year without being given any fertilizer treatment. One hectare of coast can produce 1.9 tonnes of dry alga a year.

In artificial ponds, plants can be cultivated on nylon threads. A biomass of 916-1226 g and sometimes up to 1775 g per square metre area of the pond can be obtained in 5-6 weeks. Six to seven crops can be obtained in a year. One hectare of pond can produce 8.6 tonnes of dry alga a year.

## FISH-BASED TECHNOLOGIES

S.NO.	TECHNOLOGY/TECHNIQUE(LABORATORY)	MAIN FEED STOCK/RAW MATERIAL	STATUS/SCALE OF TECHNOLOGY	COST/CAPACITY OF PLANT	ENERGY SOURCE/ REQUIREMENT	EMPLOY- MENT POTENTIAL	UTILISATION STATUS (NUMBER OF PARTIES)	
							RELEASED TO	IN PRODUCTION
63.	Chitosan (CFTRI,Mysore)	Prawn and squilla waste	Released (small)	Rs. 9,90,000/10 t per day	Electricity 300 kW/day Water 15,000 litres/day Steam 4 t/day	30	1	-
64.	Fish mackerel and Bombay duck, sun drying and curing of (CFTRI,Mysore)	Fish	In use (cottage)	Rs.7,000/100kg fish per batch	Solar	3	Several	Several
65.	Fish meal and oil from sardine (CFTRI,Mysore)	Sardine and fish waste	Released (small)	Rs.8,76,000/30 t of raw material per day	Fuel oil 330 kl/day Electricity 160 kW/day	36	1	-
66.	Fish meal for poultry feed (RRL,Bhubaneswar)	Low grade fishery wastes	In production (cottage)	Rs. 6,700/50 kg fish meal per day	Firewood 150 kg/day	6		
67.	Fish pickle, improved processing of (CFTRI,Mysore)	Fish (fleshy) cooking oil, salt & spices	Released (cottage)	Rs.20,000/100 kg per day	Electricity 50 kW/day	10	1	-
68.	Fish sausages (CFTRI,Mysore)	Fish and animal casings	In use (small)	Rs.1,10,000/40 kg sausages per day	Electricity 40 kW/day	3	Several	Several
69.	Paddy-cum-shrimp culture (in paddy fields near sea shore) (NIO,Goa)	Fast growing shrimp seeds (P.indicus) fish and shrimp waste meal, ground nut oil cake, rice/wheat bran and tapioca flour	Available (field)	Rs.6,500/965 kg shrimp per hectare per year (Nov.-April)	-	Self Employment	-	-

## OTHER MARINE-BASED TECHNOLOGIES

S.NO.	TECHNOLOGY/TECHNIQUE(LABORATORY)	MAIN FEED STOCK/RAW MATERIAL	STATUS/SCALE OF TECHNOLOGY	COST/CAPACITY OF PLANT	ENERGY SOURCE/ REQUIREMENT	EMPLOY-UTILISATION STATUS (NUMBER OF PARTIES)		
						POTENTIAL	RELEASED TO	IN PRODUCTION
70.	Agar-agar from Indian sea weeds (CSMCRI, Bhavnagar)	Sea weeds ( <u>Gracilaria</u> )	In production (small)	Rs.4,23,000/10 kg per day	Electricity 75 kW/day Water 45,000 t/day Steam 1 t/day	5	10	5
71.	Jajoba ( <u>Simmondsia chinensis</u> ) CULTIVATION of, for liquid wax (CSMCRI, Bhavnagar)	Jajoba seed Coastal sand dune and water	Available (field)	Rs.15,000 for cultivating 2.5 ha/year	Diesel 12.5 litres/day Electricity 12-17 kW/day (for lifting water for irrigation-120 acre inch per annum)	6250 man days for 10 years	Being cultivated in the farm of the Institute	
72.	Vegetables and crops, cultivation of (CSMCRI, Bhavnagar)							
	i) Bajra, Babapuri ( <u>Pennisetum typhoides</u> ) (17,000-24,000 ppm of sea water)	Seeds, sand dunes, sea water	Available (field)	Rs.4,070 for cultivating 2.5 ha, yielding grain 14-16 q/ha. Fodder 3-4 t/ha	-	Additional employment generation project	Being cultivated in the farm of the Institute	
	ii) Onion (white) ( <u>Allium cepa</u> Linn) (10,000 ppm of sea water)	-do-	-do-	Yield 10-15 t/ha	-	150 man days for 150 days	-do-	
	iii) Sugar beet (10,000-15,000 ppm of sea water)	-do-	-do-	Yield 12 t/ha	-	-do-	-do-	

## MEDICINAL AND AROMATIC PLANTS

Most of the rural population is dependent on traditional systems and folk medicine wherein more than 90 per cent of the medicines are obtained from plants. With a view to building technological bridges in this field, CSIR laboratories have paid greater attention to screening, isolation of biologically and chemically active compounds, and pharmacological and toxicological testing of the selected medicinal plants. This also involved development of suitable agrotechnology for cultivation of these plants to achieve quality control, standardisation of primary processing and production of raw materials for other industries. Successful R&D in this field has eventually led to establishment of large-scale cultivation of medicinal plants, their primary processing at the source of cultivation and final production of active principles of end products. This venture not only provided increased income and extended work opportunities at rural level, but has also provided cheaper health-care products. Cultivation of some of the selected medicinal plants could be undertaken along with other conventional crops without replacement of food crops. One could envisage a "scientific rural medicinal system" based on an integrated scheme covering cultivation/collection, production, processing and dispensing, taking full advantage of the stock of knowledge at rural levels.

Similarly, there is considerable scope for cultivation of aromatic/essential oil bearing plants as subsidiary cash crops which can provide additional job opportunities to skilled and unskilled persons.

