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Palm Sugar Processing In Cambodia

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INTRODUCTION

Palm sugar processing is considered a family enterprise. It is estimated that there are 3 million palm sugar trees, *Borrasus flabellifer,* in 10 provinces of Cambodia: Kompong Thom, Kompong Chhnang, Kompong Cham, Prusat, Kandal, Kampong Speu, Takeo, Kampot, Svay Rieng, and Preveng. More than 30,000 families' livelihoods are involved in this traditional business. In some provinces, up to 70% of the households are engaged in this activity.

As in many Asian countries, palm sugar plays a crucial role for the local and national economy. Both men and women are equally involved in processing sugar while only men are involved in palm sap collection.

There are four different types of palm sugar products based on the color and sugar content in the Cambodian market. They are:

Palm tree

From 1989 to 1999, palm sugar production declined as a result of white cane sugar imports and a drop in exports to Vietnam. Some drawbacks observed in palm sugar production that reduced the price of the final product were: poor quality control, poor hygiene standards, undeveloped sales networks and inadequate storage facilities.

Type of Palm Sugar Product	Sucrose Content
Hardtack sugar in wafer form (ska pen)	over 90%
Soft white sugar, premium quality (often with additives such as sulphurous acid)	70 to 80%
Soft brown sugar (referred to as second or third grade)	above 60%
Deep brown sugar (fourth grade) used by refineries and distilleries	below 60%

Collaboration was initiated with the Institute of Technology of Cambodia (ITC), by introducing improved palm sugar stoves for quality palm sugar processing, and paying attention to the production and marketing of granulated palm sugar. The pH level of the sap was checked before processing as the main indicator of better final quality. Farmers were trained to produce high quality sugar so that they could get a better price for their product.

PALM SUGAR PROCESSING

The palm sap is obtained from the inflorescences (flower clusters). The early sprouting inflorescences are squeezed with a large pair of pliers to break down the fiber structure and then the tip of the inflorescence is cut to allow the sap to ooze out. The palm juice (sap) is then dripped into clean and sterilized bamboo or plastic containers, which each hold a piece of Popeel wood, *Shorea roxburghii*. Popeel wood contains tannin which is used to prevent fermentation of the sap before it is cooked.

On average 4L of palm juice is collected per tree per day. In Cambodia, one family collects palm juice from around 20 trees and produces 1200kg of palm sugar each season. The tapping season starts in November and ends

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4. www.cfsp.org.kh Program managed by GERES France, supported by European Union.

in June. The maximum collection occurs from January to April.

The palm juice is then boiled in a stove until it nearly solidifies. Constant heat intensity is very important to get high quality sugar. In many cases, low quality sugar is obtained due to fluctuation of the temperature of the sap while it is boiling.

The wok with semi-solid juice is taken off the stove and stirred using a wooden paddle fitted on wooden shaft to remove the final water content. The final sugar is then stored in dry condition.

Palm sugar producers feel that the whiter the final product, the better the quality of palm sugar. To obtain a white sugar product, a number of palm sugar producers use sulphuric anhydride, a compound which is not recommended for use in food stuffs. Some use sodium hydrosulphate, 100 mg per liter of palm juice, to obtain white sugar.

WOOD ENERGY

Palm sugar processing is an energy intensive activity. In 1998, Cambodia Fuelwood Saving Project (CFSP) identified that fuelwood consumption for palm sugar processing was the second highest rate of consumption after cooking. In some provinces, individuals must travel 13km to collect fuelwood from national forests. Sugar processing consumes more than 4kg of air-dried wood per kilogram of palm sugar processed on a traditional stove. That represents roughly 5 tons per year per family or 150,000 tons of wood burned annually for palm sugar processing.

In Kompong Speu and Kandal provinces, scarcity of fuelwood is apparent. Farmers are switching

Returning From Fuelwood Collection

from fuelwood to palm leaf and rice hulls as fuel for palm sugar processing. The most striking news is the use of garment waste (treated with flame retardant, not declared by the manufacturer) as fuel for palm sugar processing. Burning textiles emits high concentrations of poisonous gases like hydrogen chloride and hydrogen cyanide. These emissions further threaten the health of sugar processors more than the normal pollution they must suffer on a day-to-day basis if they are burning biomass fuels.

STOVE TECHNOLOGY

Traditional Stoves

A traditional stove for processing palm sugar is a single pot-hole up-draft stove made of termite clay which is locally available. It has a firebox and another small hole from which to clean the ash. Three external pot rests are placed on top of the stove during use.

