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Community Education on Coffee Pulp Utilization for the Benefits of Green Economy Improvement

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ABSTRAK

Pesatnya perkembangan Kabupaten Bondowoso sebagai penghasil kopi telah menimbulkan masalah pencemaran lingkungan yang serius akibat pembuangan ampas kopi (CoP) yang tidak tepat dan tidak dapat diterima di sepanjang pinggir jalan dan areal perkebunan. Penelitian ini bertujuan untuk mengedukasi masyarakat untuk mengolah CoP menjadi bahan pakan yang bermanfaat bagi hewan ruminansia dan sekaligus mengurangi pencemaran lingkungan. Pendekatan metodologi yang digunakan adalah survei, focus group Discussion dan demoplot langsung pada sentra wilayah petani kopi di Desa Sukorejo Kecamatan Sumberwringin. Hasil penelitian menunjukkan bahwa hampir seluruh petani kopi tidak memiliki pengetahuan sebelumnya tentang pemanfaatan CoP sebagai bahan pakan ternak ruminansia dan praktik membuang CoP di sepanjang pinggir jalan dan areal perkebunan dikaitkan dengan kurangnya tenaga yang menanganinya terutama pada saat puncak panen. Pengenalan teknologi pemanfaatan amonia basa dalam bentuk NaOH untuk mengolah CoP selama kegiatan demo plot menunjukkan bahwa kualitas CoP yang diwakili oleh kandungan protein kasar dan kecernaan bahan kering meningkat masing-masing sebesar 32,5 % dan 63,4 %. Hal ini menunjukkan bahwa produk baru ini dapat berperan penting sebagai bahan pakan untuk formulasi ransum hewan ruminansia. Selain itu, dapat dijual dengan harga lebih tinggi dibandingkan CoP tanpa pengolahan yang biasanya dijual dengan harga Rp 1.200/kg sehingga menjadi sumber pendapatan tambahan.

ABSTRACT

The rapid development of Bondowoso regency as coffee production has created serious problems on environmental pollution due to improper and unacceptable coffee pulp (CoP) dumping along the roadside and plantation areas. This study aimed at community education to process CoP into valuable feed ingredients for ruminant animals and concomitantly reduce the environmental pollution. The methodological approach used a survey, focus group discussion and direct demoplot at the center of coffee farmer's region at Sukorejo village, Sumberwringin sub-district. The results showed that almost exclusively the coffee farmers had no prior knowledge on the utilization of CoP as feed ingredients for ruminant animals and the practice of CoP dumping along the roadside and plantation area was associated with the lack of manpower to handle it particularly during the peak harvesting time.The introduction of technology utilizing alkaline ammonia in the form of NaOH to treat CoP during the demo plot activity revealed that the quality of CoP as represented by the crude protein content and the dry matter digestibility increased by 32.5 % and 63.4 %, respectively indicating that this new product can play a pivotal role as feed ingredients for formulation of ruminant animal's ration. Additionally, this can be sold at higher price than CoP without treatment which is normally sold at 1,200 IDR/kg and hence it becomes an additional source of income.

1. INTRODUCTION

Bondowoso is one of the regencies in East Java with an area of 1,560.10 km2. Bondowoso City is squeezed by three large mountains, viz., Ijen, Raung and Argopuro so that the air temperature is quite cool. The eastern area of Bondowoso city is a plateau near Mount Ijen where the majority inhabitants rely on agricultural activities such as coffee planting at the forestry land and other cash crops at the front and backyards homestead (As' ad & Aji, 2020; Muis, 2023). Since the Dutch colonial era Bondowoso has been

