PAPER • **OPEN ACCESS**

An analysis of innovation on the utilization of cascara by coffee farmers

To cite this article: N Komaria *et al* 2020 *J. Phys.: Conf. Ser.* **1563** 012015

Table Of Contents

Integration of photosystem I and photosystem II from tylakoid membrane of *spirulina sp.* for DSSC natural dye pigments *D Y Kusuma, Q Hidayah, A N Izziyah and B Purnama*

Response of seed germination and seedling growth of Physalis accession from East Java *R Mastuti, B Waluyo and J Batoro*

Designing video profile fashion program Malang State University using adobe premiere *N Aini, N Hidayati and S E P Rahayu*

Temperature and strain rate effect on flow stress of al2075/bottom ash composite *F D Supriyanto, H Seputro, H Rinaldi and H I Akbar*

E-commerce implementation in supporting business services strategy (case study at petshop gifaro evidence) *J T Purba, Hery and A E Widjaja*

Solid state organic photovoltaic devices using *spirulina sp* thylakoid membrane films as active material *Q Hidayah, D Y Kusuma, O R Aji, A N Izziyah and B Purnama*

An Analysis of the utilization of *Gamal* Plant *(Gliricidia sepium)* as a shade for coffee plants *K Khusnul, Suratno, J Prihatin and Sudarti*

An analysis of innovation on the utilization of cascara by coffee farmers *N Komaria, Suratno, J Prihatin and Sudarti*

An analysis of innovation on the utilization of cascara by coffee farmers

N Komaria, Suratno, J Prihatin, and Sudarti
University of Jember
E-mail : nurulqomariah2202@gmail.com

Abstract. The process of coffee production yields a lot of waste. Based on the observation, there was no innovation in the use of cascara to have high economic value, some amount of abundant cascara is used by the farmers as cattle feed and the rest is sold. The aim of this research was to analyze the level of innovation in cascara utilization by the coffee farmers. The variables of this research were the type of innovation used by the cascara community and the analysis of the economic value that has been obtained. The methods used were survey, interview, and questionnaire. The respondents of this study consisted of 26 coffee farmers in Jember regency. The results showed that the farmers who used cascara as fertilizer were 3.9%, cattle feed by 7.7%, used cascara tea of 3.9%, sold cascara by 65.3% and disposed it as much 19.2%. Based on the economic value, the use of cascara which has the lowest value is disposed it while the higher one is sold it, use it as cattle feed, fertilizer and cascara tea. Education for farmers is needed to make cascara benefits well in producing innovative and environmentally friendly products.
.

1. Introduction

Indonesia is the fourth coffee producer in the world after Brazil, Vietnam and Colombia. Coffee is an important commodity for about 25 million farmers [1] and traded globally for many developing countries in tropical area such as in the most of South America, Central and Asia [2]. The world trade of coffee is based on 2 species covering 40% of arabica coffee (Coffea arabica L.) and 60% of robusta coffee (Coffea canephora) [3]. Farmers starts the post-harvesting process by removing the pulps of cherry coffee (exo- and mesocarp) and parchment (endocarp) which is under the wet- process (washed) and dry-process (unwashed) [4] that produces cascara coffee (wet process) and coffee husks (dry process) [5].

Cascara coffee (cascara: Spanish word for husk) is removed mechanically during the harvest time to produce qualified coffee beans. The qualified coffee beans are determined by the genotype, environment (shade and height) and its metabolism[6]. Other determinants cover the good seedling-selection of coffee, proper care, appropriate climate and environmental condition as well as harvesting at the peak of maturity to produce the optimal coffee [7]. The production of Indonesia coffee in 2019 reached 729,074 tons. The process of coffee production yields a lot of waste. The wastes come from its husks and flesh. During the process of bean production, there are some byproducts produced about 50% of coffee is not used in the production [8]. In relation to this, the volume of cascara coffee disposal taken from wet-process unit rose along with the increase of coffee consumption around the world [9]. In every 2 tons of coffee beans processed, almost 1 ton of cascara is produced in every 2 tons of coffee beans; whilst 0.18 ton of coffee husk is produced in every 1 ton of fresh coffee beans during the dry process [5].