Stove Improvement: First attempt made by CFSP (1998-2000)

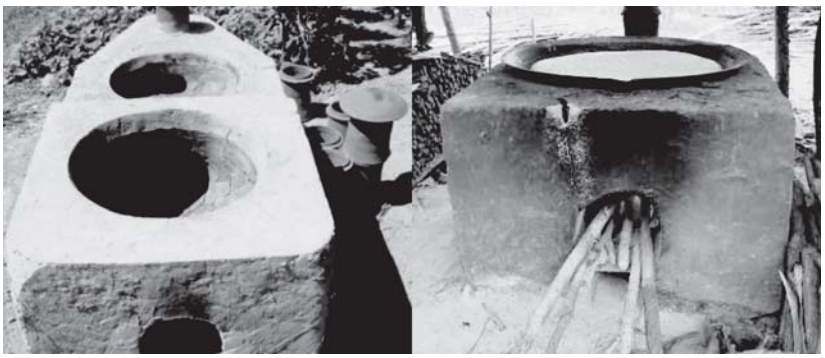
Taking into account the efficiency of sugar production, marketing the products, saving fuel and energy, and easing palm sugar processing, CFSP developed and introduced a low cost owner-built stove. So far WENetCam, with support from CFSP, has trained more than 26 technicians to construct improved wood-burning palm sugar stoves and improve the quality of palm sugar. An operation and construction manual was published and pedagogical tools were broadcast on national TV.

Owner-built palm sugar stoves are one or two pot-hole up-draft stoves also made of termite clay. The stove is constructed by a skilled person using external molds for maintaining design dimensions. The stove parts are then carved according to the dimensions given. Primary air intake, grate (use of bricks), baffle and chimney are the main components of these stoves. Based on the required production capacity, single or double potholes are built.

Loose residue-burning owner-built stoves were also introduced by using Acacia leaves, rice straw and other loose raw materials in areas where people find it difficult to obtain wood. These leaves and other loose residues are burned efficiently. The stove has an inclined grate.

Based on the information provided by WENetCam, around 2,000 improved owner-built stoves (wood burning and leaf burning) were installed by CFSP and WENetCam members. These stoves consume about 25% less fuelwood than traditional stoves to process the same amount of sugar.

Traditional PSS



Wood burning Improved PSS

Quality Improvement

The micro-organic activity that promotes sugar inversion is greatest in the palm juice when the juice is at a temperature range between 20 and 50 degrees Celsius. It is therefore important to get the overall temperature up above this range as quickly as possible. That is why producers keep Popeel wood in the palm juice containers to prevent fermentation. In some cases, producers reuse a piece of Popeel wood and the tannin contained in the wood may not be so effective. Thus, fermentation starts rapidly and yields reduced quality sugar.

In most cases, palm sugar producers add cold palm juice during boiling and thereby reduce the temperature in the wok. This causes a fluctuation in temperature and yields low-grade sugar such as soft brown sugar.

Development and Appropriate Technology (DATe) introduced a simple technique to get high hardtack sugar in wafer form (ska pen) by evaporating the water in the palm sugar (soft white grade) at low temperatures. Evaporation can be done with the remaining charcoal in the stove. The sugar is molded to get hardtack in wafer form. There is demand for this product among tourists, hotels and restaurants. It is estimated that about 25% of tourists will be interested in buying this product (0.5kg per person) and tourist demand represents about 125 tons per year. Some organizations are looking for an export market and have started collaborations with companies to export this product.

CURRENT CFSP STRATEGY ON PALM SUGAR FOR LONG-TERM SUSTAINABILITY

To ensure sustainable income-generation for family producers and high quality products, the palm sugar processing industry must be reformed to become more professional. To support high quality products, palm sugar should be produced with environmentally friendly technologies. CFSP has been working closely with the Ministry of Industry, Mines and Energy of Cambodia (MIME), and has defined a strategy for small-scale activities by introducing high performance stoves together with producer-managed palm tree plantations. Around 400 trees are needed per family to yield enough branches daily (by pruning) to process in high performance stoves. A pilot project was started in Kompong Tralach village with the help of DATe.

Improved Leaf-Burning PSS

Tree Planting and High Performance Stoves

Recently, CFSP introduced high performance stoves in collaboration with Planète Bois[5] to develop low cost models by using traditional building materials such as brick and clay. Feedback from field testing has proven the feasibility and robustness of this choice of materials. Currently, a field version has been developed for around $100 US.

