

# Appropriate Technology Development: Palm Sugar Processing System in Tomohon, Sulawesi Utara, Indonesia

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**Abstract**---*The purpose of this research is to develop appropriate technology in the palm sugar processing system. To achieve this goal is done by designing and manufacturing wood burning cook stove and stirring machine. From the results of trials of wood burning cook stove and stirring machine made and compared to traditional cooking, it can be concluded: Nira's cooking capacity increases fourfold, firewood consumption and the cooking process decreases by half, smoke and dust from combustion products do not disturb workers.*

**Keywords**---*wood burning cook stove, stirring machine, palm sugar*

## I. INTRODUCTION

The palm sugar industry in Tomohon is incorporated in a household-scale industry that is carried out from generation to generation. In order to prepare research instruments, researchers conduct observations and interviews at the palm sugar business unit that processes palm sugar in Tomohon. The home industry center for palm sugar business in Tomohon dropped. According to observations and interviews in several palm sugar business industry centers have decreased the number of business units because many palm sugar workers have switched professions as vegetable farmers, jobs in tourism, as woodworkers, as liquor makers and there is also worker who only process the nira into half sugar sold in the Masarang palm sugar company with a selling price depending on sugar content (Brix) from 11-20 sold at a price of IDR 1,571 - 2,858 / liter, even there are palm sugar farmer only selling nira in restaurants scattered in Tomohon and Tondano with selling prices around IDR 750 – 1,000 / bottle. The main reason for switching sugar producers is because there are many things that are difficult to get

firewood, and therefore there is nothing better and better than a stable price, and a price factor.

Along with increasing demand and potential benefits, the palm sugar business in Tomohon needs to be developed. Increasing demand for palm sugar abroad has opened up market opportunities that benefit palm sugar farmers. This can be fulfilled if there is good coordination and integration between farmers and related institutions [3][6]. Based on the feasibility analysis of palm sugar business in Tomohon is feasible because the results of BEP production volumes and BEP production prices without calculating labor costs or calculated labor costs are smaller in price and total production [4].

The production process is still traditional using firewood with a ratio of 1:1, meaning that cooking every 1 liter of nira requires 1 kg of firewood. This happens because the heat is not optimal and the cooking process is long [1]. The impact of using firewood continuously will cause pressure on the surrounding forest.

## II. MATERIALS AND METHODS

The material used for the manufacture of wood burning cook stove and stirring machine are steel plate, L-steel, U-steel, solid steel, stainless steel shaft, stainless steel plate, zinc plate, galvanized pipe, galvanized elbow, GRC, bolt, electric motor, dimmer, MCB, starter cam, cable and plug.

The equipment used for the manufacture of wood burning cook stove and stirring machine are welding machines, grinding machines, roller machines, drilling machines, hammers, meters, elbows, pointers, ruler, water pass, scissors. The tools for measuring the performance of wood burning cook stove and stirring machine are

thermometers, pH meters, scales, and measuring cups.

Testing on wood burning cook stove and stirring machine are done by boiling water (water boiling test) to determine the leakage of smoke in the body. Improvements to the body are carried out until no smoke leak occurs anymore. After several WBT tests, followed by cooking nira. The Nira used for testing is fresh nira that tastes sweet because it has just been tapped. The firewood used must be dry so as not to slow down the cooking process. When the nira boils (temperature of more than 100 °C) stirring is carried out on the nira by using a stirring machine to accelerate the evaporation process. After the nira thickens the color turns brown. The pan containing liquid palm sugar is then removed from the wood burning cook stove, cooled for a moment then the liquid palm sugar is transferred to the mold.

### III. RESULTS AND DISCUSSION

The Nira cooking is traditionally done in the following ways:

- a. Tapping the nira that was lowered in the afternoon cooked until boiling  $\pm$  1 hour into sugar water.
- b. The tapping result of the nira in the morning is immediately cooked with sugar water with a large and constant flame for approximately 4-5 hours.
- c. During the cooking process, stir frequently to reduce the foam while doing the first filtration of dirt and remove white foam which is part of the mangosteen bark preservative. The second screening is done when the nira has begun to bubbly.
- d. To prevent the foam froth from overflowing during cooking, add 1 cup of crushed candlenut
- e. After the nira has started to thicken and start to brown, the heat of the fire is reduced so that it does
- f. After the nira has thickened, the pan is lifted from the fireplace while stirring constantly while giving  $\pm$  1/2 liter of clean water slowly. Stirring with wood is done for 7 - 10 minutes so that it cools quickly and the sugar produced is solid (not empty middle)

The traditional Nira cooking in Tomohon can be seen In the Fig.1.



Fig.1. Traditional nira cooking in Tomohon.

Technology includes a method that is simple but useful to produce something better, this technology is commonly called appropriate technology. Make it easy to carry out daily activities to provide basic needs in economic activities [2]. Appropriate technology is designed through a variety of considerations from environmental, ethical, cultural, social, economic aspects and fits the needs of the community so that the use of resources is less [7]. The use of appropriate technology has the aim of increasing development in the countryside, among others: a) Helping to solve problems, b) Evening development, accelerating village growth and improving service capacity, c) Improving abilities, knowledge, skills and responsibilities and building themselves and the environment, d) Expand employment opportunities,

increase production and community income, e) Multiply and disseminate the use of tools that can be produced and maintained in the future, f) Increase cooperation between government and non-government institutions or non-governmental organizations, g) Increase groups information in the village in appropriate information technology services [5].

