

## Mechanization to reduce human drudgery in coconut production

The greatest challenge coconut farmers are facing is climbing coconut tree for collecting tender nut, mature nuts and for other plant protection operations. Though the Joseph model of coconut climbing machine is gaining popularity, thanks to the initiative of Coconut Development Board (CDB), yet climbing the tree for harvesting would be prohibitively costly considering the stagnant price and productivity of coconut palm. Therefore, developing a mechanised device to harvest coconut from ground is the need of the hour. Invariably this should be focal point of researchers. Coconut de-shelling and de-husking are other two operations that require further mechanization. Though, a few prototypes of coconut de-shelling and de-husking machineries are either available or are in the pipeline, manual labour could not be avoided totally in these operations. There is a need for developing appropriate processing techniques and machinery suitable for community level processing of value added products like VCO, coconut chips, desiccated coconut, coconut milk, coconut milk powder etc.

THE coconut palm is mainly grown in ecologically sensitive areas such as coastal belts, hilly areas and areas with high rainfall and humidity. Undertaking farm operations in these terrains is cumbersome. Moreover coconut is a tall tree and hence, coconut harvesting, crown cleaning and other operations involve skilled labourers. Non-availability of skilled labourers in addition to the fluctuating prices is the major challenge in coconut cultivation. Therefore, it is envisaged that the future of coconut industry lies in its mechanization. Through the concerted efforts of research over the years, various unit operations in pre and post harvest processing for coconut have been mechanized. Further, mechanization in coconut has gained popularity among farmers for its multi-dimensional benefits such as reduction of operational costs and human drudgery, timeliness of operation, increased labour productivity and efficiency. There also exists a huge scope for coconut based agribusiness in India with reference to processing and value-added products.

### MECHANIZATION IN COCONUT

#### Telescopic Sprayer

The telescopic sprayer comprises of two co-axial pipes of ultra-light weight (0.5 kg/metre length), which can be used to spray up to a height of 12.5 m. The pipe height can be locked at any desired level above 6 m. Marginal farmers could



Telescopic sprayer

attach a rocker sprayer whereas in large gardens a power sprayer could be used. The telescopic pipe assembly developed by CPCRI is very much useful if the garden is of uniform size. They are lightweight and durable.

#### Anti Buckling Device

A serious problem often faced by coconut farmers is the buckling of heavy bunches. Partial severing of the Stalk from the trunk is known as buckling. A large number of nuts in the bunch and/or big sized nuts, long and less sturdy peduncle, wider angle between the leaf and the inflorescence and weak leaf petiole are some of the causes for buckling of bunches. To prevent the coconut bunches from buckling, a mechanical support has been developed which consists of a trunk-clamp, support-clamps and telescopic support-rods.



Coconut bunch supported with anti buckling device

### Ultra Lightweight Coconut Harvester

The harvester developed by CPCRI comprises of two co-axial pipes of ultra-light weight (0.5 kg/m), which can be used to harvest up to a height of 12.5 m (40 ft) from the ground. The pipe height can be locked at any desired level above 6.25 m (20 ft). On the top end of pipe, a specially designed knife is fitted using nuts and bolts. The harvesting knife could be fabricated by local craftsman.



Telescopic harvester device

### Coconut Climbing Devices

Various types of climbing devices like tractor operated, self propelled, manually operated and some robotic type (electronic) devices have been developed and tested for harvesting coconut by both the government and private sector. Amongst the manual types, one model was developed by a farmer (Joseph model), another by TNAU (TNAU Model) and the third by CPCRI. Of all these the manual device, paddling type model developed by an innovative farmer (Joseph model) is the only machine commercially available and used by professional climbers.