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recognized as one of the coffee planting centers in Indonesia. The species of coffee grown in the area are predominantly only two prime quality that is Arabica (Coffea arabica) and Robusta (Coffea canephora) and by the year of 2016 the quality of Bondowoso's coffee received an international recognition (Rohma et al., 2023; Santosa et al., 2020). It is believed that Arabica coffee originated in Ethiopia, the country commonly regarded as coffee's birthplace. From Ethiopia it traveled to Yemen, where it was first cultivated. The Arabica coffee from Bondowoso is famous under the name of Arabica Ijen Raung coffee as recognition of the origin from the valley of Ijen Raung mountains. Previous study reported a doubling demand on coffee beverages in many different forms viz., roasted, soluble and ready to drink (RTD) (Bond, 2012). Yet, the 4.5 fold increase was noted for RTD coffee that was aligned with an increasing middle-class population and the better taste of coffee. Additionally, the increasing urbanization and the spread of better supply chain stores are considered to play a significant role in boosting the demand for coffee throughout the country. Nevertheless, the current production of coffee in Bondowoso regency is still at the fourth rank as compared with Malang, Banyuwangi and Jember regencies. Additionally, that the average production of cherry coffee biomass for Arabica and Robusta ranged between 1-2 tons / ha and 1.2 tons / ha, respectively (Moelyaningrum et al., 2019; Santosa et al., 2020). It therefore is likely that if the smallholder coffee farmers rely solely on coffee production as the main source of income, their welfare is at risk. For this reason, to improve the wellbeing of coffee farmers, innovation and technical support deserve further attention from the government.

Owing to the limited land ownership by most smallholder coffee farmers, the Indonesian Forestry Ministry has facilitated the plantation area on mutual benefit sharing basis focusing on sustainable forest principles (Intan et al., 2020; Izzah et al., 2020). The participating farmers who cultivate coffee plants in the forest area are entitled to receive 70 % of the total coffee cherry production/year depending on the land size utilization. Cherry coffee consists of 57% beans that can be processed into ready-to-eat drinks and 43% coffee grounds. Coffee pulp (CoP) production which reaches 61-92 tons / year in practice has not been used properly, they are thrown away on the roadside and cause environmental pollution. As affected by high content of biological and chemical oxygen demand, CoP cannot be oxidized or fermented immediately to become compost during disposal. Stated that such a practice on rich-cellulosic materials will lead to the release of xenobiotic such as caffeine and free polyphenols as a major pollutant with the ultimate adverse impact on uncontrolled emission of glass house carbon e.g. CH_4, N_2O and CO_2. This improper practice is related to the lack of knowledge and scarcity of labor and essential equipment such as a drying machine to utilize CoP into other valuable products such as animal feed ingredients and charcoal briquettes (Ameca et al., 2018; Nunez et al., 2015)

The potential of CoP as a renewable energy source is promising and according to previous study coffee husk or CoP contains 18.34 MJ/kg and it therefore at a maximum this would harness efficiencies of 79 TJ in this area only (Mhilu, 2014). Considering the conversion efficiency of 65 %, it will generate 2.2 GWh energy production (Miito & Banadda, 2017). Another previous study reported by previous study indicates that coffee waste has a caloric value of 23.5 MJ/kg (Joshua & Endah, 2020). Additionally, other study reported that the potential of coffee biomass residues as new-energy sources and livestock feedstuffs is remarkably enormous and deserves further studies in the country where coffee production play a vital role and produces enermous amount of waste such as Brazil and Indonesia (Pujiastuti et al., 2019). There are many reports available from the literature dealing with the studies on CoP utilization for feed ingredients such as study who reported the use of chemical treatment using alkali hydrogen peroxide (Pujiastuti et al., 2019), other study used biological treatment with fungus *Trichorderma* sp (Daning & Karunia, 2018), study that used *Aspergillus niger* (Intan et al., 2020), and stdudy that applied a combination of *Aspergillus niger*, *Trichorderma harzianum* and *Saccaharomyces cerevisiae* (Khasanah et al., 2022). Nonetheless, the potential of CoP in the area under study has been neglected. The activity reported herein aimed at empowering smallholder coffee farmers at Sukerejo village, Sumberwringin district through introducing an innovative processing of CoP waste for animal feed ingredients and production of charcoal briquettes as the source of renewable energy leading to improve their opportunity to derive household income other than coffee bean business. Additionally, utilization of CoP will reduce pollution for more sustainable agriculture development in the area.

2. METHOD

The approach used to carry out this community education for CoP utilization was divided into five steps as shown in Figure 1. The objective of using this approach was to allow the study to systematically find the main cause-root, plan the approach relevant to the main issue, visit to site of study to acquainted conditions of coffee farmers and find the appropriate location for a demo plot of CoP processing for animal feed ingredients and briquette production. The demo plot was initiated by socializing the program for smallholder coffee farmers carried out by visiting each coffee farmer who had been selected randomly. The purpose of the activity was to include the farmers into engaging communication on the current and intended management of CoP handlings. Reading materials were distributed in the forms of brochures and posters describing step by step CoP processing and briquette production. In this stage four researcher had stayed at the village for a month to assure that all activities were properly carried out Additionally, the researcher carried out several FGD to introduce the alternative ways to utilize CoP which offered the economic benefits and concomitantly reduce the environmental pollution.