In this stove, combustion stages are separated: in one chamber there is production of combustible gas from wood and in the second chamber there is proper combustion under optimized conditions. The first chamber, where heating, drying and pyrolysis of fuelwood take place with a minimum amount of primary air, is called the pyrolysis chamber.

The second chamber, where real combustion takes place, is called the flame developing chamber. The two chambers are connected by a semi-venturi where secondary air is injected. Under these conditions, a high temperature flame (around 1000°C) is produced with very low

5. **Planète Bois:** French entity specializing in wood energy technology and transfer of technology in developing countries, contact : rozisjf@club-internet.fr, (free lance wood energy expert, project coordinator for GERES)

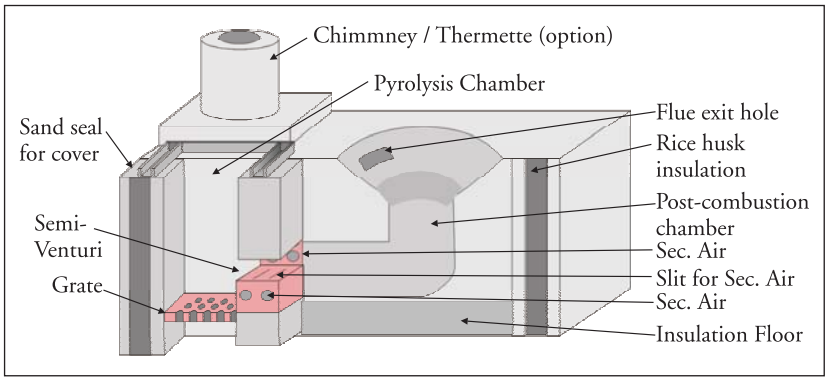
carbon monoxide (CO) emissions. Thermal heat transfer in this stove is efficient and useful heat is found to be around 60%.

Test results in Kompong Tralach showed 3.9kg of wood was burned to produce 1kg of palm sugar on a traditional stove. A study conducted in five other villages of Kompong Chhnang resulted in an average 4.4kg of wood consumed per kilogram of sugar produced on traditional stoves (CFSP 1999). A

study conducted in Takeo Province reported that a loose residue palm sugar stove consumed between 4.2kg and 6.7kg of palm leaf per kilogram of palm sugar produced. The high performance stoves, meanwhile, only consume around 2kg of wood to produce 1kg of palm sugar. High performance stoves also produce far less smoke than their traditional counterparts. The most smoke is produced in the beginning during initial firing. Once the post-combustion period begins, however, the flame temperature is very high and the amount of smoke produced decreases. As we are still in the R&D phase, improvements will be made to further reduce biomass consumption as much as possible.

Other benefits from this stove include improvements in working conditions, such as increased safety, no surrounding radiant heat, and ease of use. Producers can be involved completely in processing and the quality of the final product.

Excess heat is used for sterilizing juice before processing. In the chimney, a Thermette can be used for sterilizing palm juice or boiling water. A Thermette is a device that is installed basically as a component of the chimney with an attached container that will hold



Cross Section of HPS

liquids. The hot water is used for cleaning palm juice containers ("ampongs"), and also for household energy needs (tea preparation, cooking food and preparing animal food).

CONCLUSION

Palm sugar processing activities in Cambodia are entering a new stage for ensuring 1) sustainability through income generation, 2) environmentally friendly processing, 3) safer working conditions, 4) demand for palm sugar remains inelastic to shifts in oil pricing, and 5) products reach new export markets.

We remain impressed by Cambodian tappers daily risking their lives to ensure a minimum income for their families. CFSP is planning to collaborate with Handicap International to work toward safety for palm tree tappers by using basic safety tools to avoid injuries from falls.

Palm sugar remains an essential product with a promising market. Our role now is to accompany producers ready to make changes to ensure the sustainability and profitability of their traditional household activity. glow

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Empowering Coconut Sugar Makers

in Indonesia Through Cooperation with Private Coconut Plantations

*Bambang Wahyupurnomo**

It's truly saddening to consider the fate of coconut sugar makers. Their product is used in almost every household and yet they can never improve their standard of living and remain one of society's impoverished groups. Only one in a handful of people can improve his position to move from a tapper to a small-scale trader, much less to that of a large distributor, who can become a trader between areas and also become an exporter. Even though Indonesia has 3.7 million hectares of coconut trees planted (which may be the largest in the world), an abundance of labor, and a national market share of 1 million tons per year, this abundance of resources and available opportunities do not improve the welfare of the coconut sugar-maker. If we discuss prominent figures in history who achieved industrial success, such as the management of the large peanut business by Sudhamek, or flour business owned by conglomerate Salim Group, coconut sugar is one essential ingredient in everyone's pantry with a market share of trillions of rupiah that has never been owned by a king or queen. It is entirely possible that the reason for this lack of royal ownership is due to the complexities of the trading system of this product.

