

Appropriate Technology Program of Postharvested Coffee: Production, Marketing, and Coffee Processing Machine Business Unit

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Submission: June 25th 2018; Acceptance: July 26th 2019

Keywords: *appropriate technology; campus independence; coffee; post-harvest; production.* **Abstract** The growth of the area` of coffee plantations continues to increase every year. Therefore, it needs to be supported by the readiness of postharvest technology that is suitable to produce the quality coffee beans. This activity aims to establish a business unit for the Production Center of Postharvested Coffee Technology (PCPCT). This unit business produces and sells the postharvested coffee machines. The method of implementing the activities starts from the establishment of business unit institutions, provision of raw materials, production processes, and the final product marketing. The results of the activity indicate that PCPCT was successfully formed. Appropriate Technology Program (ATP) has been implemented in such way until producing a mobile coffee bean peeling machine (pulper) system, a coffee ore washing machine, a mobile coffee bean peeling machine system, and a coffee bean sorting machine with a vibration mechanism (huller). The product marketing mechanism runs through media brochures, internet websites, and showrooms in the exhibition venues.

1. INTRODUCTION

Coffee is one of the important commodities worldwide trade involving not only producer countries but also many consumer countries. Indonesia is the third largest coffee producing country after Brazil and Vietnam. National coffee production in 2014 was 685 thousand tons or 8.9% of the total global coffee production. Robusta coffee production is 76.7% of the total national production. The rest comes from 23.3% Arabica coffee (AEKI, 2014). According to Chandra (2013), the volume of Indonesian Robusta coffee exports has good prospects.

According to the Directorate General of Plantations (2014), in 2015, the coffee plantation area in Indonesia reached more than 1.24 million hectares, whereas 933 hectares is robusta plantations and 307 hectares is arabica plantations. The total of commodities production reached 685 tons, which 90% of it was coffee. The average of coffee areas development in Indonesia reaches 2.11% per year. According to the data from the Indonesian Coffee Exporters Association (AEKI, Indonesian's abbreviation, red.), Indonesian farmers along with relevant ministries plan to expand Indonesia's coffee plantations, while rejuvenating old plantations through intensification programs. By increasing the area of plantations, Indonesian coffee production in the next 10 years is targeted to reach between 900 thousand tons to 1.2 million tons per year (Indonesia-investments, 2015). The coffee production arises rapidly in Aceh province, particularly in the districts of Central Aceh, Bener Meriah, and Gayo Lues. According to Thurmizi (2014), Aceh coffee production reached 48.282 tons within the area of 123.746 hectares.

The rapid development of coffee production needs to be supported by the readiness of technology and postharvest facilities that are suitable for farmers' conditions so that they are able to produce coffee beans with the quality as required by the Indonesian National Standard. The success of postharvest technology development depends on the success of the system of technological innovation and assistance (Stathers *et al.*, 2013). The existence of a definite quality assurance, availability in sufficient quantities and timely supply and sustainability are some of the requirements needed for people's coffee beans to be marketed at a more favorable price level. To meet these requirements, post-harvest handling of community coffee must be carried out in a timely manner, and exactly the same as other agricultural products.

Harvested coffee beans need to be immediately processed into ready to drink product, so that it is safe to be stored for a certain period of time. For this reason, a reference is needed as a guide for farmers and/or producers to produce market-required products. Along with the increasing demands of consumers for the environment-friendly products, the standard reference must accommodate the principles of good and correct postharvest handling.

The postharvested coffee process starts from ripe coffee bean harvesting, the sorting process, superior and inferior beans, coffee bean skin peeling, fermenting, washing, drying, HS skin stripping (the result of the bean peeled process are seeds that still have horn skin, which is called HS coffee), and also sorting of dried beans and packaging and storing. The machine of postharvested coffee such as coffee bean peeling, washing, HS skin peeling, and sorting have been widely produced and sold in the marketplace (**Figure 1a** and **Figure 1b**). These machines have heavy construction and are not easy to move (non-mobile). Consequently, the postharvested coffee processing is limited and ineffective.