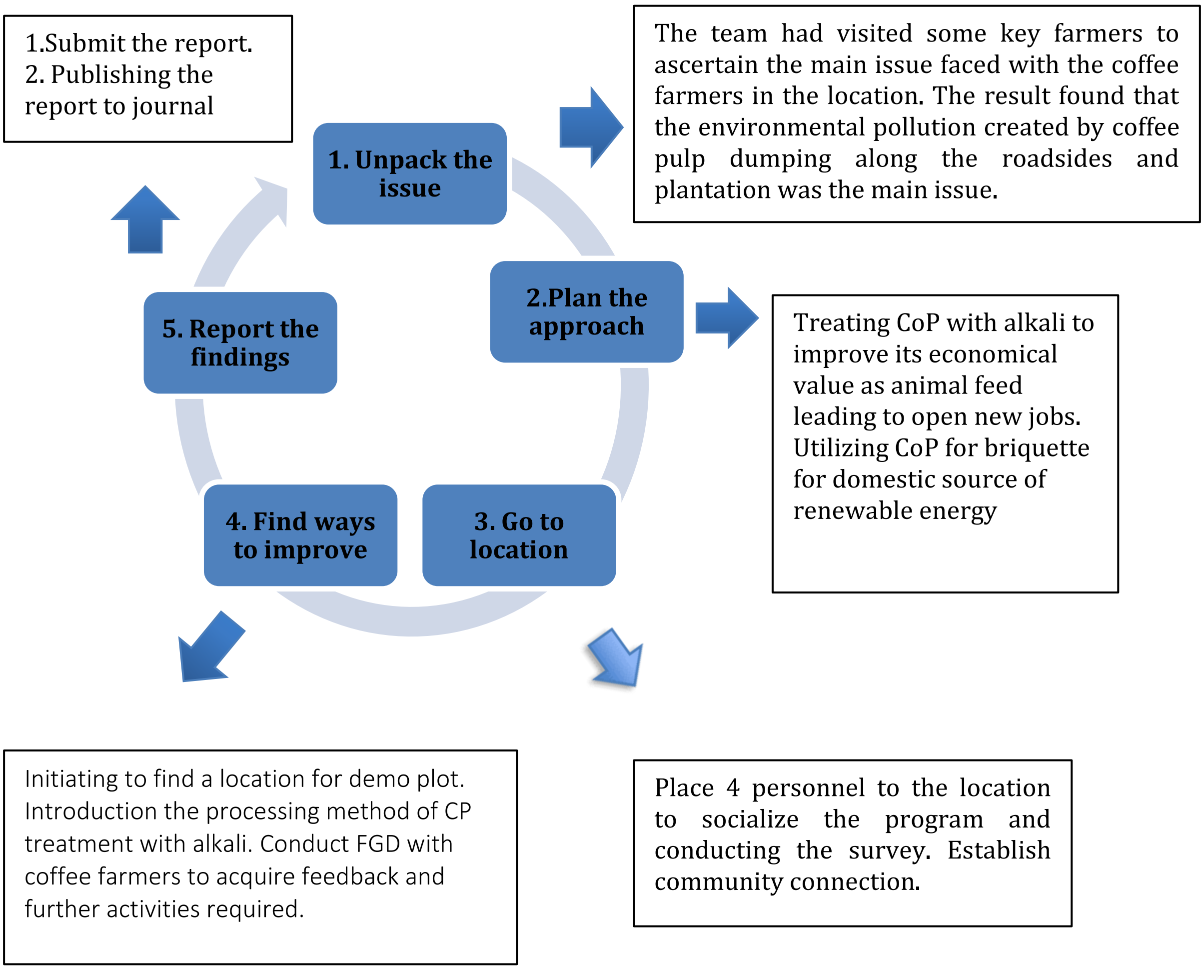

Figure 1. Flow Chart of Methods Used in the Present Study

Following this site visit data collection were analyzed descriptively and formulating ways to improve the utilization of CoP into more valuable products, namely alkali-treated CoP and briquette. The demo plot was prepared by collecting approximately 100 kg of dried Arabica CoP waste from the village of Sukorejo that was spread onto a plastic sheet and sprayed with 1 % NaOH layer by layer. This activity took place in the front yard of farmer's house to avoid fume choking and the workers wore a medical mask. On the cessation of spraying the plastic sheet was rolled up and tied with plastic rope to let the CoP reacted with NaOH for 7 days. After this, the NaOH-treated CoP was put into a plastic bucket and washed with running tap water until the slime disappeared. The washed CoP was then transferred to a wooden drying device and sprayed with 0.5 M HCl layer by layer before sun dried. Furthermore, an aliquot amount of CoP waste was used for briquette production. The briquette manufacturing procedure follows a method described with a modification of adding sawdust as raw material (Moelyaningrum et al., 2019). The ratio between CoP and sawdust was 1: 1 (w/w). A systematic diagram of alkali-treated CoP and briquette manufacturing is depicted in Figure 2.