Criteria the design of the first furnace is healthy. During this time the process of palm sugar production took place where there was smoke which made the people around him cough, his eyes hurt and the air smelled of smoke and heat. The second criterion for stove design is the efficiency or use of firewood is reduced and shortens the production process time. Firewood can be burned to the maximum because the circulation of combustion goes well. The third criterion in the design of the furnace is clean. Reduced use of firewood, the dirt produced during cooking decreases and dirt does not fly everywhere, so that the production site becomes tidy because wood stacking decreases and is comfortable and clean.

Construction is an arrangement (model, layout) and a series of things. The construction of a machine is an arrangement and sequence of several parts / elements of a machine from an equipment, which produces a product, both energy, goods and services. The construction of palm sugar wood burning cook stove is an arrangement and a series of parts / elements of a wood burning cook stove that produce a product in this case palm sugar. The parts / elements of the palm sugar wood burning cook stove consist of: frame (1), griddle (2), incinerator and firewood stand (3), elbow (4), and chimney (5). The design of palm sugar wood burning cook stove can be seen in the Fig.2.

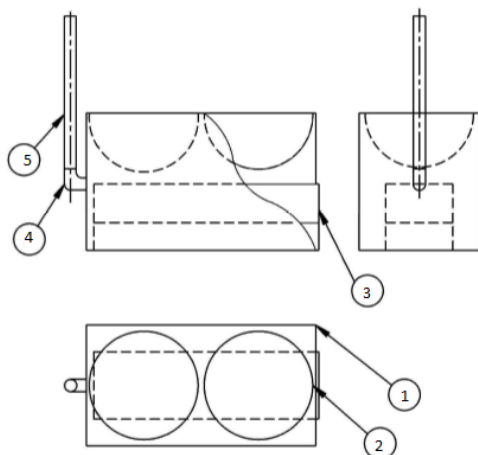


Fig.2. Wood burning cook stove design.

In the Fig.2. frame (1) is made using elbow iron which is cut using a grinding machine. The welding process is carried out to unify the parts that have been cut. The pan (2) is made of aluminum, not made but purchased, the size of the pan is adjusted to the skillet commonly used by farmers. The kiln (3) is made using cut steel plate using a cutting machine. The cut steel plate is then put together using a welding machine. The firewood stand is made using concrete steel that is cut using a grinding machine. Concrete steel that has been cut is then put together using a welding machine. Elbow (4) is made of galvanized, while the chimney (5) is made using galvanized pipes. Galvanized pipes are cut with hand grinding machines. Elbow is joined to the pipe and frame using a welding machine.

The body of the furnace is made using GRC (Glassfiber Reinforced Cement) which is cut using a hand grinding machine. The GRC is joined together with a frame using bolts. On the upper wall of the GRC is coated with a zinc plate which is cut using zinc scissors. The gaps between the GRC are covered with putty so there is no leakage. This closure is intended to prevent smoke and heat from coming out of the wood burning cook stove. Smoke leaks can disrupt the process of making palm sugar. Smoke can cause pain in the eyes and suffocate the workers. Heat leaks cause more firewood consumption. The finished palm sugar wood burning cook stove can be seen in the Fig.3.



Fig.3. Wood burning cook stove.

The construction of palm sugar stirring machine is the arrangement and sequence of several parts / elements of a machine that produces a product in this case palm sugar. The parts / elements of the palm sugar stirring machine of: electric motor (1), frame (2), foot holder (3), and stirrer (4). The design of palm sugar stirring machine can be seen in the Fig.4.

In the Fig.4. frame (2) is made with elbow steel, while the foot holder (3) is made with U-steel, which is cut using a grinding machine. The welding process is carried out to unify the parts that have been cut. Stirrer (4) is made using stainless steel shaft and stainless steel strip, cut using a grinding machine. The welding process is carried out to unify the parts that have been cut. An electric motor (1) is attached to the holder using a bolt. The ready-made stirrer can be seen in the Fig.5.

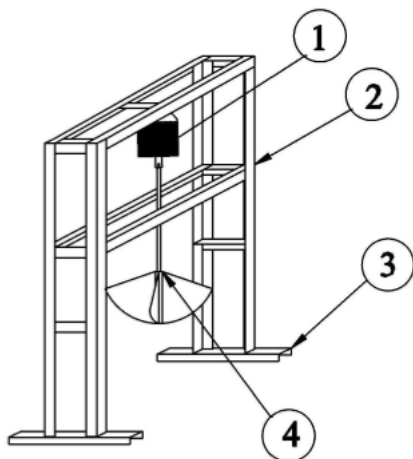


Fig.4. Stirring machine design.



Fig.5. Stirring machine.

#### IV. CONCLUSION

The development of appropriate technology in the palm sugar cooking system has produced two devices, namely wood burning cook stove and stirring machine. From the results of trials of stoves and stirrers made and compared to traditional palm sugar cooking, it can be concluded: 1) cooking capacity increased from 25 liters of nira to 100 liters of nira; 2) consumption of firewood is reduced from 100 kg to 50 kg; 3) the cooking process decreases from 4 hours to 2 hours; 4) smoke and dust from combustion products do not disturb workers.

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