

Agricultural innovations to scale up productivity and income from coconut farming

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Coconut growers face various constraints to improve farming on a sustainable basis. Lack of availability of labour, especially skilled labour for coconut climbing, and high wage rate are important problems faced by the growers in adopting timely crop management practices. In this context, it is needless to emphasize the importance of agricultural innovations to double coconut farmers' income by increasing productivity, through innovative value addition and by reducing the drudgery of coconut labourers. E-kalpa, a mobile based android application for coconut, use of artificial intelligence, drones and robotics in coconut, coconut-tree-climbing machines, basin digger, coconut cradle, kera mithra, tender coconut puncher and cutter, coconut shell removing machine, tender coconut peeler and the robotic neera sapper are some of the game-changing innovations going to boil down the immense desperation among the coconut farmers, and help to double the income from coconut.

Keywords: Coconut, E-kalpa, Basin digger, Income, Peeler

THE coconut farming is witnessing a grim situation because of increasing labour and input costs, fluctuating output prices and climate change. Enhancing productivity, reducing the cost of production, and value addition are the critical issues to address these challenges. The future of food and agriculture depends on the capacity of agricultural innovation systems to provide farmers with innovative solutions/ technologies that address an increasingly diverse and complex range of needs including improved farm productivity, environmental safety and climate resilience. Technology has always played an important role in increasing productivity and income from coconut farming to the present level. In the present article, various initiatives taken up by Coconut Development Board, research institutes, start-ups and farmers to develop agricultural innovations to double the coconut farmers' income through increasing productivity,

reducing the drudgery, innovations in value addition and innovative transfer of technology, are discussed.

Agricultural innovation to enhance productivity

Integration and assemblage of tacit knowledge of the farmers with the explicit knowledge from digital and other formal sources is the way

forward for being practically smart in the scenarios of climate change and market challenges. Recent experience showed that digital knowledge resources are of practical value and within the reach of farmers or customers, even in the remote areas, especially during the times of pandemic. Digital mode of communication has the strength of



Palm basin digger

providing rapid advisories by providing customized and authentic information to small and marginal coconut farmers; provide right information directly at the right time, at an affordable cost. To help the coconut farming community to access crop advisory digitally, Central Plantation Crops Research Institute developed E-kalpa, a comprehensive farmer friendly mobile based android application for coconut, arecanut and cocoa.

E-kalpa, a mobile based android application for coconut

An integrated android based mobile app 'E- kalpa' enabling technology delivery, interactive learning and real time data recording to make revolutionary changes in coconut farming. It has GPS enabled platform, developed to connect stakeholders of plantation sector with emphasis to coconut, arecanut and cocoa. E-kalpa is the integration of five major services viz., farmers issue reporting and supporting, synchronized farming, farmer diary, knowledge base and notifications and is available in English, Hindi, Malayalam and Kannada languages. It provides the farmer, latest CPCRI technologies and farming practices for increasing yield. It has online reporting facility for any type of issues related on farming which needs immediate solutions from experts.

E-Kalpa has the following features.

a) Technology snippets / knowledge base on coconut, arecanut and cocoa

A total of 271 technology snippets on coconut, arecanut and cocoa on varieties, production technologies, plant protection technologies, cropping systems, harvest and post-harvest technologies including machineries and processing have been developed. The contents are available in multi-language mode. Periodical

refinement of the technology snippets based on user's feedback is being adhered to systematically.

b) Input calculator for coconut

Input use for coconut plantation varies depending upon the size of the farm and the age of the palms. In the input calculator, a farmer has to enter the number of coconut palms in his garden, according to the age and with a click, the detail report of quantity of inputs (for e.g. organic manure, dolomite/lime, chemical fertilizers, cowpea for basal management) for each of the palms and the total requirement will be displayed. Points to remember for fertilizer application are also provided.

c) Crop information

Coconut is mostly cultivated as the base crop of homestead system integrating various other crops. Hence a small-scale farmer would need information regularly and continuously on these varied crops.



E-kalpa provides basic information and critical knowledge on cropping seasons, seed rates, spacing and recommendations on nutrient management of 79 crops in this component. This feature is very much useful not only for farmers but also for field level workers and extension officials.

d) Farm issue management through real time problem reporting

This is an interactive feature of 'E-kalpa' for reporting field problems and accessing solutions from scientists and is available in online mode. Farmers can report the field issues or problems as and when they notice it in their field. This can be sent in the form of messages, images, audio or video. Diagnosis and solutions are provided directly by the scientist or multi-disciplinary team of

scientists of CPCRI. The issue reported is automatically tagged with the mobile number and the GPS, which enables tracking of the field problems. The app not only helped farmers in accessing information, the interactive feature/process empowered farmers and extensions officials in transferring knowledge with confidence.

