

# Coconut oil – combining energy supply and income diversification

Biofuel as an alternative to expensive imported diesel fuel could provide Pacific Island countries with a means of reducing their reliance on imported fuels as well as cutting greenhouse gas emissions. An action research project in Fiji has explored how coconuts can be used both to generate energy and to manufacture cosmetic products that can contribute to income diversification for the rural population.

Over recent years there has been increasing interest in the use of coconut as an alternative source of energy for rural communities in the Pacific Island region. Many energy agencies in the region are currently seeking to identify biofuel good practice. As part of this process, the Pacific Islands Applied Geoscience Commission (SOPAC), with funding from the Technical Centre for Agricultural and Rural Cooperation (CTA), implemented an action research project to develop a small-scale coconut processing model that could be replicated in rural communities in the Pacific. The aim of the project was to explore the feasibility of a shift in production away from traditional low-value dried copra towards a more valuable product – coconut oil – which can be used to

manufacture biofuel (for use in modified diesel engines) and other value-added products such as body oil, body lotion and coconut soap. Such a shift would provide village communities with the opportunity to increase and diversify their income base, thereby boosting their economic resilience.

## ■ From copra to biofuel

In July 2009 SOPAC installed and commissioned a small-scale coconut oil processing mill at the Centre for Appropriate Technology and Development (CATD) in the Fiji Islands. This demonstration processing mill consists of a coconut oil mill, a biofuel blending unit and an 18 kVa diesel engine generator.

**Coconut oil mill:** The coconut oil mill involves a copra cutter which cuts dried copra into small pieces that are then passed through a cold-press expeller. The expeller extracts coconut oil from the copra; copra meal, which is used as pig fodder or manure, is a by-product. The cold-press expeller produces on average around 10 to 15 litres of coconut oil per hour; 12 to 15 coconuts (2.17 kg copra) are needed to produce one litre of coconut oil. The expressed coconut oil is then stored in a settling tank, allowing the large particles in the oil to settle and sink to the bottom of the tank. After a few hours in the settling tank the oil is passed through a vacuum filter which removes any remaining par-

*The demonstration processing mill consists of a coconut oil mill, a biofuel blending unit and an 18 kVa diesel engine generator.*



Photo: SOPAC

### Frank Vukikomoala

Economic Development Division  
Secretariat of the Pacific  
Community (SPC)  
Suva, Fiji  
frankv@spc.int



Photo: SOPAC

ticles larger than one micron in size. The filtered coconut oil that results is filled into a 200-litre drum which forms part of the manufacturing process for biofuel and other value-added products.

**Biofuel blending and power generation:** The biofuel blending unit involves a stirrer fitted into the 200-litre tank; here coconut oil and diesel are blended in a ratio of 80 percent coconut oil to 20 percent diesel fuel. In a number of cases an additive to facilitate mixing and combustion was added to the 80:20 biofuel blend during the mixing process. The biofuel thus produced has a low freezing point: pure coconut oil solidifies at temperatures below 22 °C, whereas the 80:20 biofuel blend remains in a liquid state and retains fairly constant viscosity despite fluctuating external temperatures. To generate power, the biofuel produced is fed directly into the diesel engine generator, which is an indirect injection engine with a generator rated at 18 kilovolt-ampere – kVA – (14.4 kW) under standard (prime) operating conditions. According to the supplier's specification, the engine's fuel consumption is 3.9 litres/hour at 75 percent load. CATD currently uses the

biofuel for the 18 kVa engine generator and tractor. The 18 kVa engine generator provides power for the coconut-oil production process and the other value-adding activities. The generator also serves as a backup power supply for the CATD offices which can be called on when the supply from the main grid fails.

### ■ Value-added products and production cost

In addition to supplying CATD with the demonstration processing mill, SOPAC – aided by local biofuel experts and oil specialists – trained CATD operators and trainers in the production of biofuels, body oils, body lotions, coconut soap and virgin coconut oil. Training also covered the quality and marketability of the products. The costs of producing the value-added products manufactured from coconut oil are detailed below.

■ **Coconut biofuel blend.** In the month of September, the cost of producing one litre of biofuel at CATD was approximately 1.72 Fijian dollars (FJD – 1.00 FJD = 0.38 euro). This is

*Rural people can diversify their income by making value-added products such as body oil or soap from coconut oil.*

13 cents below the retail price of diesel in September 2010, which was FJD 1.85. If replicated in a rural community, production costs would be even lower since copra is available free or can be bought at a much-reduced price.

■ **Coconut soap.** Soap produced at the demonstration site could be used for laundry and bathing or sold as souvenirs. The cost of producing 90 grams of body or laundry soap at CATD is around 55 to 65 cents.

■ **Coconut body oil.** The refined coconut oil produced from the oil mill is blended with incense made with native flowers and sunned. The cost of producing a litre of body oil at CATD is around FJD 1.60.

■ **Body lotion.** This involves blending emulsifying wax (beeswax), coconut oil, water, essential oil and fragrances of native flowers. The cost of producing 100 ml of body lotion at CATD is around FJD 1.24.

■ **Copra meal.** This is a by-product of the extraction of oil in the coconut expeller. Copra meal has been used as pig fodder and manure at CATD.