The observation results done to 26 coffee farmers in Jember regency revealed that cascara coffee produced in the dry process was not widely used so they sold it at a cheap price. Some farmers said that cascara was disposed if there were no buyers. The result of the research [10] showed that most cascara produced by farmers were disposed and not taken into recycle-process to make it as useful products. It was different from the coffee production industry, the wastes were collected by special agents who sold the residues for different purposes (for composting, gardening, bioenergy production, fungi growth, etc.) [11]

Cascara coffee contains caffeine, polyphenol, and tannin as well as carbohydrate, protein and mineral (especially potassium). Protein, sugar and mineral and high humidity contains in cascara coffee causes rapid growth of microorganisms; it would bring up the environmental pollution if it was not utilized [5]. The waste of coffee process causes environmental pollution on the surface of the water since there are polyphenols as antinutritional and phytotoxic substances such as caffeine, tannin, organic acid in which its usage are limited in agriculture. The residues of coffee processing such as pulp and mucus are usually disposed in the water resources around the processing-location like river and lake, it makes the oxygen in the water decrease, and cause the death of plants and animals due to the reduced oxygen and increased acidity [12]. The water which is used for fermentation on wet-process known as coffee wastewater also has high concentration of organic pollutant for water and soil, but the coffee residues contain fermented sugar and other nutrients can be used as a substrate for the growth of microorganisms which are able to produce bioethanol and aromatic volatile compounds [13].

The required solution is to change the coffee byproducts with organic ingredients for quality improvement [14]. Cascara coffee is used in food production as phytochemicals sources but the product is not widely developed [8]. Another use of cascara is to develop the method in managing the pulp of cherry coffee waste as beverage production, namely cascara tea [15]. Cascara is known as a coffee cherry tea made from the pulp of coffee which is rich in biocative compounds like polyphenol with good antioxidant properties and there are also carbohydrate, soluble fiber, mineral and protein which are beneficial to health. Biochemical analysis on cascara coffee needed to be done to identify the useful compounds to increase the value of coffee byproducts[16]. Thus, the researchers conducted a research entitled "An Analysis on the Use of Cascara by Coffee Farmers". This research was intended to analyze the innovation level on the use of cascara by coffee farmers.

2. Methods

This research was a descriptive research. This research was done in October 2019. The respondents of this research covered 26 coffee farmers in Jember regency. It analyzed the innovation types on the use of cascara done by the community and also the economic value that was obtained. The data collection methods were done throuh survey, interview and questionnaire. The survey was done by visiting the coffee farmers and observing the plantations around the location of coffee farmers in Jember Regency; whilst the interview and questionnaire were given through the analysis questionnaire of the innovation type on the use of cascara done by the community using check-list (√) to the alternatives answer of yes/no included the reasons. The data were analyzed descriptively in the form of detail answers from the farmers.

3. Result and Discussions

The data collection techniques used were documentation, survey, interview and questionnaire. The interview was carried out to obtain the data directly from the object, so were the documentation and survey studies. The questionnaire was given to support the data triangulation. The quetionnaire results distributed to 26 coffee farmers are provided on Table 1.

Table 1. The questionnaire of coffee farmers.

No.	Question	Total Answer of Respondent	
		Yes	No
1	Is the productivity of your coffee crops always high?	22	4
2	Do you find any difficulties during the post-harvesting process?	6	20
3	Are the crops sold in the form of cherry?	4	22
4	Do you process the crops before selling?	-	26
5	Do you do the fermentation process during the post-harvesting process?	-	26
6	Do you process the coffee husks which are separated from the beans?	-	26
7	Do you know the benefits of coffee husks?	4	22
8	Do you know about cascara?	1	25
9	Cascara is defined as tea of coffee husks containing natural antioxidants, no preservatives and is safe for consumption? Do you know about this product?	1	25
10	Do you know the application of processing coffee skin into cascara?	1	25
11	With the benefits and advantages of this product. Do you feel the need for this product?	26	-
12	Taking into account the overall aspects of this product, (in terms of benefits, practicality, price, and taste). Are you interested in developing this product?	26	-