Sources: globalindoteknikmandiri (2018)

Figure 1a. Machine of postharvested coffee that available in the marketplace



Sources: indonetwork (2018)

Figure 1b. Machine of postharvested coffee that available in the marketplace

In one hand, in several remote areas in Indonesia, there are still many traditional coffee farmers who really need some facilities to improve the quality of their coffee. On the other hand, the existence of postharvested coffee technology on the market has large and heavy construction, relatively high prices and barely meet the local demands. This problem inspired us for the establishment of Campus Intellectual Product Business Development Program (CIPBDP), Center Production of Appropriate Technology Program (APT) for Postharvested Coffee Technology, Politeknik Negeri Lhokseumawe (PNL).

In order to develop a knowledge-based economic for higher education institution, universities need to be given access in the form of knowledge and technopark that utilizes the knowledge, education and research results of lecturers. CIPBDP, PNL, is one of the community service schemes. The program is expected to encourage universities to build access to produce their own products and/or technology products. The mission of the CIPBDP program is to create access to the socialization of lecturers' intellectual products in universities in order to meet the needs of the community both internally and externally. Colleges have the opportunity to earn income

and support the students as young entrepreneurs. Therefore, PNL formed the business of the Production Center for APT for Postharvest Coffee. The purpose of the business is to increase campus income through the business of producing coffee postharvest machines which ultimately supports campus self-sufficiency efforts. This activity is also a forum for the dissemination of product-based lecturer research for community needs, as well as a place to create young entrepreneurs.

2. LITERATURE REVIEW

APT has been developed for a long time and has been applied by various parties covering various fields. Nowadays, there are already many appropriate technologies surrounding us. APT is a technology which are designed for a particular society so that it can be adapted to the environmental, ethnic, cultural, social, political and economic aspects of society. In accordance to its type, APT the technology that has many variations in the field of science and its application. Furthermore, APT was created to make human work easier and able to increase economic value. It is a choice of technology and its application which has the characteristics of decentralization, small-scale industries, clean and saving energy, labor intensive, and closely related to local conditions.

The rapid development of coffee production now needs to be supported by the readiness of technology and facilities which are suitable for farmers' conditions so that they are able to produce coffee beans with the quality as required by the Indonesian National Standard (SNI). One of the technological processes in coffee production is postharvest technology. Postharvest technology has an important role in increasing the added value of agricultural commodities through the processing of agricultural products. The good application of postharvest technology makes farming more efficient from the

micro side and can be an opportunity to increase production by reducing the level of yield loss at harvest time and low-quality results.

Several definitions of postharvest have been stated in several studies as follow. Postharvest is one of the activities to improve the quality of agricultural products, for that various actions or treatments are given to agricultural commodities after harvest until the commodity is in the hands of consumers. Postharvest handling aims to ensure that the conditions of agricultural commodities are good and appropriate when consumed or when used as raw materials in processing section. Postharvest activities are divided into two parts. The first one is postharvest handling or often called primary processing. This activity includes all treatments from harvest until the commodity can be consumed as 'fresh' or as raw material for further processing. In general, this activity does not change the form. The second is fully processing or often called secondary processing. This activity includes activities that change the shape of agricultural commodities to other forms with the aim of preserving, preventing changes that are not desired or for other purposes (Mutiarawati, 2007).

Meanwhile, according to Mayrowani (2013), postharvest handling activity of plantation crops is defined as an activity in handling plantation products, that is, from harvesting to being ready to become raw materials or final products which are ready for consumption. As mentioned earlier, postharvest coffee technology is also divided into two major activity groups, namely first: primary handling which includes handling commodities to become semi-finished products or ready-made products, where product changes/transformation only occurs physically, while chemical changes usually do not occur at this stage. Second: secondary handling, namely the continuation of primary handling, where at this stage, there will be a change in the physical form and chemical

composition of the final product through a processing process. The application of postharvest technology is related to the local socio-cultural conditions, so that the policy making must not distort the local socio-economic conditions, but still be able to accommodate the national mission of increasing production and quality of results.

Postharvest agricultural products are all activities carried out since the process of handling agricultural products up to the process of producing intermediate products (intermediate products). Postharvest handling aims to reduce yield loss, reduce the level of damage, and increase the storability and usability of commodities to obtain added value (Setyono *et al.*, 2008). The imperfect postharvest handling can cause loss of yield, both the weight and quality of the products which are produced, especially for the rainy season harvest (Firmansyah *et al.*, 2007).