As part of the marketing of coconut oil products, a market survey was undertaken by the University of the South Pacific (USP) in October 2009 to investigate and identify potential market outlets and customers for the four major products derived from copra oil that CATD and rural-based enterprises in Fiji could produce – body oil, body lotion, body soap and laundry soap. By comparing the existing prices charged by urban retailers in Fiji for these products with the production costs of value-added products from the Centre for

Appropriate Technology and Development (CATD) coconut oil processing mill it is possible to identify the potential savings that value-added products from coconut oil could offer when sold in the rural markets.

The project's findings are currently being compiled and will be documented for dissemination to Pacific Island countries (PICs). SOPAC will follow this up by working with national energy agencies to progress the development of small-scale coconut oil processing mills at potential sites in PICs; this will involve making funding opportunities available and promoting public-private partnerships.

### ■ Putting the results into practice

As part of its biofuel project, the government of Fiji has developed, installed and commissioned a biofuel production plant on the island of Koro which has been operating successfully since March 2010. The biofuel produced has had the intended effect of reducing fuel costs for the communities on Koro where biofuel is now being sold as fuel for diesel engine generators in the villages and for diesel-operated vehicles. Further sites have been identified and

the government of Fiji is planning to install an additional 23 biofuel mills in the coming years. The Ministry of Agriculture has also been progressing the development of small-scale manufacturing projects involving the production of virgin coconut oil, soap, body lotion and body oil from coconut. In accordance with its development plans the Ministry of Agriculture will be installing small low-tech coconut oil mills in a number of islands.

The training programme developed at CATD will provide training support to ongoing biofuel electrification projects and small-scale coconut processing projects in Fiji; operators from the targeted communities will have access to the findings and experience of the coconut demonstration mill at CATD.

SOPAC also assisted CATD to develop its small-scale coconut processing training programme which was trialled in September 2010. The training involved two different modules which were delivered simultaneously, as follows:

**1. Coconut oil mill operation, biofuel processing and equipment maintenance and servicing.** Instruction in this area was mostly hands-on and covered biofuel production,

operation of equipment and maintenance; training was targeted at rural operators and technicians. The equipment involved included the coconut oil mill, the filtration units, the biofuel blending system and the diesel engine generator.

**2. Small-scale coconut oil processing and marketing.** This involved training in the production of coconut oil products (virgin coconut oil, soap, lotion and body oils), product packaging, marketing and business issues, hygiene requirements and other standards and microfinancing opportunities. Training was targeted at individuals, women's groups and village representatives interested in establishing small businesses based on processed coconut oil products.

The training created an opportunity for CATD to establish links and partnerships with other government departments and institutions in putting together their resources for servicing, developing and strengthening the coconut industry while at the same time promoting energy security in Fiji. The training therefore cooperated with the Fiji Department of Energy and the Ministry of Agriculture in selecting participants (operators and community members) from their identified project sites.

### Zusammenfassung

Ländliche Elektrifizierungsprojekte in den meisten pazifischen Inselstaaten beruhen vorwiegend auf Dieseldieselkraftstoff; solche Projekte sind jedoch durch hohe Transportkosten, lange Wege und das Fehlen von Einkommensmöglichkeiten schwer zu realisieren. Die *Pacific Islands Applied Geoscience Commission* (SOPAC) und das CTA (Technical Centre for Agricultural and Rural Cooperation) haben jetzt gemeinsam ein kleines Projekt zur Verarbeitung von Kokosnussöl finanziert. Die Nutzung der lokalen Koprproduktion als Bio-Kraftstoff für die ländliche Elektrifizierung in Verbindung mit der Produktion von Mehrwertprodukten zur Diversifizierung der Einkommensmöglichkeiten hat sich als ein gangbarer und nachhaltiger Weg für ländliche Gemeinden der pazifischen Inselregion erwiesen. Das Projekt umfasst

ein komplettes Paket mit einer Ölmühle im Miniaturformat, Absetztanks, Anlagen zur Mischung von Kokosnuss- mit Dieseldieselöl und einem Dieseldieselaggregat mit indirekter Einspritzung. Diese Anlage wurde im *Centre for Appropriate Technology and Development* (CATD) auf den Fidschi-Inseln installiert und wird seither erfolgreich betrieben.

### Resumen

Los proyectos de electrificación rural en la mayoría de los estados insulares del Pacífico dependen del combustible diesel. Este tipo de proyectos afrontan desafíos tales como los altos costos de transporte, la lejanía y la falta de oportunidades de generación de ingresos. La Comisión de Geo-ciencias Aplicadas de las Islas del Pacífico (*Pacific Islands Applied Geoscience Commission* – SOPAC) y el Centro Técnico de Cooperación Agrícola y Rural (*Technical Centre for Agricultural and*

*Rural Cooperation* – CTA) han financiado conjuntamente un proyecto de procesamiento de aceite de coco a pequeña escala. El utilizar el suministro local de aceite de copra como biocombustible para la electrificación rural – en combinación con la producción de bienes de valor agregado para diversificar la base de ingresos – parece constituir una opción viable y sostenible para las comunidades rurales de estas islas. El proyecto viene como paquete completo: consiste en un mini-molino de aceite, tanques de sedimentación, equipos para mezclar el aceite de coco con el combustible diesel y un motor diesel de inyección indirecta de 18 KV. Estos paquetes han sido comisionados e instalados por el Centro para Tecnologías Apropriadas y Desarrollo (*Centre for Appropriate Technology and Development* – CATD) de las Islas Fiji, y vienen operando exitosamente.