### Chemberi Joseph Model

Joseph model has got mainly two assemblies of similar construction. The steel rope wires of both top and bottom assembly needs to be looped with the tree and locked. The user then climb on to the machine by placing one foot each on both the assemblies holding the handles provided. Standing on one assembly the user lifts the other assembly to loosen the steel rope and raise it by hand. After attaining a comfortable height, he pushes back the assembly with foot so that it gets tightened to the tree. The user has to co-ordinate these two assemblies simultaneously by using hands and legs to climb on coconut tree. This model costs ₹1,500/- only which is easily affordable by even small farmers. It does not require much skill and with 2 to 3 days initial training both boys and girls can easily climb coconut tree.

While imparting training and commercializing the



Chemberi model of coconut climbing machine

Joseph model of climbing machine, the only limitation felt by the climbers is the safety of climbers, in case of machine failure or from accidental falling. Recently, CPCRI has developed a safety attachment to this model of climbing machine. The safety attachment is independent of the climbing machine and gives fool-proof safety to the climber from falling.



Safety attachment for climbing device

### TNAU Model

This was developed by Tamil Nadu Agricultural University (TNAU). This is a sitting type or push up type model. The user has to sit on the seat which is provided on upper frame and has to insert his foot between the rubber rollers available in the lower frame. The upper frame can be lifted by hands and the lower frame has to be lifted by leg. The process has to be repeated for the continuous climbing.



TNAU model of coconut climbing machine

### Coconut De-Husking Machine

Coconut de-husking is the first post harvest operation in any coconut processing industry. Traditionally coconut is dehusked manually using a spike. Drudgery and risk of getting injured make the operation male dominated. A power operated semi automatic coconut de-husking machine has been designed and fabricated at ICAR-Central Plantation Crops Research Institute. The machine has a capacity to de-husk 200 coconuts/hour.



Coconut de-husking machine



Shell fired copra dryer

### Copra Dryers

The common practice of making copra is by sun drying the fresh coconut kernel on cement floor or on sand floor for seven to nine days. Unlike in other crops, the endosperm of coconut is exposed while drying and so is susceptible for contamination due to dirt. Prolonged drying, especially during monsoon, also results in microbial infection. The energy efficient dryers developed by CPCRI produce dust and microbial contamination free copra in a short period.

### Shell Fired Copra Dryer

The copra dryer is working on indirect heating and natural convection principles using coconut shell as fuel. This dryer requires less amount of fuel, makes copra in short time and is less expensive too. Capacity of the dryer is 1000 nuts/batch. The quality of copra obtained is light brown in colour which fetches good price in the market. The burner designed generates heat for 5 hours without tending and the residual heat is retained for one more hour. The average drying time is 24 h.

### Solar Tunnel Based Integrated Copra Dryer

Solar drying relies on the sun as the source of energy. It generates higher air temperature and consequential lower relative humidity. For cloudy and rainy days, a multi source dryer has been developed with solar energy as the main source of energy and electricity and biofuel as



Solar-cum-electrical dryer with agricultural waste as third source of energy



Coconut de-shelling machine

alternate sources of energy. The dryer consists of a semi circular parallel plate solar collector, electric heaters of 1000 W (6 numbers), blower cum exhaust motor and the drying chamber. It is a auto regulated dryer with temperature and humidity control. It is a batch type dryer and the capacity of the dryer is 2000 coconuts/batch. The dryer can be used to dry other crops such as cardamom.

### Coconut De-Shelling Machine

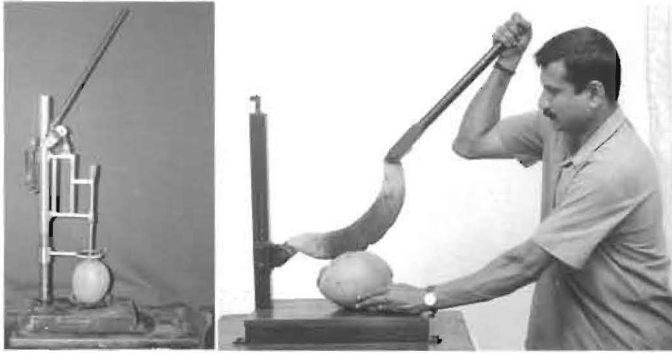
A power operated batch type coconut de-shelling machine has been developed to separate shell and copra after partial drying. Capacity of the machine is 400 half cups/batch. The optimum average moisture content for maximum de-shelling efficiency (92.16%) is 35% d.b. The optimum speed of the de-shelling machine is 10 RPM and the time taken for de-shelling is 4 minutes/batch.