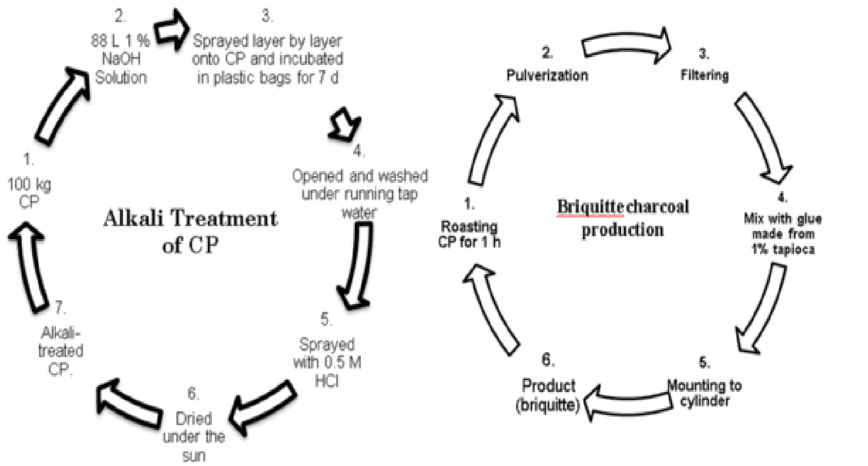

Figure 2. Process of Manufacturing Coffee Pulp into Alkali-Treated CoP (Left) and Briquette Charcoal (Right)

3. RESULTS AND DISCUSSION

Results

The program of community education was carried out in Kluncing hamlet, the village of Sukorejo, Sumberwringin District, Bondowoso Regency at latitude 7 °57'18.07 and Longitude 144°1'20.71. This activity started from June to September 2022 during which the average daily temperature was between 24 and 21°C. Essentially the location is surrounded by pine forest and annual trees growing in the front and backyard of farmer's houses resulting in low - medium light intensity. Based on the annual climatic data presented in **Figure 3**, the location was covered by clouds even though during the month of August the daily precipitation was low, but the humidity was considered high. It was therefore a longer time was required to dry the CoP.

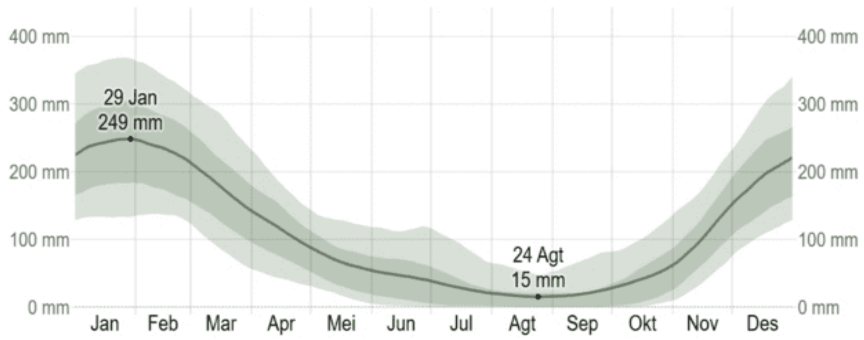

Figure 3. Climate Profil in Bondowoso During the Year of 2022 (Anonymous, 2022).