Coffee is one of the type of plantation that has long been cultivated and has a fairly high economic value. World coffee consumption reaches 70% and 26% for Arabica and robusta coffee species, respectively. Coffee is originated in Africa, namely the mountainous region of Ethiopia. However, coffee itself was only known by the world community after the plant was developed outside its home region, namely Yemen in the southern part of Arabic countries, through Arabic merchants (Rahardjo, 2012).

Mostly and based on how it works, there are two ways to process wet coffee bean into rice coffee, which is called coffee bean processing in either wet and dry way. The main difference from the two methods is in the dry method of stripping the bean flesh, the skin of the horn and the epidermis is done after drying (coffee spindles), while the wet method of stripping the bean is done while still wet. Dry processing is usually carried out by small planters since it can be done with simple equipment. This method of processing is easy to do because simple equipment and it can be done in the farm

household. The stages of dry coffee processing include harvesting, bean sorting, drying, stripping, sorting dry beans, packaging, and storing coffee beans.

Postharvested coffee processes such as stripping coffee bean skin, washing, HS skin stripping, and sorting have been carried out with appropriate technology machines. Some studies that have been conducted by Widodo (2012) and Syahrir (2013) have designed and developed coffee bean peeling machines. Coffee processing tools and machines produced by the Indonesian Koka Research Center and commercialized are: coffee bean peeling machine (pulper), HS coffee washer, dryer, dry huller (huller), coffee sorting equipment, storage warehouse technology coffee in a controlled atmosphere, roaster, mixer, and coffee water meter (Mulato *et al.*, 2010).

3. METHOD

3.1 Location and Duration

The service activities for the Production Center for APT of the PNL in 2018 are the second year of the three-year plan. The activity was carried out in two locations, namely at the PNL campus as an activity center and Hikmah workshop as an activity partner.

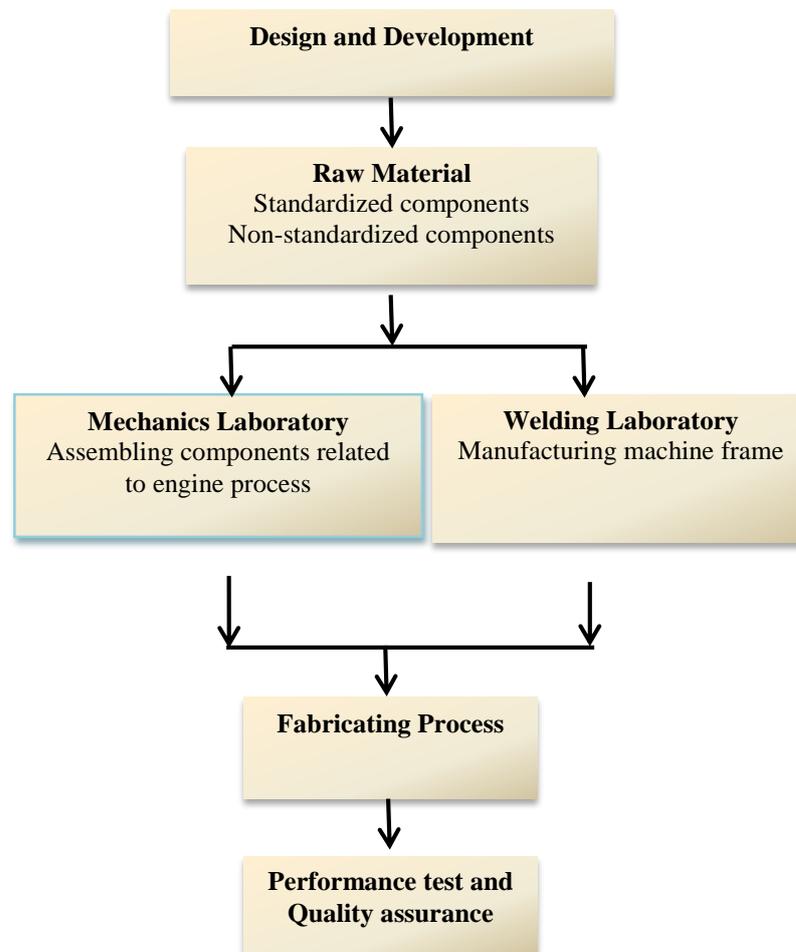
3.2 Product

The produced which are successfully produced are mobile coffee skin peeling machine, coffee bean washing machine, dry coffee peeling machine, and coffee bean sorting machine.