Based on Table 1, the question of the coffee crops' productivity is always high, 22 farmers answered yes and 4 farmers answered no. The question of the difficulties they have ever faced during the post-harvesting process, 6 farmers answered yes and 20 farmers answered no. The question of the crops are directly sold in the form of cherry, 4 farmers answered yes and 22 farmers answered no. The question of the crops are processed before being sold, 26 farmers answered no. The question of the fermentation process during the post-harvesting process, 26 farmers answered no. The question of the coffee husks separating from the beans are processed, 26 farmers answered no. The question of the benefits of coffee husks, 4 farmers answered yes and 22 farmers answered no. The question whether they know about cascara or not, 1 farmer answered yes and 25 farmers answered no. The question of cascara tea is made of the coffee husks containing natural antioxidants, no preservatives, and is safe for consumption and whether or not they know about this product, 1 farmer answered yes and 25 farmers answered no. The question of whether or not they know how to process coffee husks into cascara, 1 farmer answered yes and 25 farmers answered no. The question of the product's benefits and advantages and whether or not they needed this product, 26 farmers answered yes. The question of by considering the all aspects of this product (the aspects of benefits, practicality, price and taste) and whether or not they are interested in developing this product, 26 farmers answered yes.

Based on the results of the interview, the farmers said that the weather, climate, shade trees, and height influenced the productivity of coffee crops. In the post-harvesting process, they did not face many difficulties. The farmers who got no grinding machine was able to sell it in the form of coffee cherry tea even though the results were not optimal. Most farmers whose lands were more than 1 Ha on already had a grinding machine, so that the process of grinding coffee was able to be done when the harvest came. The process of the crops before being sold (if it was wet-processed/fermented) was barely done, the farmers were interested in selling the coffee beans directly so that they got the outcomes.

The reasons behind it were the limited land and lack of understanding about the process of wet processing for coffee bean fermentation. Milling was done to get coffee beans through dry process. The husks separated from the beans were not processed, some farmers sold it immediately and some disposed it, only few farmers had to process the coffee husks into fertilizer. The researcher pointed out that that coffee husks in Spanish were called cascara. The farmers neither knew the term of cascara nor its benefits. Cascara obtained from the process of coffee mill was sold to the agent, yet when they were asked about the way to process cascara, nobody knew about it so its economical value was low. The researchers informed the farmers that cascara has so many advantages, beside its function as fertilizer; it can also be used as cattle feed, foods, safe-consumed beverages, yet they know little about it.

The researchers also explained how to make cascara tea, they were very interested and enthusiastic to develop this product. However, they thought they might experience obstacles in selling the product considering that few people know about cascara tea product. The results of the analysis of cascara utilization innovation by coffee farmers can be seen on Figure 1.

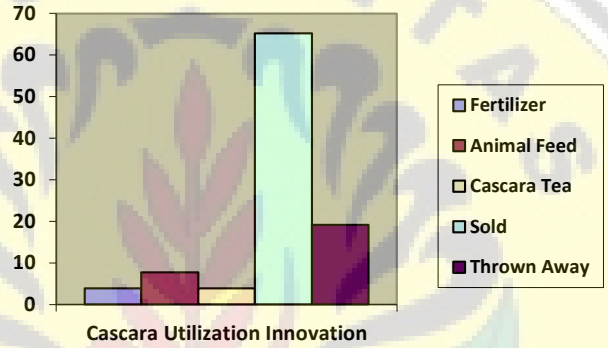

Figure 1. Cascara utilization innovation.

Based on Figure 1, the results indicated that farmers who used cascara as fertilizer were 3.9%, as cattle feed as much as 7.7%, as tea of 3.9%, as commodity by 65.3% and as waste by 19.2%. Based on the results of the observation, the farmers placed cascara waste after grinding under the coffee plants. However, this was not in accordance with the existing literature. After grinding, cascara should not be used directly as fertilizer because there were polyphenols which were considered to be antinutritional and phytotoxic which caused environmental pollution and resulted in the death of plants and animals due to oxygen and the increase of acidity [12].