The village of Sukorejo is situated at the Ijen -Raung mountainous area and inhabited by a population of about 6,343. The main activity of villagers is predominantly farming with the most notable commodity is coffee. There are two kinds of coffee plantations, namely rural coffee plantation which describes the agricultural actor is landless farmer who cultivate coffee on the land own by the Department of Forestry, while the other plantation runs by P.T. Perkebunan Nusantara XII, a state government business sector. Currently, two types of coffee are planted in Sukorejo village, that is Arabica (*Coffea arabica)* and Robusta *(Coffea canephora)* under the shade of pine trees. Planting density between those two types differs, viz. 2 x 2 m and 4 x 4 m for Arabica and Robusta, respectively. Overall, 95% of the coffee cultivation was on the forestry land under the profit-sharing system. The share for coffee farmers was 70 % while the forestry department received 30 % of the coffee production/Ha/year. Based on the average of land ownership area that ranges from 0.5 ha – 4.5 ha / farmer, the profile of coffee farmer respondents and the average coffee production is presented in Table 1.

Table 1. Respondent Profile of Coffe Farmers at Sukorejo village, Sub-District of Sumberwringin, Bondowoso Regency, East Java Province

No	Main job	Side Job	Age (Yrs)	Education	Commodity	Coffee Type	Land Acreage (Ha)	Prod./ harvest (Ton)	Cost/harvest (million IDR)	Utilization of CoP	Prior knowledge on CoP Use for feedstuf
1	1	4	56	JHS	Coffee	(A), (R)	2,5	10	4	-	None
2	1	-	52	ES	Coffee	(R)	0.5	2	2	-	None
3	1	-	62	ES	Coffee	(R)	0.5	3	3	-	None
4	1	2	50	JHS	Coffee	(A), (R)	1	2	5	-	None
5	1	4,5	47	JHS	Coffee	(A), (R)	3	4.5	6.750	-	None
6	1	-	52	SHS	Coffee, ginger, chili	(A), (R)	0.5	0.8	1.6	Sold fresh (1 IDR/bag)	None
7	1	4	50	ES	Coffee, ginger, chili	(A), (R)	10	10*	20	-	None
8	1	-	45	JHS	Coffee	(A), (R)	1	1	2	-	None
9	2	1	60	ES	Coffee, ginger, chili	(A), (R)	0.5	2	4	-	None
10	3	1,2	45	SHS	Coffee	(A), (R)	4	4	20	-	None
11	1	2,5	55	SHS	Coffee	(A), (R)	5	7	7	-	None
12	1	4	58	JHS	Coffee, ginger, chili, turmeric	(A), (R)	1	1	2	Sold dry (25 IDR/bag)	None
13	1	6	65	SHS	Coffee, ginger,	(A), (R)	0.25	1	2	-	None
14	1	-	37	SHS	Coffee, ginger, chili	(A), (R)	2	4	12	Discard, sold dry (10,5 IDR/bag)	None
15	1	4.7	44	SHS	Coffee, stink bean, chili	(A)	2	6-7	9-14	-	None
16	1	-	40	SHS	Coffee, ginger, chili	(A) (R)	0.07	1-2	2-4	-	None
17	1	2	38	ES	Coffee, stink bean	(A), (R)	4.5	3-4	6-8	Sold dry	None
18	1	-	58	ES	Coffee, ginger, chili, turmeric	(A), (R)	5 ha	4-5	10-12	Sold fresh	None
19	1	6	37	SHS	Coffee, ginger, chili, turmeric avocado, durian, jack fruit, stink bean	(A), (R)	1,5 ha	1-2	2-4	Sold fresh	None