Tapping activities are usually carried out as a part-time job alongside work as a farmer, taking care of animals or as a plantation overseer in rural areas. In general, in Central Jawa, tappers only work in areas bordering on their residences. The amount they can collect in one day is relatively small, from between 7 and 20 trees. In addition to tapping their own trees, there are two ways of dividing the proceeds. The first, called *ngeons*, is where 1/10 of the already cooked sugar goes to the owner of the tree.

Tapper

The second, called *maro*, is where the already cooked sugar is split in half between the tree owner and the tapper.

Generally on individual farms, the distance of the fields, the types of coconut palm grown and the ages of the palms all vary such that these factors influence the effectiveness of tapping and the harvest that results. Cooking the sugar involves the whole family and is carried out in individual kitchens. Sometimes the quality of cooked coconut sugar is not very good because of a high content of foreign particles that make their way into the sugar. This contamination occurs because of the generally poor quality of cooking that occurs, for example, when families boil cassava for eating in the same pot at the same time as they are cooking the coconut sugar.

The basic materials for making the sugar-cooking stoves are clay and brick. They fuel the stove using firewood. Prepared sugar sells for between 1,350 Rp. to 2,200 Rp. per kilogram. From these sales, tappers usually make between 7,500 Rp. and 20,000 Rp. per day. Even though this sum may be regarded as small, it is enough to shore up the finances of a family, most of whom are farmers, especially during the dry season. The harvest is often bought on a system of advanced payments,

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Seller with Molded Coconut Sugar

where the middleman pays for the harvest before it is ripe and the farmer must guarantee that price regardless of whether the value of the crop has changed by the time it is harvested. Coconut sugar-makers are often entrapped in the system of advanced payments because they cannot return the money they have already borrowed, nor can they repay their debts for a moped bought earlier.

Other than being manipulated by middlemen, fluctuations in the price of coconut sugar can be caused by three factors: higher demand during the month of Ramadhan; the rainy season, which affects production of sap; and increases and decreases in supply, such as in the harvest season when farmers are busy with their fields so the supply of coconut sugar declines.

THE COCONUT SUGAR PRODUCTION CENTER (SPGK) CIJAMBE CIKIDANG

In 1999, the Sekar Karya Bersama Cooperative, which accommodates those laid off after the fire that burned the GORO Jakarta Sunday Market building during the May 1998 riots, received an offer to continue a pioneering coconut sugar project originally run by one entrepreneur which had failed. The area of this pioneering project was located on the coconut and chocolate plantations owned by PTPN VIII in Cipetir Sukamaju Plantation in Cijambe Village, Cikidang Sub-District, Sukabumi District, West Java.

With a breadth of 300 ha and about 37,000 early ripening coconut palms, this plantation is quite productive. There are also cocoa bushes that bear lots of fruit. The coconut palms are all about 10 years old and 8-10 meters tall. The distance between palms is uniform at 9x9 meters. Unfortunately, the harvest had not achieved the levels hoped for, for the following two reasons: 1) the fields were often the target of looting by the community surrounding them, and 2) the final sugar product did not harden and so could not be properly molded.

The looting occurred because the people living in the surrounding area have never felt that they benefited from this plantation. Like a chick that starves in a rice barn, compared to the profits made by PTPN which reach hundreds of billions of rupiah, the income of the laborers living in the area and working on the plantation is just about 6,000 Rp. per day. Consequently, the standard of living of the community living around the plantation is still classified as impoverished, which has an impact on looting activities.

There were two possible causes for the sugar not hardening during processing, namely, one was the tapper's lack of experience in choice of type of metal used for the pans in which to cook the sugar, and two, was the type of coconut palm that was tapped was not very good for making coconut sugar.

To overcome these issues, a comparative study has already been done on several coconut sugar centers in the areas of Banyumas, Gombong, Purwokerto, Purbalingga, and Wangon. To assure the success of the product, 4 senior tappers and their tools were included in the group toward the end of the visit to Cijambe. With the knowledge gained from this comparative study, they began to experiment with production. A high quality coconut sugar could only be obtained with the second attempt at production. The success of the experiment opened up opportunities for expanding production, which eventually attracted the interest of an entrepreneur who decided to invest 150 million rupiah in the project.