## CULTIVATION OF MEDICINAL PLANTS

S.NO.	PLANT LABORATORY	SOIL/CLIMATE	DURATION OF CROP	YIELD PER HECTARE (AVERAGE)	COST OF CULTIVATION PER HECTARE	EXPECTED PROFIT PER ANNUM/HA	UTILISATION STATUS PRODUCTION/ ANNUM
73.	Belladonna ( <i>Atropa</i> sp.) (CIMAP,Lucknow)	Deep fertile soil of medium texture and temperate climate	3 years	Leaves - 100 kg/yr Roots after 3 years - 100 kg	Ist year Rs.3,500 Subsequent years Rs.2,500	Rs.7,500 after 3 years (Leaves @Rs.5/kg Roots @Rs.10/kg)	Grown at CIMAP farms
74.	<u>Dioscorea</u> Species (CIMAP,Lucknow)						
	i) <u>Dioscorea floribunda</u> Mart. & Gall.	Medium loam deep soils	2 years	Dried tubers after 2 years - 6 t	i) Ist year Rs.12,500 2nd year Rs.5500 ii) Capital cost for erection of trellis Rs.20,000	Rs.12,000 after 2 years (@Rs.5/kg of tubers)	Grown by one firm in Bangalore
	ii) <u>Dioscorea deltoidea</u> wall.	Medium loam deep soils	3 years	Dried tubers after 3 years -5t	i) Ist year Rs.10,000 Subsequent years Rs.4,000 ii) Capital cost for erection of trellis Rs.20,000	Rs.12,000 after 3 years (@Rs.6/kg of tubers)	-
75.	<u>Pyrethrum</u> ( <i>Chrysanthemum cinerariaefolium</i> Vis.) (CIMAP,Lucknow)	Fertile deep and well drained soil, mild cool climate 10-24°C; Annual rainfall 1000 mm, but well distributed	5 years	i) Flowers 220 kg/yr. with pyrethrins content of 1.0 percent in Kashmir ii) Flower 440 kg/yr in Nilgiris with pyrethrins contents of 1.5 per cent	Ist year Rs.1,600 Subsequent years Rs.1,000 (average) Rs.1200  -do-	Rs.1,000 (@Rs.6/kg of flowers)  Rs.4,000 (@Rs.12/kg flowers)	Being cultivated in Kashmir
76.	Periwinkle ( <u><i>Catharanthus roseus</i></u> ) L.G.Don) (CIMAP,Lucknow)	All types of soils, except saline/alkaline	1 year	Roots - 750 kg Leaves 2000 kg (rainfed)	Rs.2,000	Rs.7,500 (@ Rs.10/kg of roots; @ Re.1/kg of leaves)	Released to 50 farmers

S.NO.	PLANT (LABORATORY)	SOIL/CLIMATE	DURATION OF CROP	YIELD PER HECTARE (AVERAGE)	COST OF CULTIVATION PER HECTARE	EXPECTED PROFIT PER ANNUM/HA	UTILISATION STATUS PRODUCTION/ ANNUM
77.	Serpentina root ( <u>Rouwolfia</u> <u>serpentina</u> Benth <u>ex</u> Kurz) (CIMAP, Lucknow)	Sandy allu- vial loam to red lateri- tic loam, acidic and neutral soil, hot and humid tropical climate.	2 years	Dried roots after 2 years - 100 kg	Rs.7,500 for 2 years	Rs.12,500 after 2 years (@ Rs.20/kg) Seeds are also saleable (@ Rs.100/Kg)	

## CULTIVATION & PROCESSING OF AROMATIC PLANTS

S.NO.	PLANT (LABORATORY)	SOIL/CLIMATE	DURATION OF CROP	YIELD PER HECTARE (AVERAGE)	COST OF CULTIVATION PER HECTARE	EXPECTED PROFIT PER ANNUM/HA	UTILISATION STATUS PRODUCTION/ ANNUM
78.	<u>Geranium</u> ( <u>pelargonium</u> <u>graveolens</u> L. Her.ex.Ait) (CIMAP,Lucknow)	Well drained porous soil; mediterranean type of mild climate with low humidity, warm winter and mildsummer temperature, annual rainfall 1000-1500mm	4-5 years	Oil-18 kg /annum	Ist year Rs.7,000 Subsequent years Rs.6,000	Ist year Rs.10,700 Subsequent years Rs.12,000 (@Rs.800/kg)	20 t
79.	Japanese mint ( <u>Mentha</u> <u>arvensis</u> L. <u>subsp.haplocaly</u> Briquet var. <u>piperascens</u> (Holmes) (CIMAP,Lucknow)	Medium,deep soil pH 6-7.5 with adequate irrigation, tropical and sub-tropical climate	8 months	Oil-75 Kg/annum	Rs.3,000/annum	Rs.5,000 (@ Rs.100/ kg. of oil)	400 t
80.	Java citronella ( <u>Cymbopogon</u> <u>winterianus</u> Jowitt) (CIMAP,Lucknow)	Sandy loam pH 5.8 to 8, tropical and sub-tropical climate, annual rainfall 200-250 cm,well distributed or assured irrigation, altitude 180-1200 m.	4 years	Ist year Oil-100 kg Subsequent years Oil-150 kg	Ist year Rs.7,000 Subsequent years Rs.6,000	Rs.6,000 (@ Rs.800/kg of oil)	400 t
81.	Lemon grass ( <u>Cymbopogon</u> <u>flexuosus</u> (Steud.) wats) (CIMAP,Lucknow)	Sandy loam soil; warm & humid climate; altitude 900-1200m;	6 years	Oil - 75-100 kg/annum	Rs. 3,000/annum (@ Rs. 70/kg of oil)	Rs.3,000	650 t

S.NO. PLANT (LABORATORY)	SOIL/CLIMATE	DURATION OF CROP	YIELD PER HECTARE (AVERAGE)	COST OF CULTIVATION PER HECTARE	EXPECTED PROFIT PER ANNUM/HA	UTILISATION STATUS PRODUCTION/ ANNUM
	annual rain- fall 250-300 cm, well distributed or assured irrigation					
82. Palmarosa ( <u>Cymbopogon martinii</u> var. <u>motia</u> ) (CIMAP, Lucknow)	Loamy soil; annual rain- fall about 150 cm or assured irrigation	4 years	Oil-50 kg/annum	Rs.2,500/annum	Rs.6,000 (@ Rs. 160/kg of oil)	-
83. Peppermint ( <u>Mentha piperita</u> L.) (CIMAP, Lucknow)	Medium deep soil; pH 6-7.5 with adequate irrigation; tropical & sub-tropical climate/ temperate climate	3 years	Oil-50 kg/annum	Rs.3,000/annum	Rs.7000 (@ Rs.200/kg of oil)	20 t



## PLANT DRUGS AND ESSENTIAL OILS TECHNOLOGIES

Plant drugs and essential oils have been time-honoured products from ancient Indian industry. CSIR has developed improved designs of distillation stills and scientific techniques which are helpful in improving the quality of products and reducing the cost.

Essential oils or their active constituents find use in perfumery, flavouring, pharmaceutical and cosmetic industries. For example, Japanese mint is a source of natural menthol, which is extensively used in pharmaceutical and cosmetic preparations. It is also used as a flavour in chewing gums, toothpastes, tobacco and *pan masala*. Peppermint oil, which is obtained from *Mentha piperita*, finds use in the flavouring industry. Lemongrass oil is used as such in the perfumery/flavouring industries and it is a source of an important chemical citral, a starting material for the production of vitamin A. More than 100 essential oils obtained from plants are used in perfumery, cosmetic and flavouring industries.

Similarly, medicinal plants have great potential. *Dioscorea deltoidea* and *D. floribunda* contain an important active principle called diosgenin — the starting material for the production of sex hormones, oral contraceptives, etc.; pyrethrum flowers obtained from the plant *Chrysanthemum cinerariaefolium* contain an active principle called pyrethrin and are used as a safe insecticide. Roots of *Rauwolfia serpentina* are a source of a chemical reserpine, which is used for lowering high blood pressure. There are more than 100 plants which are used in modern medicine. The number of plants used in Ayurveda, Siddha and Unani is more than 200.