Note: 1 = Farmer; 2= General Trader; 3= Government Servant; 4= Goat farmer; 5= Public Transport Driver; 6= Coffee Processing Service;7= Building worker; *= Production from 2 Ha; A = Arabika Coffe and R = Robusta Coffe From Table 1, it can be estimated that the average coffee production was 1.76 tons / ha / year based on total production divided by the land acreage. Most farmers sold coffee in the form of wet cherry bean logs with a price ranged between IDR 14,000-15,000 / kg, and some farmers sold in the form of green bean at more expensive prices, namely between IDR 70,000- 80,000 / kg. Some farmers preferred to sell their coffee by a wholesale system due to a special reason such as lack of labors, in need of cash money for household purposes, and required money for capitalizing agricultural activities especially for replanting the coffee. From the survey there was an indication that the average income of coffee farmers was only IDR 1,483,000/month which is still below the minimum regional income standard in Bondowoso regency, that is IDR 1,978,000/month indicating that the livelihood of smallholder coffee farmers at Sukorejo village is at risk unless there is an opportunity to generate other generating income activities. This notion is in agreement with the data of poverty numbers where in Sukorejo village there are 1,500 households that are considered poor (Sukorejo Village Data 2020). Unfortunately, most coffee farmers confessed that they had no knowledge and experience to process CoP for animal feed other than making cascara. In addition to that, they have not sufficient members of the family who help to utilize CoP for other valuable products. It therefore is likely that lack of knowledge on the utilization CoP for animal feed and a shortage of labor were the main mitigating problems despite a large amount of CoP was produced but it only discarded which creates environmental pollution along the road side or plantation area. According to the chairman of Forest Village Community Institution, the area of land used to grow coffee was around 70,000 / ha with an average production of 1.76 tons / ha. From the activity of coffee processing the amount of CoP produced was around 43% with a total of 123 wet tons or 74 dry tons / year. This amount will go to dump along the roadside or plantation area as shown in Figure 4.

Figure 4. Coffee Pulp Waste Disposal on the Side of the Road at Sukorejo village

The process of education for coffee farmers on the utilization of CoP into animal feed ingredients and production of briquette was carried out by mentoring and farmer engagement approaches either by an intensive door to door communication, discusion with the members of Forest Village Community Institution, or practical demo plot at the center of farmer's households. The initial stage was carried out by delivering material on the processing of CoP that can be used as animal feed ingredients for complete feed formulation. This activity was attended by members of the cooperative and the chairman of Forest Village Community Institution. It is hoped that this activity will increase the income of farmers where currently the price of CoP is IDR 1.200 - IDR. 1.400 / kg. A simple calculation (1,76 tons/ha with a dry matter of 60% then the farmer gets a yield of 454 kg/ha of dry coffee skin), so that there will be an extra income between IDR 545.00 – IDR 635.00 /ha is obtained. Thus, the income of farmers will reach IDR 1.174.000 – 2.264.000 / month. At this level, the income will be above the minimum regional wage. As a result of this activity, farmers are very enthusiastic about the assistance in processing CoP into animal feed ingredients because 100% of coffee production will generate profits for farmers. Coffee production cost, revenue, and income over coffe production cost (IOCPC) is show in Table 2.

Table 2. Coffee Production Cost, Revenue, and Income Over Coffe Production Cost (IOCPC) at Sukorejo Village, Sumberwringin Sub-District, Regency of Bondowoso, East Java province

Responden	Land Acreage (ha)	Production (ton)	Coffee cherry Production (kg)	Revenue (IDR X 000)	Land Rent Cost (IDR x 000)	Maintenance cost (IDR x 000)	IOCPC (IDR x 000)
1.	2,50	10,0	10.000	140.000.	42.000	25.000.	73.000.
2.	0,50	2,0	2.000	28.000.	8.400.	5.000.	14.600.
3.	0,50	3,0	3.000	42.000.	12.600	5.000.	24.400.
4.	1,00	2,0	2.000	28.000.	8.400.	10.000.	9.600.
5.	3,00	4,5	4.500	63.000.	18.900.	30.000.	14.100.
6.	0,50	0,8	800	11.200.	3.360.	5.000.	2.840.
7.	10,00	10,0	10.000	140.000.	42.000.	100.000.	-2.000.
8.	1,00	1,0	1.000	14.000.	4.200.	10.000.	-200.

Responden	Land Acreage (ha)	Production (ton)	Coffee cherry Production (kg)	Revenue (IDR X 000)	Land Rent Cost (IDR x 000)	Maintenance cost (IDR x 000)	IOCPC (IDR x 000)
9.	0,50	2,0	2.000	28.000.	8.400.	5.000.	14.600.
10.	4,00	10,0	10.000	140.000.	42.000.	40.000.	58.000.
11.	5,00	7,0	7.000	98.000.	29.400.	50.000.	18.600.
12.	1,00	1,0	1.000	14.000.	4.200.	10.000.	-200.
13.	0,25	1,0	1.000	14.000.	4.200.	2.500.	7.300.
14.	2,00	6,0	6.000	84.000.	25.200.	20.000.	38.800.
15.	2,00	6,5	7.000	98.000.	29.400.	20.000.	48.600.
16.	0,07	1,5	2.000	28.000.	8.400.	700.	18.900.
17.	4,50	3,5	4.000	56.000.	16.800.	45.000.	-5.800.
18.	7,00	6,5	7.000	98.000.	29.400.	70.000.	-1.400.
19.	1,50	1,5	2.000	28.000.	8.400.	15.000.	4.600.
Average	**2,46**	**4,20**	**4.331.58**	**60.642.**	**18.192**	**24.642.**	**17.807.**