This investment money stimulated more professional management of production. One example of this management was proposing collaboration with the owners of the coconut palm plantation, PTPN VIII. This proposal was

Filling Molds

welcomed by PTPN VIII and the production group began renting use of the trees at 20,000 Rp. per tree per year. This step was also taken in the hopes of reducing looting by the locals living around the plantation. The production center also brought 30 coconut sugar-making families complete with provision of various facilities such as barracks for sleeping in and cooking, cooking utensils (woks, knives, buckets, rope, bamboo for carrying coconut sugar sap, etc.) 40 coconut trees, and with pre-production funds of up to 350,000 Rp. per household head. Stove production was accomplished by each potter/tapper with materials such as bricks and cement provided by the stove center. The fuelwood used was dried twigs from the cocoa plants or coconuts from around the plantation.

After two weeks, each coconut sugar-maker had to store 6 kg of sugar with the manager of the center and sell the remaining sugar through the center. The manager marketed the sugar and took 300 Rp. profit per kilogram sold. From the 6 kg of sugar stored with the center, 3 kg was for the investor and 3 kg went to covering the operational costs of the center.

In the beginning, the production of sugar by each tapper was just about 12-22 kg per day. Slowly but surely, however, production reached 18-40 kg per day. Increased production meant that the level of income per sugar-maker increased to between 15,000 Rp. and 75,000 Rp. per day. With total daily production between 800 kg and 1 ton, Cijambe Village, which used to be quiet, is now lively with hawkers and sugar-sellers. With as much as one million rupiah in circulation every day, the economy of the village has also improved.

There are, however, constraints that are often faced. For example, with the marketing of the sugar, which from the beginning encountered lots of problems facing "mafia/ bandits" in the market, various marketing methods had to be carefully studied so that sugar-makers would not face bankruptcy. For example, if someone goes to Jakarta to market the product in person, it is just like walking into the mouth of a crocodile. One also must face dirty tricks by many traders who ask for a shipment as large as a ton to be sent in advance and offer the payment on arrival. One must be careful of this system because often, once the goods are in the warehouse, the amount of money offered is only half the amount agreed to and then the trader offers the second half for when the second, larger shipment arrives. At the time the second shipment arrives, however, the trader only repays the debt on the first shipment. This pattern continues until the amount of funds withheld by the trader grows larger and larger.

This type of trade is carried out not just by petty traders, but also by those considered "big players" in the market. For example, one mid-sized distributor from Cibadak remembered being very cautious with one trader who became the supplier for a big kecap factory because using the above trickery, he lost 200 tons of sugar to this trader without being paid. To overcome this problem and avoid bankruptcy, he decided to change his strategy from "winning the ball" to "protecting the goal." He changed his marketing by inviting traders to the plantation to make orders in advance, paying a down payment and then getting a schedule for picking up the goods. The trucks to pick up the sugar had to be provided by the buyers themselves. Since using this

Making Crystallized Sugar

system, marketing has improved and there are more and more traders who line up to put in orders.

OBSTACLES ENCOUNTERED

In contrast to the other centers, SPGK Cikidang has not encountered any problems during operation in the areas of investment, marketing, or supply of raw materials used (coconut trees). The largest obstacle they faced was in recruiting and maintaining a steady and skilled labor supply. The first problem was in recruitment, because if a skilled and experienced potter could be found, he or she often refused to move from the original hometown to a production center to work. The second problem was keeping people on site, as the average time a tapper stayed at the center was between 8 and 18 months. Most people became fed up because tappers are never given days off for national holidays or bad weather. As soon as they save enough money, they go back to their hometowns, and thus continues the alternating staff at the center. These difficulties meant that often the number of employees did not increase over time and the production center could not keep up with increases in demand for the product. Other alternatives, such as educating the population living near the plantation, did not work out. Keep in mind the reluctance of people to work hard climbing dozens of trees every day. During the five years the center has been operating, only two locals have succeeded in becoming tappers. This lack of local tappers makes the center depend on those from other areas.