3.3 Process

The production process is carried out in the Mechanics and Welding laboratories. The flow of the production process of coffee postharvest APT machines is illustrated in

Figure 2.



Source: Primary data (2018)

Figure 2. The flowchart of production process of APT machine of postharvested coffee

3.4 Marketing

The product marketing strategy is carried out through the provision of showrooms, brochure making, publications on internet websites, and in the mass media.

4. RESULTS AND DISCUSSION

The fabrication process is illustrated in **Figure 3** at Hikmah Workshop, it produces a mobile coffee skin peeling, coffee bean washing, dry coffee bean peeling and vibrated coffee bean sorting machines. Meanwhile **Figure 4** shows the brochures of the Postharvested Coffee APT Machines Production Center, PNL.



Source: Primary data (2018)

Figure 3. Fabricating process



Source: Primary data (2018)

Figure 4. Brochure of the product

4.1 Mobile Pulper Coffee Machine

The mobile pulper coffee machine is more unique and better than the one which are available in the marketplace. This mobile-machine can be used remotely since it is easily moved from one location to another. The machine can be used in a coffee farms, which is mostly in the highlands (mountains) or hillsides. This mobile pulper machine is

expected to simplify and accelerate the process of coffee peeling. Apart from functioning as a coffee pulper, this pulper machine also can be used as a ground plow machine. This process serves to spray soil in the coffee farm area. For the ground felling process, the plowshares are installed with the plowshares mode.

When compared with the construction of marketable coffee pulper machines, produced machines has many advantages, both from construction and functional. The construction of this machine is barely found in the marketplace. This causes the peeling process is limited to certain locations. **Figure 5** shows a comparison of the coffee pulper machines that are available in the marketplace and the one which are produced by the PNL Postharvested Coffee Technology Center.



Source: Primary data (2018)

Figure 5. The comparison of coffee pulper in the marketplace (left) to the one which is produced by the PNL Postharvested Coffee Technology Center (right)

4.2 Batch Type Coffee Bean Washing Machine

The washing process aims to remove the remaining fermented mucus that is still attached to the horn skin. For small capacity, washing can be done manually in a tub or bucket, while for large capacity it needs to be supported by a machine. There are two types of washing machines, namely batch and continuous types.

The produced batch type washing machine (**Figure 6**) has a cylindrical washing container. This machine is designed for small capacity and limited consumption of washing water. HS coffee beans as much as 50-70 kg are inserted into the cylinder through the inlet and then pour into some water. Washing water needs range from 2-3 m³ per ton of HS coffee beans. Batch type coffee washing machines have six stirring vanes that intersect each other. The mixer rotates the coffee beans to be cleaned. Coffee bean washing machines use 5.5 HP motor. The washing process is repeated for 2-3 minutes.



Source: Primary data (2018)

Figure 6. The coffee bean washing machine batch type produced by the production center of PNL postharvested coffee machines

4.3 Coffee bean peeling machine (Huller Machine)

The peeling process is for separating the coffee beans from the horn skin for wet or semi-wet processing and to separate the coffee beans and dry coffee beans for dry coffee processing. The results of this process are called rice coffee beans. Peeler used is a type of cylinder with a diesel motor drive, depending on its capacity. Inside the cylinder walls, there are swipe rotors, filters, and centrifugal fans to separate coffee

beans from coffee and horn skin. HS coffee beans are fed into the cylinder through the intake funnel, and then, they go down into the gap between the surfaces of the rotor and become a small pieces. The rotor surface has a screw and is able to push the coffee beans out of the cylinder, while the flakes pass through the filter and are sucked by the fan.

The huller machine is designed to peel HS or coffee beans with water content close to 12%. If the water level gets higher, the peeler capacity drops and the number of broken beans increases slightly. The huller machines can be moved easily, (**Figure 7**), so the peeling process is more effective. This coffee bean huller machine is attached to a motorcycle in order to mobile it.



Source: Primary data (2018)

Figure 8. The produced huller

The sorting process is done to separate coffee beans by size, defects of beans and unknown materials. Sorting sizes can be done by mechanical sieves or manually. The sorting is done in such a way to separate the coffee beans in dimensions according to the provisions of SNI 01-2907-2008. The coffee bean sorting machine (**Figure 8**) consists of three levels of results, namely large, medium and small.