## PLANT DRUGS

S.NO.	TECHNOLOGY/TECHNIQUE(LABORATORY)	MAIN FEED STOCK/RAW MATERIAL	STATUS/SCALE OF TECHNOLOGY	COST/CAPACITY OF PLANT	ENERGY SOURCE/ REQUIREMENT	EMPLOY- UTILISATION STATUS		
						MENT POTENTIAL	(NUMBER OF PARTIES) RELEASED TO	IN PRODUCTION
84.	Palatable isappgol, granules for laxative (CDRI, Lucknow)	Isappgol (Plantago ovata seed husk)	Available (small)	Rs.50,000 to Rs.1,00,000/ 100 kg per day and upwards	Electricity marginal	5-10	-	-
85.	Pyrethrum for insecticide (RRL, Jammu)	Pyrethrum flowers	In use (small)	Rs.5,00,000/ 50 t flowers per annum	Wood/Coal 100 t/annum	15	2	-

## ESSENTIAL OILS

S.NO.	TECHNOLOGY/TECHNIQUE (LABORATORY)	MAIN FEED STOCK/RAW MATERIAL	STATUS/SCALE OF TECHNOLOGY	COST/CAPACITY OF PLANT	ENERGY SOURCE/ REQUIREMENT	EMPLOY- MENT POTEN- TIAL	UTILISATION STATUS (NUMBER OF PARTIES)	
							RELEASED TO	IN PRODUCTION
86.	Attars, per- fumed water and oil from flowers (NBRI, Lucknow)							
	i) Rose oil/water (from Damask rose)	Fresh flowers of Damask rose ( <u>Rosa dema- scena</u> )	Available (cottage)	Rs.30,000/50 kg flowers dis- tillation per charge (one ha. of plantation yields about 3,000 kg flowers)	Fuel wood 60 q for distilling 3,000 kg flowers	6	-	-
	ii) Jasmine con- crete & absolute	Fresh flowers of Jasmine ( <u>Jasminum grandiflorum Linn.</u> ) Petroleum ether 40-60°C or Normal hexane 65-70°C	Available (small)	Rs. 2,00,000/ 24,000 kg flowers in 4 months in the year	Electricity 5 kWh	5	-	-
87.	Blue oil from <u>Matricaria chamomilla Linn.</u> (NBRI, Lucknow)	Dried flowers	In production (cottage)	Rs.5,000 for growing of 1500 kg flowers on a hectare of land plus Rs.2,500 for distillation plant	Fuel wood 2.25 q for 1,500 kg flowers	10	Several	Cultivation - 100 Processing - 1
88.	Citronella oil (RRL, Jorhat)	Citronella grass	In use (cottage)	Rs.20,000/ 200 kg per batch	Wood/Coal 30 kg /batch	2-3/ha	Consultancy given to 45 parties	
89.	Citronellol (2-3 dihydroge- ranolol) (RRL, Jammu)	Eucalyptus citrodora oil	In production (small)	Rs.2,00,000/ 10 kg of finished product per day	Electricity marginal	10	4	2

S.NO.	TECHNOLOGY/TECHNIQUE(LABORATORY)	MAIN FEED STOCK/RAW MATERIAL	STATUS/SCALE OF TECHNOLOGY	COST/CAPACITY OF PLANT	ENERGY SOURCE/ REQUIREMENT	EMPLOYMENT POTENTIAL	UTILISATION STATUS (NUMBER OF PARTIES)	
							RELEASED TO	IN PRODUCTION
90.	Citrus oil, terpeneless (CFTRI,Mysore)	Citrus oil (lemon/ lime oil/ orange oil)	Available (cottage)	Rs.40,000/ 2 columns deterpentation of 4-8 kg of citrus oil per day	Electricity marginal	2-3	-	-
91.	Essential oil (RRL,Bhubaneshwar)	Lemon grass, citronella, Palmarosa grass,Cinnamon leaves	In production (cottage)	Rs.7,000/100 kg per day	Wood/ Coal 30 kg/day	2		
92.	Menthol (RRL,Jammu)	Mint oil from mentha leaves	In production (small)	Rs.4,00,000/3 t of menthol per annum	Electricity 5 hp	6	39	7
93.	Rose oil (CIMAP,Lucknow)	Rose flowers	Pilot plant (small)	120 kg of flowers per batch, cost being estimated	-	-	-	-

## LEATHER PROCESSING/TECHNOLOGIES

Sl. No. PROCESS (LABORATORY)	TRADITIONAL PROCESS	IMPROVED PROCESS AT RURAL LEVEL
94. Carcass-Processing (CLRI, Madras)		
i) Carcass collection and transport to processing centre	Carcasses are dragged, or transported by a hand-cart, to the village outskirts for flaying. A drawback is that hides in many cases get damaged because of dragging as well as because of delays in flaying. When animals die of natural causes and in places where carts cannot ply, the carcasses have to be removed manually.	A carcass-collection cart with a hoist is recommended. Improvement in design with standard components like wheels, beams, pulleys and rollers for easy transportation of carcasses. For urban use, a jeep with trailer is suggested.
ii) Flaying and curing	<p>Done by an ordinary knife, this is an improper method. The drawbacks are that hides get cuts, and more flesh is left in some parts, such flesh putrefying and damaging the hides.</p> <p>The hides are not cured immediately and are mostly dried in the sun. Sometimes, the salt applied is inadequate, or contaminated, or used salt is re-utilised.</p>	<p>i) Two types of flaying knives should be used: (i) round-edged, and (ii) sharp and pointed. A flaying platform may be provided.</p> <p>ii) To remove blood and dirt, use of 30% NaCl by weight of hides, or a mixture of salt and preservatives, is recommended. This mixture should be applied in 3 parts on the flesh side of hides. There should be washing pits and a good supply of water.</p> <p>iii) A weighing machine should also be provided.</p>
iii) Carcass disintegration, pre-processing/ composting	Flayed carcass is left as such to vultures and dogs and the bones are collected afterwards.	<p>i) Carcass parts should be separated into tallow, bones and flesh for animal feed, manure, horns and hoofs.</p> <p>ii) Where there is no arrangement for carcass cooking, the meat and bone should be buried and the bones recovered later for being sold to bone mills or to those who utilize bones.</p>