Cascara is considered to have benefits for farm animals. Before using cascara as cattle feed, proper processing and dosing must be done first because cascara cannot be given directly to the cattle animals. However cascara was not suitable as animal feed (horses) in large numbers due to the high levels of caffeine [17]. The processing of cascara fermented with Aspergillus niger could be used to substitute rice bran as a concentrate for animal feed. Fermented cascara was also beneficial for the growth rate and blood profile of female rabbit with higher hemoglobin, erythrocyte, and hematocrit levels [18]. The utilization of cascara tea increased the income of coffee farmers in Jember Regency. Cascara is a healthy refreshing drink to extract natural antioxidant [19]. The production process was not complicated and had many benefits as a potential source of antioxidant with phenolic compounds which produced refreshing and stimulating functional drinks that contributed to the global market. Cascara contained 226 Mg of caffeine/L drinks and a fairly large antioxidant content as much as 3.02 and 8.86 mmol TE/L[20]. Brewing cascara as tea was one way of extracting caffeine and utilizing its byproducts [8]. Based on the results of the survey, the respondents disposed cascara directly under the coffee plants. It can be seen on Figure 2.

Figure 2. Cascara husk that was not ready to be used as fertilizer.

Respondents piled cascara on a land to be stockpiled for some time until cascara was ready to be used as fertilizer which can be seen on Figure 3.

Figure 3. Cascara that was ready to be used as fertilizer.

The farmers brought cascara that was ready to be used as fertilizer to their land. It can be seen on Figure 4.

Figure 4. Coffee plants profile that was given cascara fertilizer.

Based on Figure 3, the profile of coffee plants filled with cascara had unhealthy stems and leaves. Cascara was placed on the coffee field as much as possible. Cascara had a high caffeine content, tannin and polyphenol which were very pollutant to plants so they must be used in limited quantities due to the high amount of organic matters [8].

Coffee was one of the beverages widely favored by the world community and consumers. An increase on the price of coffee could be pursued by utilizing potential resources that had low economic value (in the form of byproducts of a processing process) into a product that had benefits and a high economic value. Parts of coffee pulp and husk which was initially considered as waste turned out to have active compounds containing 63% of cellulose, 17% of lignin, 11.5% of protein, 2.3% of hemicellulose, tannins as much as 1.8-8.56%, pectin as much as 6.5%, non-reducing sugar as much as 2%, caffeine as much as 1.3%, chlorogenic acidas much as 2.6%, and caffeic acid as much as 1.6%. The 2.6% of chlorogenic acid was known to be beneficial because it had antioxidant properties that were beneficial to the health [21].

The utilization of fermented cascara increased the selling value, the nutritional value of the material and the coefficient of digestibility. In addition, to minimize greenhouse gases and make the agricultural environment not polluted. [18]. The production of cascara coffee could be used as a biological additive in the food and pharmaceutical industry to fight diseases and aging and could be used as a raw material for extracting high-value products such as polyphenol and other antioxidant [9]. Another benefit of cascara was that it could be used as a bioethanol substrate because it had a high level of cellulose. As explained above, cascara could be used as energy drinks or food supplements because it was rich in caffeine and antioxidants. Therefore, the production of polyphenol-rich drinking water products from cascara coffee was a good way to solve the coffee waste source and diversify the current source of drinks products. The process of utilizing cascara tea decomposed coffee processing waste and increased the income of coffee farmers in Jember Regency. The increasing farmers' income was expected to improve the standard of living and welfare of farmers. The lack of farmers' knowledge about the benefits of cascara coffee was a major challenge in improving environmental management and prices which had an impact on the global economy [22].

4. Conclusion

The results showed that those farmers who used cascara as fertilizer were 3.9%, as cattle feed as much as 7.7%, used cascara tea as much as 3.9%, sold and disposed the cascara in sequence as much as 65.3% and 19.2%. Based on economics value, the utilization of cascara from the lowest value was disposed, the higher one were sold, as cattle feed, as fertilizer and cascara tea. There was a need of education for farmers, so that cascara can benefit well in producing innovative and eco-friendly products

Acknowledgments

We gratefully acknowledge the support of FKIP-University of Jember of year 2019.