### Copra Moisture Meter

Moisture is the most important factor influencing the quality of copra. Copra with a moisture content of less than six percent is considered good quality as



Copra moisture meter



Tender coconut punch and cutter

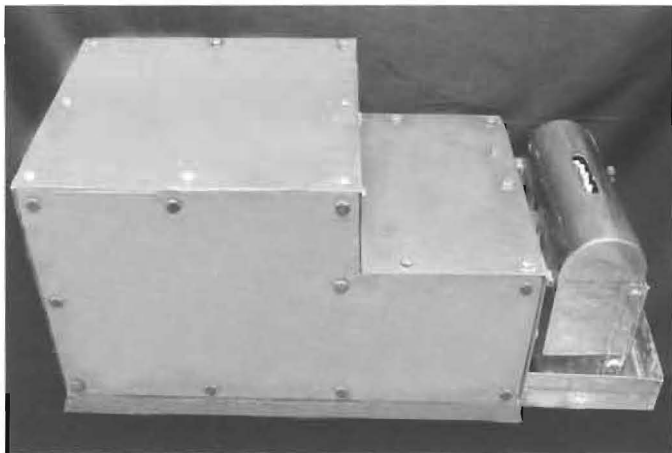
it is not easily damaged by insects, moulds or microorganisms. At the CPCRI, Kasaragod, an electronic moisture meter was developed to determine the moisture content of copra, based on the electrical conductivity of the kernel. The instrument can read moisture content from 5 to 40%.

### Tender Coconut Punch and Cutter

Tender nut punch and cutter are two simple devices to pierce the tender coconut and the cut open it after drinking the water inside. A clean hole sufficient enough to insert a straw is formed and one can drink the fresh water. After drinking the water, the nut is placed on the wooden platform and cut open by pressing the lever attached to the blade.

### Snowball Tendernut Machine

Snow ball tender coconut is globular tender coconut kernel containing tender coconut water inside. The ball scooped out with the help of specially devised tool after cutting the shell of tender coconut of 7-8 months maturity by using snow ball tender coconut machine.



Snowball tendernut machine

### Fresh Coconut Shell Removing Machine

Coconut shell removing is the second post harvest operation in a coconut processing industry using fresh coconut kernel as the raw material. Traditionally coconut shell is removed using a knife.

The machine developed at ICAR-CPCRI is intended to reduce both time and drudgery involved in the manual de-shelling process. Coconut to be processed is pressed



Coconut shell removing machine

towards the rotating blades by firmly placing it on the stationary blade. Shell gets detached from the kernal due to the impact force of the rotating blade. The machine has a capacity to remove the shell of 150 coconuts/hour.

### Coconut Testa Removing Machine

Many high value coconut products like, Coconut chips, Virgin coconut oil, Desiccated coconut etc. requires removal of testa. At present, testa is removed manually using potato peeler which is a cumbersome and time consuming process. Moreover a sizable amount of coconut meat also would be lost along with the removed testa. The coconut testa removing machine would reduce the drudgery and improve the efficiency and capacity of any production units that requires removal of testa. The main component of the machine is a circular wheel covered with emery cloth or water paper attached to a prime mover, an electric motor. One person can remove testa of about 75 coconuts per hour.