Use of artificial intelligence, drones and robotics in coconut farming

Artificial intelligence driven technologies are emerging to help in improving the efficiency with respect to crop and soil monitoring, weather forecasting, predictive agricultural analytics, markets and supply chain efficiency. The cloud computing infrastructures with the use of data ecosystems, Internet of Things (IoT) and AI enables the development of digital agriculture and strengthen the farmers in practicing smart farming, smart irrigation, smart fertilizer application, and disease/pest diagnosis/detection, smart spraying,

and harvesting. Machine learning and soft computing methods with pattern recognition through image and video (drone cameras, satellite imagery) data processing are being widely used worldwide in monitoring and managing various farm operations and predicting the incidence of disease/ pests, weather forecasts, time of application and optimum dose of chemical sprays, time of harvest, life of produce etc. Deep learning techniques are being used effectively on image data for segmentation which results in disease/ variety identification and crop yield estimation and prediction with far more accuracy. Drones are used for mapping and inspection in coconut gardens and mapping the boundaries, for collecting data for yield forecasting. Sensors for identifying the maturity of coconuts are in developing stage at Kerala Agricultural University to identify tender coconut and mature coconut there by enable harvesting of coconut using drones.

Agricultural innovation to address labour shortage and to reduce drudgery

Lack of availability of labour, especially skilled labour for coconut climbing, and high wage rate are important problems faced by the growers in adopting timely crop management practices. It is in this context that the 'Friends of Coconut Trees (FoCT)' programme implemented by Coconut Development Board to develop a professional group of youth for harvesting and plant protection operations in coconut assumes much significance.



Kera mithra



Farmers in Kerala found coconut farming less remunerative due to high input cost and labour shortage, and facing acute shortage of traditionally skilled coconut tree climbers. Coconut-tree-climbing machines, basin digger, coconut cradle, kera mithra, tender coconut puncher and cutter, coconut shell removing machine, tender coconut peeler and the robotic neera sapper are some of the innovation that will help to reduce the drudgery of coconut farmers.

Coconut-tree-climbing machine

Coconut-tree-climbing machine helps the person to climb up and down a tree in sitting position in just two minutes and 18 seconds, is relatively safer for use. CPCRI scientist developed a safety device for coconut climbing machine. When attached, the safety device to climbing machine provides complete safety to the person climbing coconut especially using the Chemberi model coconut climbing machine.

Basin digger

Kerala Agricultural University (KAU) has developed a new coconut basin digger for the benefit of farmers. The basin digger, an attachment to tiller, facilitates digging of coconut-tree basins within seven minutes at ₹ 38. The cost of digging a tree basin manually is around ₹ 60.

The mechanical digger scores over other methods in terms of time as it can dig around forty basins a day whereas a labourer will not be able to finish more than ten basins a day.

Coconut cradle

The coconut cradle is meant for urban and peri-urban spaces where regular harvesting of coconuts is not feasible. The cradle collects falling nuts, thereby avoiding their falling over people, vehicles, or structures. The cradles can be lowered and nuts collected in them can be taken out at will. Two types of coconut cradle/collectors were designed and developed by Kerala Agricultural University viz., mesh type coconut cradle and net type coconut cradle. They are developed as home protection equipment to collect fallen nuts from the coconut tree near the premises of house, which can be easily operated by the owner with a lever system. The fallen nuts can be collected once in 2 months

Kera mithra

The coconut-husking tool is one of the most popular engineering inventions of KAU. Most households have made it mandatory, along with knives and machetes. The easy-to-use design has lessened the dependency of expert hands to perform the complex task of husking coconuts.



Mild Steel (MS) Climber

Coconut shell removing machine

The coconut shell removing machine reduces both time and drudgery involved in the manual de-shelling process. It also gives coconut kernel in single piece so that testa removing would be easy. The machine is quite gender friendly. The machine has a capacity to remove the shell of 120 coconuts per hour. An experienced person could achieve a capacity of 150 coconuts per hour. Tender nut punch and cutter, snow ball tender nut machine, coconut de shelling machine, telescopic sprayer for palms, shell fired copra dryer,

solar cum-electrical-cum-agricultural waste fired copra dryer, Solar tunnel dryer are other devices and machinery developed by CPCRI.

Robotic neera tapping device, sapper

Coconut neera, the sweet sap of unopened mature spadix of coconut trees has been used as a natural drink for decades. An innovation in this genre is the Robotic Neera Tapping Device developed by Nava Design and Innovations, a Kerala-based start-up. The start-up has come up with the highly innovative automatic neera tapping device, which is a classic

example of leveraging technology for greater cause with highest social impact. Robotic neera tapping device is a device for mechanised extraction of inflorescence sap from coconut trees and it is an app-based device. The sapper is fixed on the inflorescence selected and identified by the tapper. A thin, long pipe connects the device with the tank on the ground to collect neera. Once the device is installed and switched on, a notification is send informing that the device is ready to be operated through a mobile app. On the basis of the command given post installation, the robotic machine finely slices the inflorescence to extract neera. As there is no human contact with sap while collection, which helps keeping it uncontaminated. NAVA's device can be programmed in such a way that the tapping/cutting of female flower (inflorescence) can be automatically regulated. This helps inflorescence to produce coconuts also, without disrupting market for coconuts for household consumption and producing coconut oil. This device will help reduce the drudgery by bringing down the tree climbing to only once instead of three times per tree per day.