References

[1] DaMatta F M, Rahn E, Laderach P, Ghini R, & Ramalho J C 2019 Why could the coffee crop endure climate change and global warming to a greater extent than previously estimated? *Climatic Change* 167-178

[2] ICO 2019 Growing for prosperity : Economic viability as the catalyst for a sustainable coffee sector German: *Federal Ministry for Economic Cooperation and Development*

[3] FAO 2015 FAO Coffee Pocketbook Rome: *Food and Agriculture Organization of the United Nations*

[4] Kleinwachter M, Bytof G, & Selmar D 2015 *Coffee Beans and Processing*. Germany: Elsevier

[5] Roussos S, Aquiahuatl M A, Trejo-Hernandes M R, Perraud I G, Favela E, Ramakrishna M, Gonzales G V 1995 Biotechnological management of coffee pulp- isolation, screening,

characterization, selection of caffeine-degrading fungi and natural microflora present in coffee pulp and husk *Appl Microbiol Biotechnol* 756-762
[6] Cheng B, Furtado A, Smyth H E, & Henry R J 2016 Influence of genotype and environment on coffee quality *Trends in Food Science&Technology* 20-30
[7] Poltronieri P, & Rossi F 2016 Challenges in Specialty Coffee Processing and Quality Assurance. *Challenges* 1-22
[8] Bondesson E 2015 A nutritional analysis on the by-product coffee husk and its potential utilization in food production. Uppsala: *Sveriges lantbruksuniversitet Swedish University of Agricultural Sciences*
[9] Geremu M, Tola Y B, & Sualeh A 2016 Extraction and determination of total polyphenols and antioxidant capacity of red coffee (Coffea arabica L.) pulp of wet processing plants *Chemical and Biological Technologies in Agriculture* 1-6
[10] Zamora A J, Pastoriza S, & Rufian-Henares J A 2015 Revalorization of coffee by-products. Prebiotic, antimicrobial and antioxidant properties *LWT- Food Science and Technology* 12-18
[11] Pujol D, Liu C, Gominho J, Olivella M A, Fiol N, Villaescusa I, & Pereira H 2013 The chemical composition of exhausted coffee waste *Industrial Crops and Products* 423-429
[12] Navia P D P, Velasco R D, & Hoyos C J L 2011 Production and Evaluation of Ethanol from Coffee Processing by Products *Vitae* 287-294
[13] Bonilla-Hermosa V A, Duarte W F, & Schwan R F 2014 Utilization of coffee by-products obtained from semi-washed *Bioresource Technology* 142-150
[14] Kassa H, Suliman H, & Workayew T 2011 Evaluation of Composting Process and Quality of Compost from Coffee By-Products (Coffee Husk & Pulp) *Ethiopian Journal of Environmental Studies and Management* 8-13
[15] Rathinavelu R, & Graziosi G 2005 Potential alternative uses of coffee wastes *International Coffee Organization* 1-4
[16] Esquivel P, & Jimenez M V 2011 Functional properties of coffee and coffee by-products *Food Research International* 488-495
[17] Delfiol D J, Filho J P, Casalecchi F L, Kievitbosch T, Hussni C A, Correa F R, Borges A S 2012 Equine poisoning by coffee husk (Coffea arabicaL.) *BMC Veterinary Research* 1-8
[18] Nuriyasa I M, Puspani E, & Yupardhi W S 2018 Growth and Blood Profile of Lepus Nigricollis Fed Diet Fermented Coffee Skin in Different Levels *International Journal of Life Sciences* 21-28
[19] Phuong D N, Quynh H T, & Anh L H 2019 Optimalization of Conditions of Extraction Process From Coffee Cherry Pulp (Cascara) and Application to Drinking Water Product with Antioxidant Activity *Vietnam Journal of Science and Technology* 26-32
[20] Heeger A, Cagnazzo A K, Cantergiani E, & Andlauer W 2016` Bioactives of coffee cherry pulp and its utilisation for production *Food Chemistry* 1-7
[21] Corro G, Paniagua L, Pal U, Banuelos F, & Rosas M 2013 Generation of biogas from coffee-pulp and cow-dung co-digestion *Energy Conversion and Management* 471-481
[22] Bitzer V, Glasbergen P, & Arts B 2013 Exploring the potential of intersectoral partnerships to improve the position of farmers in global agrifood chains: findings from the coffee sector in Peru *Agriculture and Human Values* 5-20