Sl. No.	PROCESS (LABORATORY)	TRADITIONAL PROCESS	IMPROVED PROCESS AT RURAL LEVEL
95.	Tanning (CLRI, Madras)	<p>i) Fallen flint hides in mixed lot are used with no proper soaking. Old jawasee/awk bath are used for years and these emanate a very strong foul smell, with the resultant stigma and social problems. It takes 20-90 days for unhairing. Similarly, jawasee treatment is done in two baths, and without being washed it is taken to old (Malni) oza bath.</p> <p>ii) Lime process: Hides are partially soaked and immersed in an old-lime liquor with fresh lime for 15-20 days, unhaird fleshed and washed.</p>	<p>iii) Pre-processing of bone flesh for bone flesh meal plant.</p> <p>iv) Composting of waste for manure.</p> <p>v) Recovery of tallow by scrapping and melting in pan.</p> <p>vi) Preservation of tallow before supply to processing units</p> <p>vii) Recovery of guts for rackets; hair for brushes; hide trimmings, ear, and tails for glue-making; and horns/bones for curios.</p>
	ii) Tanning	<p>Tanning is done by the pit-or bag-tanning method, by using aval or babul bark or any other locally available bark. The drawbacks are that the quantity of bark used is often insufficient, and the leathers are unevenly tanned. As a result, the final products are disfigured with dark patchy colours, while some are hard leathers, with a foul smell.</p>	<p>Tanning is done by the following method using locally available barks:</p> <ul style="list-style-type: none"> <li>i) E.I. tanning</li> <li>ii) Improved bag-tanning</li> <li>iii) Wet-blue chrome</li> <li>iv) Rural chrome process for sole/lace</li> <li>v) 'Novotone' finishing.</li> </ul>

Sl. No. PROCESS (LABORATORY)	TRADITIONAL PROCESS	IMPROVED PROCESS AT RURAL LEVEL
iii) Post-tanning	Salt dissolved in old tan liquor is sprinkled on the flesh side of pit- or bag-tanned leather and dried as such on ground. These are then processed, dried, beaten and stored. The leathers are creasy and uneven in colour, emit a foul smell, and are mostly used for rural footwear, Charas (water-lifting leather bag) and <u>maskh</u> (water container for sprinkling), buckets, and agricultural accessories.	The tanned hides are treated with myrab and oil, using locally available oil, epsom salt, and jaggery. These are hooked for semi-drying, followed by setting by slickers, and are dried. The finished leathers are of uniform light colour, smooth, soft and plain, and are free from foul smell. Thus, this leather can be used for shoes and other footwear and leather products to meet the demand from rural and urban markets.
96 Leather Products (CLRI, Madras)  Footwears and leather goods manufacturing	Desi <u>juti</u> (native shoe), irrigation leather ( <u>charas</u> ), leather bucket, agricultural accessories, etc. are made to meet the local village demand. For this, old traditional tools are used.	With the improved technology, shoes, chappals, sandals, school bags, shoulder bags for upper-class men and women, pouches, waist belts, sport goods like football and volleyball, industrial leather goods, etc. could be produced to meet the demand of rural as well as urban markets. Use of improved tools and improved designs is recommended.
97 Leather-processing management (CLRI, Madras)	Hardly any concept about management except where there is some organised structure. Because of constraints in the availability of sufficient quantities of carcasses within easily transportable reach, processing becomes uneconomical and unproductive.  Rural artisans are also exploited by the urban-based industries and their agents.	Improved management considerations 1) After the death of the animal, its immediate removal from rural homes, farms and other places in the village is absolutely necessary. Hence, appropriate transportation from the place of death to the disposal ground is a must. The expenses in this regard have to be incurred by the owner of carcass, the flayer, the tanner or any agency. Expenditure cannot be avoided even if the carcass is to be buried, and hence need not be brought into the economics of utilisation.

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S1. PROCESS  
No. (LABORATORY)

TRADITIONAL PROCESS

IMPROVED PROCESS AT RURAL LEVEL

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- 2) The development of growth centres with common facility/service centres by location depends on:
  - a) size of procurement of dead animals
  - b) availability of hereditary flayer/leather artisans.
  - c) Promotional objectives and policies and the current consumption pattern of leather goods for local consumption and for catering to urban demand.
  - d) scope of subsidiary occupation to the rural poor.
- 3) Given necessary training, supply of required materials, services, facilities and supervision and R&D support, it is possible to establish a technology appropriate to rural areas.
- 4) By-product utilization should also be organised simultaneously.
- 5) Production and fabrication depend on local demands, nearness to market, ancillary contacts, etc.
  - a) Introduction of improved tools and equipment;
  - b) Utilization of locally available resources and technologies; and
  - c) Introduction of improved and newer designs in combination with traditional crafts/skills would be necessary to help the villager to earn a higher income, which in turn would improve the socio-economic conditions of the rural leather artisans..



## OTHER TECHNOLOGIES

Increasing income through diversification of activities and expanding opportunities for employment are the important elements of rural development. One of the ways of meeting these objectives is through promotion of non-farm technologies which are less capital-intensive, have a short gestation period and can be taken up as decentralised economic activities in rural and backward areas. CSIR scientists have developed such production-oriented technologies, the application of which will not only generate additional work opportunities, but will also provide gainful employment to a large section of rural population which cannot otherwise be absorbed in traditional agriculture. It has, however, to be ensured that indiscriminate multiplication of these technologies is avoided keeping in view the availability of raw materials, energy, skill, consumption and market.

## OTHER TECHNOLOGIES

S.NO.	TECHNOLOGY/TECHNIQUE(LABORATORY)	MAIN FEED STOCK/RAW MATERIAL	STATUS/SCALE OF TECHNOLOGY	COST/CAPACITY OF PLANT	ENERGY SOURCE/ REQUIREMENT	EMPLOYMENT POTENTIAL	UTILISATION STATUS (NUMBER OF PARTIES)	
							RELEASED TO	IN PRODUCTION
98.	Cabinet drier (solar for fruits/vegetables (RRL,Jammu)	Glass pans, black paint, vegetables, fruits	In use (cottage)	Rs.1,600/80 kg per batch (size 2.5 x 2.5 metre ground area)	Solar	Self employment	Several	Several
99.	Cashew nut decorticator (CMERI,Durgapur)	Cashew nut in mild roasted form	Design available (cottage)	Rs. 350 for one shelling unit, excluding mounting and seating arrangement	Manual	Self-employment	-	-
100.	Clay flooring and roofing tiles(Mangalore type) (CBRI,Roorkee)	Alluvial clay of suitable composition	In production (small)	Rs. 1,50,000/75,000 tiles per year (8 hours/day shift)	Wood/Coal 450 t/annum crank press/screw press operated manually	Skilled-2 Unskilled-18	5	5
101.	Cupola,mini (NML, Jamshedpur)	Pig iron, pig iron-scrap and coke	Released (cottage)	Rs.18,000/25 kg per hour molten metal	Electricity 10-15 kW/day	5	3	-
102.	Ferro-cement Unit, grain storage bins, water tanks, septic tanks, biogas digester and holders, etc. (SERC,Roorkee)	Cement,sand water proofing chemicals, wire meshes, M.S.bars/wires	In production (small)	Rs.1,20,000/200 units per month	Electricity 3-5 kW/ Unit	Skilled-6 Unskilled-14 (masons and carpenters)	15	6
103.	Flowers and foliage,de-hydration of (NBRI, Lucknow)	Fresh flowers, foliage etc.	In use (cottage)	Rs. 10,000/50,000 flowers per annum	Electricity 25 kWh	Self-employment	10	1
104.	Hand tools, harvesting and tilling (NML,Jamshedpur)	High/medium carbon steel plates,6 mm approximately	Available (small)	Rs.1,00,000/3-5 t per annum	Electricity 10-15 hp	Self-employment	-	-