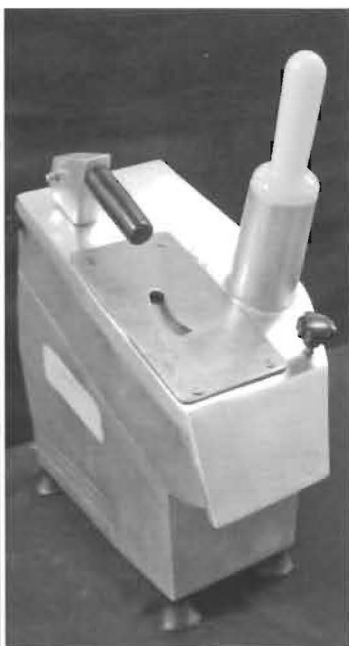
Testa removing machine

### Coconut Slicing Machine

Slicing coconut kernel to produce chips of uniform thickness is the single most



Manually-operated coconut slicing machine



Coconut chips making machine



Manually operated coconut milk extractors

important unit operation in the coconut chips making process. Conventionally this is done manually and the process is very cumbersome and time consuming. Quality of chips, especially uniformity of thickness, would depend on the skill of the operator. In order to make this operation simple and faster manual and power operated coconut slicing machines were developed at CPCRI.

#### Coconut Chips Dryers

Two types of dryers (electrical and agricultural waste fired) were developed by CPCRI to dry the sliced coconut kernel to the desired moisture content.

#### Coconut Pulveriser

The coconut pulveriser consists of power operated rotary blade. The coconut kernel pieces are fed into the hopper manually. Due to the impact of the rotary blade and the rubbing on the stationary blade, the coconut kernel turns into fine powder. The machine has a capacity of 250 nuts/hr.



Coconut pulveriser

#### Manual Coconut Milk Extractors

Two different manually operated coconut milk extractors are developed to enhance the milk extraction efficiency.