Coffee bean sorting machines are produced using a vibration mechanism. Vibration is occurred from the pendulum which is placed in the center of the drive shaft. This pendulum can be adjusted for unbalance. A larger pendulum shift will produce greater vibration.



Source: Primary data (2018)

Figure 9. The produced sorting machine of coffee beans based on vibrating mechanism

The products of postharvested coffee machines are adjusted to consumer demands. Consumers can see the shape and ability of the machine by coming to the showroom at the production center of the APT for the PNL postharvested coffee machines. The showroom is located on Banda Aceh-Medan Highway Km 275, Alue Awe, Lhkseumawe, Aceh.

Due to the increasing income from machine selling, the production center of APT for postharvested coffee PNL has also created a marketing website. The website can be surfed through centermesinkopi.com, it is then easier to interact with the buyers and see the needs of the machine in accordance with the consumer demands. In addition, in order to conduct several marketing strategies, brochures, internet website, showrooms, and mass media are used for the publishing this machine to a large number of audience.

5. CONCLUSION

The dedication activities of the CIPBDP PNL is a service activity which successfully forms a business unit. The APT products are mobile coffee skin peeling machines, coffee bean washing machines, dry coffee bean peeling machines, and coffee bean sorting machines. The APT machines have been socialized to coffee farmers, especially coffee farmers in the Aceh province, through brochures, websites, and exhibitions in the showroom.

6. ACKNOWLEDGEMENT

The authors convey to the Ministry of Research, Technology and Higher Education for financial support through the Community Service Program scheme of the Campus Intellectual Product Development Program in 2018.

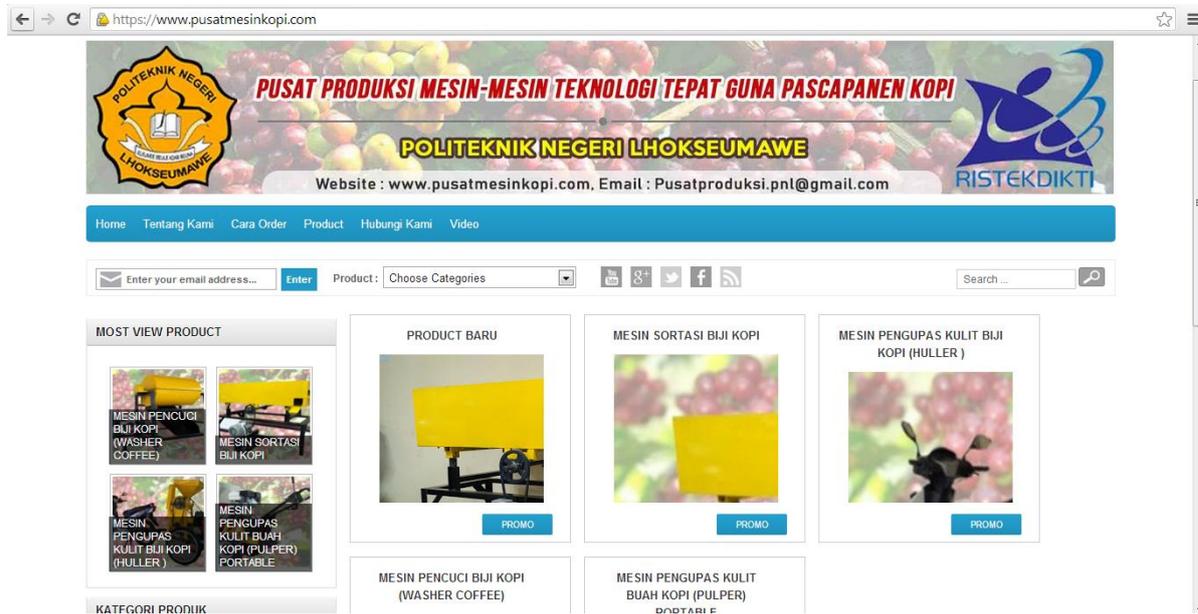
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APPENDIX



Source: Primary data (2018)

Figure 10. Internet website of PNL coffee machine production Center



Source: Primary data (2018)

Figure 11. Publication through mass media