S.NO.	TECHNOLOGY/TECHNIQUE(LABORATORY)	MAIN FEED STOCK/RAW MATERIAL	STATUS/SCALE OF TECHNOLOGY	COST/CAPACITY OF PLANT	ENERGY SOURCE/ REQUIREMENT	EMPLOYMENT POTENTIAL	UTILISATION STATUS (NUMBER OF PARTIES)	
							RELEASED TO	IN PRODUCTION
105.	Jute gunny bags, pest-proofing of, (CFTRI, Mysore)	Chemicals	In use (cottage)	Rs.16,000/ treatment of 3000 bags per day	Manual	Self-employment	2	2
106.	Leaf cup/plate making machine (CFTRI, Mysore)	Dry leaves of banana, areca sheets, etc.	In production (cottage)	Rs.3,500/ 3,000 cups per day	Electricity 300 W/day or Kerosene oil	Self-employment	90	3
107.	Mineralised salt lick for cattle (CSMCRI, Bhavnagar)	Salt and minerals	In production (small)	Rs.1,02,000/ 200 salt licks of 2 kg each per day.	Electricity 5.2 kW/day Water 500 kl/day	5	39	15
108.	Musk melon seeds, dehulling of (CFTRI, Mysore)	Seeds of musk melon	Released (tiny)	Rs. 30,000-40,000/ 100 kg of seeds per hr.	Electricity 8 hp	5	-	-
109.	Speciality paper (RRL, Hyderabad)	Cotton rags and cotton linters	In production (small)	Rs.6,50,000/ 270 kg paper per day	Electricity 500 kW/day Water 150 kl/day	108	4	1
110.	Slate, paper (RRL, Jorhat)	Paper boards, wood, resin	In production (cottage)	Rs.15,000/200 slates per day	Electricity 0.02 kW/day	5	58	9
111.	Slate, plastic (RRL, Jorhat)	Plastic sheets, chemicals	In production (small)	Rs.50,000/200 slates per day	Electricity 20 kW/day	5	18	3
112.	Sodium silicate from rice husk ash (I.S.S.) (CGCRI, Calcutta)	Rice husk ash, soda ash	In production (small)	Rs.25,000/0.5 t sodium silicate per day	Electricity 16 kW/day Fuel (Coal) 120 kg/day	4 per shift	8	1
113.	Water filter candles for domestic use (RRL, Jorhat)	China clay and non-plastic material	In production (cottage) (small)	i) Rs.20,000/50 candles per day ii) Rs.6,46,000/ 1000 candles per day	Coal marginal Coal 300 q/annum	4 25	17	2

## UNITS WHICH HAVE GONE INTO PRODUCTION USING CSIR TECHNOLOGIES

Sl. No.	Technology/Technique (Laboratory)	Technology Reference Number	Name of unit
<b>AGRO BASED TECHNOLOGIES</b>			
1.	Castor oil, dehydrated (RRL, Hyderabad)	2	1. Chempack Industries, Pune 2. Premier Oil Mills, Calcutta
2.	Cocoa mass, refined, cocoa powder (CFTRI, Mysore)	3	Mysore Foods & Farms Products P. Ltd., Gokulam Extension Post, Bangalore
3.	Cotton, chemical (RRL, Hyderabad)	7	Cellulose Products of India, Ahmedabad
4.	Food, weaning, malted (for infants) (CFTRI, Mysore)	8	1. Laxmi Narayana Yuvaka Raitha Sangha Sankanahalli, Hassan District 2. Titan Protein Food Formulations Saraswati Puram, Mysore
5.	Grapes, sun dried (CFTRI, Mysore)	11	Thasgaon Vaichyanik Sheti Seva & Drakshakul P. Ltd., Jasgaon, Distt. Sangli
6.	Liquid fruits (CFTRI, Mysore)	12	The Midland Fruits & Vegetables Products (India) P. Ltd., New Delhi
7.	Maize mill including destoner (CFTRI, Mysore)	13	1. Sidhivinayaka Machinery & Equipments, Saraswathi Puram, Mysore

Sl. No.	Technology/Technique (Laboratory)	Technology Reference Number	Name of unit
			2. Srinivasa Engineering Works, 960, Chamundeswari Road, Mysore
			3. Bhavani Agriculture Industries, Ganjam, Srirangapatna Taluk
8	Papain (CFTRI, Mysore)	14	1. Sh. P.C. Gupta, 13th Cross, Kalidasa Road, Mysore
			2. Hussaini Agro Products, Sindkheda, Distt. Dhulia
9.	Papain, crystalline and concentrate (RRL, Hyderabad)	15	South India Research Institute, Hyderabad
10.	Pectin, peel oil and calcium citrate (CFTRI, Mysore)	16	Southern Citrus Products P. Ltd., Raja Street, Gudur
11.	Potato chips, fried (CFTRI, Mysore)	17	Nilgiris Co-operative Marketing Society Ltd., Ootacamund
12.	Pulse mill, modern (CFTRI, Mysore)	19	1. S.K. Engineering & Allied Works, Bahraich
			2. Sak Industries, 33, Technocrats Industrial Estate, Balanagar, Hyderabad
13.	Rice mill, mini (CFTRI, Mysore)	21	1. General Engineering Co., Old Post Office Road, UDUPI, South Kanara
			2. Mysore Precision Engineers, Yadavagiri, Mysore

Sl. No.	Technology/Technique (Laboratory)	Technology Reference Number	Name of Unit
14.	Wax emulsion (CFTRI, Mysore)	24	Indian Chemical Specialists, New Ramdaspath, Nagpur
<b>SPICE BASED TECHNOLOGIES</b>			
15.	Asafoetida (Hing), powder/tablets (CFTRI, Mysore)	26	Laljee Godhoo & Co., Bombay
16.	Chilly, drying of (CFTRI, Mysore)	27	Poonam Chand Tiwari, Khandwa
17.	Garlic powder (CFTRI, Mysore)	29	1. Garlic Corporation, Kothi Bazar, Jeora 2. Exporlic, Indore 3. National Garlic Industries, Ramganj, Jaipur
18.	Mustard powder (CFTRI, Mysore)	31	Weikfield Products Co. (I) P. Ltd., Weikfield Estate, Pune
19.	Pepper, green, canning and bottling of (RRL, Trivandrum)	32	1. L.R. Rangaier & Sons Pvt. Ltd., Calicut 2. Spicex Chemicals Pvt. Ltd., Mysore 3. Spick Trading Co., Cochin 4. Food Spectra, Kuthiachode, Alleppey, Kerala 5. Krihika Agencies, Trivandrum