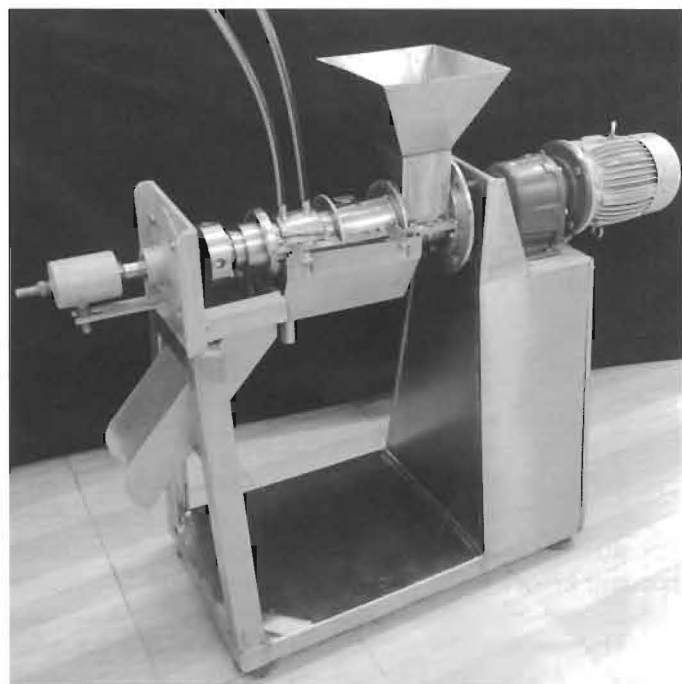
#### Screw Type Coconut Milk Expellers

Two screw type coconut milk

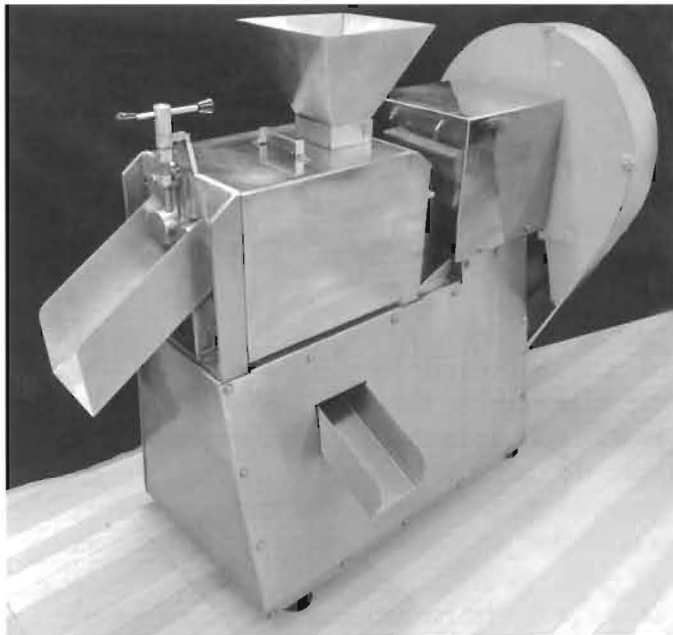
expellers, single and double screw, with different capacities have been developed to extract coconut milk. The single screw expeller has a capacity of 300 coconuts/hour and the double screw has capacity of 1,000 coconuts/hour.

#### Virgin Coconut Oil Cookers

CPCRI has standardized the protocol and commercialized the technique to producing virgin coconut oil by hot processing method. Conventionally virgin coconut oil is prepared by heating coconut milk in an open container at low flame with continuous stirring. It is done manually and the constant stirring is a laborious process. Many a times the milk gets charred and the charred milk



Single screw coconut milk expeller



Double screw coconut milk expeller



Virgin coconut oil cooker-LPG/biogas



Agricultural waste fired virgin coconut oil cooker

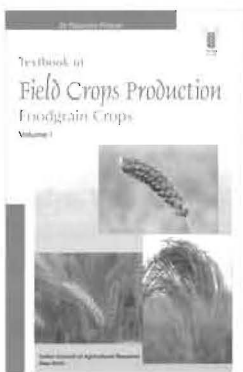
stick to the bottom and the sides of the vessel.

This happens when the stirring is not proper or when excess fuel is burnt. In order to overcome the limitations of the traditional Virgin Coconut Oil (VCO) production, two types of VCO cookers were developed at CPCRI to extract the VCO by hot processing. One machine uses LPG/ biogas as fuel and the other one uses any agricultural waste as fuel source.

For further interaction, please write to:

Drs A C Mathew and M R Manikantan (Scientists),  
Dr P Chowdappa (Director), Central Plantation Crops  
Research Institute, Kasaragod 671 124, Kerala.

## Textbook of Field Crops Production – Foodgrain Crops



(Volume I)

The first edition of Textbook of Field Crops Production was published in 2002 and there has been a heavy demand for the book. This book is now being brought out in two volumes. The chapters cover emerging trends in crop production such as System of Rice Intensification (SRI), export quality assurance in the production technology of commodities like Basmati rice, organic farming, resource conservation technologies, herbicide management etc. Good agronomic practices must judiciously inter-mix the applications of soil and plant sciences to produce food, feed, fuel, fibre, and of late nutraceuticals while ensuring sustainability of the system in as much possible environment and eco-friendly manner. The advent of hydroponics, precision farming, bio-sensors, fertigation, landscaping, application of ICT, GPS and GIS tools, micro-irrigation etc. is in the horizon. The textbook covers both the fundamentals of the subject and at the same time inspire and prepare both teachers and students for the emerging frontiers.

### TECHNICAL SPECIFICATIONS

No. of pages : i-xii + 396 • Price : ₹ 400 • Postage : Rs 100 • ISBN No. : 978-81-7164-116-1

For obtaining copies, please contact:

#### Business Manager

Directorate of Knowledge Management in Agriculture  
Krishi Anusandhan Bhavan-I, Pusa, New Delhi 110 012  
Tel : 011-25843657, Fax 91-11-25841282; e-mail : bmicar@gmail.com