Agricultural innovation in value addition of coconut farming

Value addition in coconut gives more economy to the farmers and entrepreneurs. The prominent among them include neera, virgin coconut oil, snow ball, coconut chips, coconut jelly, coconut vinegar, desiccated powder, coconut milk, preserved tender nut water etc. Products like neera syrup, coco sugar, coconut vinegar, coconut honey, coconut nectar etc, which are produced from neera, have export potential. Post-harvest processing of coconut is now being changed from the edible and inedible traditional products to several other value added products. All parts of the coconut wood can be manufactured into commercial products. Coconut wood is used in construction, furniture, high value products, charcoal, chemicals pulp and paper. Properly seasoned coconut wood is excellent

Farmer Innovation - Device to peel tender coconut

KC Sijoy, the founder of Koocos Industries in Thrissur, Kerala designed a mechanical device that can peel tender coconuts in 40 seconds per piece and won ₹ 25 Lakh for innovative device to peel a tender coconut. This machine take 40 seconds to peel one coconut, it also slices the semi-hard covering into 1-millimeter pieces so that it can be used as cattle feed. The machine is powered by a 500-watt motor and has a lever on one end to hold and release the coconut, along with a rotating device on the other end, to revolve the coconut. A sharp knife is placed under the coconut, which is operated by a pulley system that moves left to right. Another lever can bring down two more sharp knives to slice the edges. The machine is equipped with 100 mm blades that remove the entire outer covering within 40 seconds. After this, the peeled coconut is placed on a cutting board attached to the machine to remove to the top and bottom. The coconut is left in a cylindrical shape, with a flat top and bottom, which makes it safe for transportation and easy for stocking with the flesh and water remain unaffected. The consumer would have to break open the top using a sharp knife to remove the contents inside. This machine is hi-tech and is equipped to break through tough shells.



of farming communities and encourages the local innovations.

Role of information and communication technology for improving coconut farming

Information and Communication Technology (ICT) are diverse set of technological tools and resources used to communicate, and to create, disseminate, store, and manage information. The ICTs comprise of hybrid devices of computing and networking technologies which have capability to improve intra and interpersonal, group and mass communication. These 'new media' ICTs offer unlimited possibilities for connecting people across the several classes and regions. These developments created new opportunities for the extension workers to perform the information dissemination, capacity building and technology application more effectively.

SUMMARY

Coconut sector has a huge potential for promoting innovations as it has rich resources of traditional indigenous knowledge. Research institutes over the years have developed and fine-tuned many innovations which include new technologies, machines and implements, new varieties, crop management practices, pest and disease management problems, agricultural labour problems. Time-tested, rational and effective farmer practices suited to the local situations and local culture may be blended with modern crop production technologies, which in turn would promote sustainable coconut production. Innovative efforts should be continued for strengthening the transfer of technology and for improving productivity and profitability from coconut farming.

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and cheap wood flooring and panelling material.

ICAR has established Agri-business Incubation (ABI) centres in 25 ICAR institutes to nurture early stage innovative start-ups and entrepreneurs. New technologies and innovative coconut based products are developed at Agri Business Incubator (ABI) at KAU and at CPCRI. With, the help of ABI, entrepreneurs could make use of the laboratory, machinery and scientific assistance at CPCRI and KAU for manufacturing marketable products.

Innovative approaches for technology transfer

Viable technologies related to crop production, crop protection and processing for enhancing income from coconut was developed by CPCRI and KAU. Effective linkages between research, extension and farming community are a crucial requirement for sustainable coconut development.

Interactive videoconferencing

Interactive video conferencing facilitates scientist-farmer interaction on available technologies and experiences of coconut farmers in the farm level adoption of technologies. Interactive videoconferencing has

been used by CPCRI, KAU and Coconut Board as an important technology transfer activity and for organising Research-Extension - Farmer interface programmes on coconut.

Farmer field school

A farmer field school (FFS), an innovative approach to make farmers expert in coconut farming, is school without walls and group of farmers meet together in one of their fields to learn about their crops and various factors that affect the crops. They learn how to improve their farm by observing, analysing and trying out new ideas on their own fields. This innovative approach to adult education was developed as an alternative to the conventional top-down extension approach and is based on the concepts and principles of people-centered learning. In this approach, the farmers have an opportunity to learn for themselves about crop production problems, and ways to address them, through their own observation, discussion and participation in practical *learning-by-doing field exercises*. This people centered learning process make farmers experts in their own farms. The FFS system further helps to improve the decision-making capacity

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