Sl. No.	Technology/Technique (Laboratory)	Technology Reference Number	Name of Unit
20.	Pepper, green, dehydrated (CFTRI, Mysore)	33	<ol style="list-style-type: none"> <li>1. Spicex Chemicals P. Ltd., Mysore</li> <li>2. Krithika Agencies, Trivandrum</li> <li>3. Food Spectra, Ezhupunna, Alleppey Distt.</li> <li>4. Vijaya Puram Social Service Society, Kottayam</li> <li>5. Green Peppers, Unnikulum</li> </ol>
21.	Spice oleoresins (CFTRI, Mysore)	36	<ol style="list-style-type: none"> <li>1. Synthite Industrial Chemicals P.Ltd., Cochin</li> <li>2. Chillies Export House P. Ltd., Virudhunagar</li> <li>3. Shri Vyankatesh Spices, Dharampeth, Nagpur</li> </ol>
		4	<ol style="list-style-type: none"> <li>4. Spicex Chemicals P. Ltd., Mysore</li> <li>5. Sri Sai Oils &amp; Oleoresins, Petaling Jaya, Selangor, Malaysia</li> <li>6. Nepal Spice Products P. Ltd., Nepalganj, Nepal</li> <li>7. Enjayeess Spices &amp; Chemicals Oils P. Ltd., Vallikodu, Kottayam</li> </ol>
22.	Spice oil (CFTRI, Mysore)	37	<ol style="list-style-type: none"> <li>1. Devi Industries, Madurai</li> <li>2. Synthite Industrial Chemical P. Ltd., Cochin</li> </ol>

Sl. No.	Technology/Technique (Laboratory)	Technology Reference Number	Name of Unit
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**MUSHROOM CULTIVATION AND PROCESSING**

23.	Mushroom cultivation (CFTRI, Mysore)	42	D.B. Ghorpade, Bangalore
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**FERMENTATION BASED TECHNOLOGIES**

24.	Amylo-glucosidase (CFTRI, Mysore)	43	1. Kamla Sugar Mills Ltd., Udamalpet 2. Triton Chemicals, KRS Road, Mysore
25.	Pectic enzyme (CFTRI, Mysore)	47	1. Mycozyme Industries, Metagalli, Mysore 2. Triton Chemicals, Metagalli P.O., KRS Road, Mysore
26.	Vinegar from pine apple waste and sugary material (CFTRI, Mysore)	48	Canning Industries Cochin Ltd., Trichur, Kerala

**FOREST BASED TECHNOLOGIES**

27.	Board, paper (RRL, Jammu)	50	1. Surinder Mirani & Bros., Madhya Pradesh 2. Agees Straw Products, Jaindiala, Punjab 3. J & K Card Board Factory, Muthi, Jammu 4. Sandip Industries, Gangyal, Jammu
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Sl. No.	Technology/Technique (Laboratory)	Technology Reference Number	Name of unit
28.	Cedar wood oil (RRL, Jammu)	52	<ol style="list-style-type: none"> <li>1. Wood Oil &amp; Chemicals, Samba</li> <li>2. Sangam Essential, Samba</li> <li>3. Urmila Drugs and Pharmaceuticals, Ghaziabad (U.P.)</li> </ol>
29.	Resin, distillation of and hardened rosin (RRL, Jammu)	55	<ol style="list-style-type: none"> <li>1. Suket Chemical P. Ltd., Sundernagar, Mandi (H.P.)</li> <li>2. Prabhat Terpenes &amp; Synthetic, Jammu</li> <li>3. Sud Pine Industries, Jammu</li> </ol>
30.	Tamarind powder (CFTRI, Mysore)	56	<ol style="list-style-type: none"> <li>1. Brahmappa Tavanappanavar (Mysore) P.Ltd., Mysore</li> <li>2. Food Associates, Malleswaram, Bangalore</li> <li>3. Shri Ranga Foods, Coimbatore</li> <li>4. K. Veerabhadra Mudaliar &amp; Co., Santhapet, Mysore</li> <li>5. Shri Annapoorneswarer Enterprises, Hebbol, Bangalore</li> </ol>

#### POULTRY BASED TECHNOLOGIES

31.	Egg albumen flakes (CFTRI, Mysore)	58	Al. Flakes Industry, Yadavagiri, Mysore
32.	Egg Shell powder (CFTRI, Mysore)	60	Foods & Inns Ltd., Chambur, Bombay
33.	Poultry Feed (CFTRI, Mysore)	62	SIFI Feeds, Mysore

Sl. No.	Technology/Technique (Laboratory)	Technology Reference Number	Name of unit
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#### MARINE BASED TECHNOLOGIES

34.	Agar-agar from Indian sea-weeds (CSMCRI, Bhavnagar)	70	<ol style="list-style-type: none"> <li>1. Cellulose Products of India Ltd., Ahmedabad</li> <li>2. Gell Enterprises, Anand</li> <li>3. New Oceanic Products Ltd., Kagda Pith, Ahmedabad</li> <li>4. Blow Chem Enterprises, Madras</li> <li>5. South Sea Chemicals P. Ltd., Hyderabad</li> </ol>
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#### MEDICINAL AND AROMATIC PLANTS

##### *Essential oils*

35.	Blue oil from <i>Matricaria chamomilla</i> Linn. (NBRI, Lucknow)	87	German Remedies, Lucknow
36.	Citronellol (RRL, Jammu)	89	<ol style="list-style-type: none"> <li>1. Eskay Corporation, Kerala</li> <li>2. Guptvanshi, Bareilly</li> </ol>
37.	Menthol (RRL, Jammu)	92	<ol style="list-style-type: none"> <li>1. Anand Chemicals, Chandigarh</li> <li>2. Shri Sham Lal Goyal, Chandigarh</li> <li>3. Wadhwa Chemicals, Delhi</li> <li>4. Aroma Chemicals, Chandusi</li> <li>5. Pearl Chemicals, Muzaffarnagar</li> <li>6. Central Research Organisation, Rangoon</li> <li>7. S.K. Chemicals, Bhagalpur</li> <li>8. Hindustan Chemical Industry, Delhi</li> </ol>

Sl. No.	Technology/Technique (Laboratory)	Technology Reference Number	Name of unit
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#### LEATHER PROCESSING/TECHNOLOGY

38.	Leather Processing/ Technologies (CLRI, Madras)	94-97	<ol style="list-style-type: none"> <li>1. Haryana Charm Udyog Sangh, Ambala Cantt. (Haryana)</li> <li>2. Akash Trading Co, Jullundhur (Punjab)</li> <li>3. Gram Pratishthan Bardoli (Gujarat)</li> <li>4. Saurashtra Rachnatmak Sangh Rajkot (Gujarat)</li> </ol>
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#### OTHER TECHNOLOGIES