These issues caused the loss of several good deals offered by investors interested in the project, for example, investment for expanding the enterprise. In one proposal, all 300 ha would be used for coconut sugar production and

Activities	Traditional Sugar Processing (community coconut fields)	Industrial Sugar Processing Center (company plantations)
Tapping System		
Number of trees per day	12-24	30-70
Distance between plants	Different between palms / dispersed	Distances the same in one field
Height of coconut palms	Varies 7-20m	Same and all < 10m
Species of plant tapped	Various	Same
Production of sap	Various	Comparable
Age of coconut palms	Various	Same
Production System		
Cooking sap: produces	6-12 kg / day	9-35 kg / day
Location	Spread out in families' kitchens	Central industrial kitchens
Product	Various qualities	Same quality
Quality Control	Various depending on the house	Same
Mixture	Various and not watched	Same and Supervised
Ingredients	Various	Collective and the same
Marketing System		
Price	Depends on tapper and middleman	Depends on producer and market
Price	Lower	Higher
Marketing	Depends on tapper's policies	Depends on the production center
Supply Chain	Longer (goes through collectors at hamlet, village level, middlemen, traders, until it reaches the consumers.)	Shorter (product can go straight from the center of production to consumers.)
Producer's Income Levels	12,000-24,000 Rp. / day	18,000-70,000 Rp. / day
Profit-sharing System	*"Ngeons"* 1/10 to landowner, 9/10 to sugar-maker	Every tapper stores 6kg of sugar every 2 wks for center manager and must sell the rest to the manager. The center then pays the plantation owner 1.25kg of sugar (out of the 6kg from every tapper) every 2 wks for using the coconut palms.
Notes: Distance between palms affects the amount of energy needed by tappers to collect sap, as does height of the palms. The age and species of palm affects the quality of sap that can be produced.		

would require an increase in employees to as many as 1200 tappers. That particular investor interested in working with this state-owned enterprise wanted to increase production to 20 tons per day. Investment funds required to reach that capacity summed up to "only" five billion rupiah, compared to billions of rupiah needed for the same production capacity of sugar from sugar cane. As a result of the obstacles encountered above, however, the deal fell through.

THE FATE OF SPGK

Throughout its years of production, SPGK continued to improve its system of operations. Various experiences managing the coconut sugar business have resulted in SPGK holding out in the business while increasing the amount of profit gained by the tappers under its auspices. In 2003, however, something terrible happened which set back all their hard work over the last few years. The management of PTPN VIII decided to convert thousands of hectares of their coconut fields in West Java to oil palms. It is clear that the consideration of the business is only for the bottom line while sacrificing the interests of the communities which had just started to take steps towards a prosperous life. Around the year 2003, the thriving coconut and cocoa fields were razed in the blink of an eye, and switched with seedlings of oil palm. Just the leftover edges of some coconut fields at the Sukamaju-Cipetir plantations became the focus for those tappers who were holding out in competition with those collecting young coconut leaves and coconut palm trunks. At this time, there are only 14 tappers left separated in two locations. Their combined production capacity is 2 tons of coconut sugar per week. Naslam, Makmur, Unus and other tappers are in a dilemma about what to do. They can search for coconut fields to tap in another area, or they can return to their own land, become farmers, and earn 7,500 Rp. per day.

Molded Sugar

CONCLUSION

There are many tappers in need of fertile coconut fields and many coconut plantations in need of tappers. Gathering together and relocating the tappers to coconut plantation areas is better than the tappers holding out in their original area, which is planted with only a few and/or old coconut palms. This matter, however, must be supported with the creation of centers of coconut sugar production where processes are professionally managed. By bringing together all the involved actors, such as tappers, investors, plantation owners and kecap producers, a promising coconut sugar market will be created. From this phase, income that points toward the prosperity and welfare of the coconut sugar-makers will increase. Not just that, but the increase in production will empower the community economy which later could create a center for village economic growth. Just count, if in one coconut plantation in a remote village SPGK could accommodate 100 tappers by stimulating 20,000 Rp. Worth of sales per household per day. This influx of money could become as much as two million rupiah in circulation per day in that remote village. Certainly, this change will encourage and stimulate the village economy.

For the long-term, one must rethink the ownership of the coconut plantations. All the tappers must be connected to a cooperative that receives banking credit support. The marketing aspect also must involve the large-scale kecap industry which has the capacity to manage 1,000-2,000 tons of coconut sugar per month. The methods of cooking must be considered so that they become more effective and efficient. Processing the coconut sugar, which has always occurred in various kitchens using traditional stoves and wood fuel, should be centralized in one industrial kitchen. Production in that kitchen should use energy-saving stoves that save fuel and are low in polluting emissions. glow