39.	Clay flooring and roofing tiles (Mangalore type) (CBRI, Roorkee)	100	<ol style="list-style-type: none"> <li>1. Kshetriya Kumhar Udyog, Shri Gandhi Ashram, Meerut</li> <li>2. Kumhar Udyog, Shri Gandhi Ashrama, Chutmalpur, Distt. Saharanpur</li> <li>3. Khadi &amp; Village Industries Commission, Bombay</li> <li>4. H.P. Housing Board Mechanised Tile &amp; Brick Plant, Paonta Sahib (H.P.)</li> <li>5. Gram Udyog &amp; Krishi Vikas Parishad, Powayan, Shahjahanpur</li> </ol>
40.	Ferrocement units (SERC, Roorkee)	102	<ol style="list-style-type: none"> <li>1. Uttarakhand Concrete Products, NOIDA Complex, Distt. Ghaziabad</li> <li>2. St. Pedro Precast Unit, Panaji</li> </ol>

Sl. No.	Technology/Technique (Laboratory)	Technology Reference Number	Name of unit
			3. Indian Concrete Products, Meerut Cantt
			4. Ashok & Associates, Lucknow
			5. Building Construction & Repairs Corporation, Ghaziabad
			6. Gupta Sanitary Stores, Dehradun
41.	Leaf cup/plate making machine (CFTRI, Mysore)	106	1. Nalanda Agro Works, Kurji, Patna 2. Anil & Co., Rajendra Nagar, Mysore 3. H.K. Industries, Patna
42.	Mineralised salt lick for cattle (CSMCRI, Bhavnagar)	107	1. Natural Salt Industries, Belgaum (Karnataka) 2. Chemical Salt Producers, Bhavnagar 3. Sambhar Salts Ltd., Sambhar Lake, Rajasthan 4. Kisan Brothers Ltd., Ahmedabad 5. Arogya Pharmacy, Pune 6. Saggiter & Demor (Agro Chemicals), Valsad (Gujarat) 7. R.B. Sudhpura & M.N. Sidhpura, Gondia (M.P.) 8. Mahesh Licks Ltd., Dewas (M.P.) 9. Kisan Veterinary Products, Abohar 10. Romit Engineers, Indore 11. Shri Ram Cattle Feed Plant, P.O. Chalaya, Distt. Amreli (Saurashtra)

Sl. No.	Technology/Technique (Laboratory)	Technology Reference Number	Name of unit
			12. Web Pharma, Anand (Gujarat)
			13. Manali Associates, Saharanpur
			14. Jai Kisan Agro Industries, Sanyogita Ganj, Indore
			15. Cattle Cares Industries, Dehradun
			16. Senthyl Chemicals, Mádras
43.	Speciality paper (RRL, Hyderabad)	109	Srinivasa Paper Mills, Karimnagar
44.	Slate paper (RRL, Jorhat)	110	1. K.K. Enterprise, P.O. Pergaon (Assam)
			2. Crystal Enterprises, Gauhati
			3. Indian Slate Industries, Jaipur
			4. Manoj Slates Works, Kalindi Distt. (Orissa)
			5. Modern Paper Slate Works, P.O. Pirat, Calcutta
			6. Paper Slate Industries, Mokokchung (Nagaland)
			7. R.R. Industries, Bharalumukh, Gauhati
			8. R.K. Paper Slate Industries, C/o Vendana Show Emporium, Rohtak (Haryana)
			9. Lipika Chemical Enterprises Agartala (Tripula)
			10. Shri Krishna Bharatia, Sahibganj

Sl. No.	Technology/Technique (Laboratory)	Technology Reference Number	Name of unit
45.	Slate plastic (RRL, Jorhat)	111	1. Mariappa Enterprises, Madurai (Tamilnadu) 2. Rajeshwari Enterprises, Vinidhanagar 3. Plastic Art, Kolhapur, Maharashtra
46.	Sodium silicate from rice husk ash (CGCRI, Calcutta)	112	Industrial Dessicants, Calcutta
47.	Water filter candles (RRL, Jorhat)	113	1. Vijaya Chemical Industries, Kenduguri, Jorhat (Assam) 2. Ceralian Filters (P) Ltd., Poona 3. Sudershan Electrical Ind. Pvt. Ltd., Thana

#### ABBREVIATIONS OF CSIR LABORATORIES MENTIONED IN THE PUBLICATION

1. CBRI – Central Building Research Institute, Roorkee (UP) 247672
2. CDRI – Central Drug Research Institute, Lucknow (UP) 226001
3. CFTRI – Central Food Technological Research Institute, Mysore (Karnataka) 570013
4. CGCRI – Central Glass & Ceramic Research Institute, Calcutta (West Bengal) 700032
5. CIMAP – Central Indian Medicinal & Aromatic Plants, Lucknow (UP) 226016
6. CLRI – Central Leather Research Institute, Madras (Tamil Nadu) 600020
7. CMERI – Central Mechanical Engineering Research Institute, Durgapur 713209
8. CSMCRI – Central Salt & Marine Chemicals Research Institute, Bhavnagar (Gujarat) 364002
9. NBRI – National Botanical Research Institute, Lucknow (UP) 226001
10. NIO – National Institute of Oceanography, Dona Paula, (Goa) 403004
11. NML – National Metallurgical Laboratory, Jamshedpur (Bihar) 831007
12. RRL (B) – Regional Research Laboratory, Bhubaneswar (Orissa) 751013
13. RRL (H) – Regional Research Laboratory, Hyderabad (AP) 500007
14. RRL (Jm) – Regional Research Laboratory, Jammu (J&K) 180001
15. RRL (Jt) – Regional Research Laboratory, Jorhat (Assam) 785006
16. RRL (T) – Regional Research Laboratory, Trivandrum (Kerala) 695019
17. SERC – Structural Engineering Research Centre, Roorkee (UP) 247672

## REGIONAL EXTENSION CENTRES/FIELD STATIONS OF CSIR LABORATORIES

### CBRI CENTRES

CBRI Extension Cell  
Research Station (R & B)  
Errum Manzil  
Hyderabad-500481

CBRI Extension Cell  
C/o N.B.O., 'G' Wing  
Nirman Bhawan  
New Delhi-110011

CBRI Extension Cell  
6th Floor, Nizam Palace  
A-234/4, Acharya J.C. Bose Road  
Calcutta

CBRI Extension Cell  
North T.T. Nagar  
Bhopal-462003

CBRI Extension Cell  
C/o School of Architecture  
Ahmedabad-380009

### CFTRI CENTRES

CFTRI Experiment Station  
Bhavans' College Campus  
Andheri West  
Bombay-400058

CFTRI Experiment Station  
Pilot Plant Building of CDRI  
Opp. High Court  
Lucknow-226001

CFTRI Experiment Station  
Gill Road  
Ludhiana-141006

CFTRI Experiment Station  
Hoige Bazar  
Mangalore-575001

CFTRI Experiment Station  
Gole Bungalow  
Nelson Square  
Nagpur-440001

CFTRI Experiment Station  
C-25, Industrial Estate  
Sanatnagar  
Hyderabad-500018

### CGCRI CENTRES

CGCRI Naroda Centre  
Naroda Industrial Estate  
Ahmedabad-382330

CGCRI Extension Centre  
Khurja-203131 (U.P.)

### CLRI CENTRES

CLRI Regional Extension Centre  
No. 220, Dharavi Road  
Bombay-400071

CLRI Regional Extension Centre  
7/1/D, D.P. Row (Old Suri Lane)  
Calcutta-700014

CLRI Regional Extension Centre  
Govt. Training Institute  
Nakodar Road  
Jullundur-144001 (Punjab)

CLRI Regional Extension Centre  
Opp. City Station  
Rajkot-360001 (Gujarat)

CLRI Regional Extension Centre  
Govt. Leather Working Centre  
Souterganj  
Kanpur-208001 (U.P.)

### CIMAP CENTRES

CIMAP Regional Centre  
NAL-WTC Campus, Belur  
Bangalore-560037

CIMAP Regional Centre  
Pantnagar  
P.O. Nagla Dairy Farm  
Nagla-263149  
Dist. Nainital (U.P.)

CIMAP Regional Centre  
P.O. Tung  
Dist. Darjeeling-734224

CIMAP Regional Centre  
West Brook  
Convent Road  
Kodaikanal-624101

CIMAP Regional Centre  
Boduppall, RRL Campus  
Uppal Road  
Hyderabad-500009

### CMERI CENTRES

CMERI Liaison Office  
23, R.N. Mukherjee Road  
Calcutta-700001

Mechanical Engineering Research &  
Development Organisation  
NCL Campus, Pashan Road  
Pune-411008

Mechanical Engineering Research &  
Development Organisation  
Gill Road  
Ludhiana-141006

Mechanical Engineering Research &  
Development Organisation  
CSIR Madras Complex  
TTTTI - Taramani P.O.  
Madras-600113

Mechanical Engineering Research &  
Development Organisation  
CSIR Complex  
Kalamassery-683104 (Cochin)

### CSMCRI CENTRES

CSMCRI Marine Algal Research Station  
M.S. Bungalow  
Mandapam-623518 (Tamil Nadu)

CSMCRI Sea Water Irriculture Unit  
House No. 2013, Field Station  
Satyanivas Building, Hill Patna  
Berhampur-5  
Dist. Ganjam (Orissa)

### NIO CENTRES

Regional Centre of NIO  
Sea Shell, Seven Bungalows  
Versova  
Bombay-400061

Regional Centre of NIO  
P.O. Box No. 1913  
Cochin-682018



Regional Centre of NIO  
Andhra University Campus  
Visakhapatnam  
Waltair-530003

#### **NML CENTRES**

NML Marine Corrosion Research Station  
Digha Distt. Midnapur-721428  
(W. Bengal)

NML Foundry Station  
Industrial Estate  
Dassnagar

Howrah-711402 (W. Bengal)

NML Regional Liaison Centre  
India Exchange Place  
7th Floor  
Calcutta-700001

NML Field Station  
Industrial Estate  
Batala-143505 (Punjab)

NML Field Station  
Industrial Estate  
Naroda  
Ahmedabad-382330

NML Research Station  
CSIR Madras Complex  
TTTI, Taramani  
Madras-600113

#### **RRL, JAMMU CENTRES**

Regional Research Laboratory (Branch)  
Sanat Nagar  
Srinagar-190005

RRL Extension Centre  
Bundla Tea Estate  
Palampur-176061 (H.P.)

#### **RRL, JORHAT CENTRES**

RRL Branch Laboratory  
Itanagar (Arunachal Pradesh)

RRL Sub Station  
Yaongimsen Village  
P.O. Changtongia  
Distt. Mokokchang (Nagaland)

RRL Sub-Station  
Shillong (Meghalaya)

RRL Sub-Station  
P.O. Lamphelpet  
Imphal (Manipur)

RRL Extension Centre  
P.O. Sepahijala  
Agartala (Tripura West)

#### **RRL, TRIVANDRUM CENTRES**

CSIR Cochin Complex  
Kalamassery Development Plot  
Kalamassery-683104 (Kerala)

## INDEX (ACCORDING TO RAW MATERIAL)

<i>Raw material</i>	<i>Technique/technology reference No.</i>	<i>Raw material</i>	<i>Technique/technology Reference No.</i>
1. Animal casings	68	31. Foliage	103
2. Apple	12	32. Fruits	10,12,24
3. Asafoetida	26	33. Garlic	29,
4. Aspergillin	47	34. Ginger	30,36,37
5. Bagasse	50	35. Gram	8
6. Bajra	72	36. Grapes	11,12,20
7. Banana	1,12	37. Grass	51
8. Beet root	9	38. Guava	12
9. Carbon-steel plates	104	39. Isapgol	84
10. Cardamom	37	40. Jajoba	71
11. Cashew nut	99	41. Jasmine flowers	86
12. Castor seeds	2	42. Kokum	9
13. Cedrus deodara	52	43. Leather	94-97
14. Cement	102	44. Leaves	106
15. Chicken broiler	57	45. Lemon grass	91
16. Chillies	27,28,36	46. Lime/Lime oil	16,90
17. Chir-resin	55	47. Maize	13
18. Cinnamon leaves	91	48. Milk	44
19. Citronella grass	88,91	49. Mint oil	92
20. Citrus oil	90	50. Mushroom	39-42
21. Clay	100, 113	51. Muskmelon seeds	108
22. Cocoa beans	3	52. Mustard seeds	31
23. Coconuts	4,5,6	53. Onion	72
24. Corncobs	48	54. Oranges	46
25. Cotton linters/rags	7,109	55. Paddy	21
26. Dhaincha seeds	53	56. Paddy straw	42,50
27. Egg	58,59,60,61	57. Palmarosa grass	91
28. Eucalyptus	89	58. Papaya latex	14,15
29. Fish	63-69,	59. Paper board	110
30. Flowers	86,87,93,103	60. Paper, waste	51

<i>Raw material</i>	<i>Technique/technology Reference No.</i>
61. Pepper	32-35
62. Pig iron	101
63. Pine apple peels	48
64. Pine needles	49,50,54
65. Plastic sheet	111
66. Potato	17,18
67. Pulses	19
68. Pyrethrum flowers	85
69. Ragi	8
70. Rhizopus, strain of	45
71. Rice husk ash	112
72. Rose flower	86,93

<i>Raw material</i>	<i>Technique/technology Reference No.</i>
73. Salt	107
74. Sea weeds	70
75. Sesame seeds	22
76. Sugar beet	72
77. Sugary material	48
78. Tamarind	56
79. Turmeric	9,36,38
80. Vegetables	10,24,98
81. Walnuts	23
82. Wheat	25
83. Wheat straw	50

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## INDEX (ACCORDING TO CULTIVABLE PLANTS)

<i>Plant</i>	<i>Technology/technique Reference No.</i>
1. Balladonna	73
2. Dioscorea	74
3. Germanium	78
4. Japanese mint	79
5. Java citronella	80
6. Lemon grass	81
7. Mushroom	39, 42
8. Palmarosa	82
9. Peppermint	83
10. Periwinkle	76
11. Pyrethrum	75
12. Serpentina root	77

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