Note: Revenue (Total coffee cherry production x IDR 14.000); Land rent cost (30% from revenue is the portion of forestry department's income; maintenance cost IDR 10.000.000 (Pruning cost IDR 1.500.000; Fertilizier cost IDR 3.500.000; Weeding cost IDR 3.000.000; Harvesting cost IDR 2.000.000). The second stage was carried out by practicing the procedures for processing CoP into animal feed with the use of alkali and the practice of making briquettes. **Figure 2** describes a diagrammatic processing of alkali treatment and briquette production. This innovation is carried out to improve the nutritional quality of CoP which generally have an NDF value ranges between 50 and 56 %. The processing carried out requires a drying time for 4 days in case of no rain and cloudiness. If drying is carried out in the rainy season it takes approximately 7-10 days. This is a new problem that must be solved to accelerate the adoption of innovative processing of CoP into feed ingredients and briquettes products for Animal Feed. The results of this activity get CoP with superior quality which can increase the digestibility value up to two folds. These results showed that this alkaline treatment can be applied in the community to improve the quality of feed in livestock, especially for ruminant animals. The chemical composition of CoP without and with alakali treatment is presented in Table 3. The documentation of the activities is presented in Figure 4 and Figure 5.

Table 3. Nutrition Value CoP with and Without Alkali Treatment (%DM)

Coffee pulp	DM	OM	CP	NDF	DM Digestibility (%)
Arabica	94.12	88.41	9.55	57.29	36.14
Arabica + NaOH	94.43	87.41	12.65	55.39	59.07

Figure 4. Coffee Farmers Engagement During Focus Group Discussion on the Benefits of Alkali-treatment of CoP

Figure 5. Documentation of Community Education Faor Coffer Farmers at Sukorejo Village

Discusion

Smallholder farmers in developing countries seldom to improve their livelihoods due to knowledge and technological illiteracy despite their significant contribution to improving business, economic, environment and social sustainability (Arpi et al., 2018; Rentizelas et al., 2021). In addition to that they also lack capital that renders improvement of their main activity and adopts innovation. This notion conforms clearly with the condition of smallholder coffee farmers at the location under study where the practice of CoP dumping seems associated with those illiteracy to utilize CoP waste to become valuable products and concomitantly reduce the environmental pollution (Qadeer et al., 2022; Wu et al., 2020). Despite awareness of environmental pollution due to improper dumping of CoP is apparent, there is no practical solution due to lack of labor and capital to do it (Kusmulyono & Faizal, 2020; Santoso et al., 2021; Widiyatmoko et al., 2022). This was also underpinned by the chairman of Forest Village Community Institution who confessed that pollution from CoP dumping has been the main problem for such a long time, but there is no help or action taken place by third parties to eliminate the problem of environmental pollution that may be detrimental to the well beings of people living at the surrounding areas. The Indonesian Law No 19 of 2013 article 1 paragraph 2 such conditions should not have occurred as the article explicitly states that under this condition the farmers deserve attention through a program of farmer empowerment to enable them carrying out better farming practices through education and training, counseling, and supporting (Minarni et al., 2017; Pujiati et al., 2021). This is supported by study who stated that introduction of agricultural technology enhances agricultural productivity leading to achievement of food security and poverty alleviation (Suprehatin, 2021). Nevertheless, up till now there is paucity in the program of CoP waste utilization especially for animal feed that simultaneously reduces the environmental pollution (Foteinis et al., 2020; Nizaar et al., 2020). It is generally agreed that perception of smallholder farmers leading to adoption of novel agricultural technology is associated with the multidimensional aspects and particularly they demand a real evidence of the benfit of the introduced novel technology which can be classified into internal factors such as education, number of family members, land ownership and external factors such as the existence of extension programs and supporting institutions (Doshi et al., 2019; Shukla et al., 2020; Suprehatin, 2021). Surprisingly, the number of samples in this study who were considered having elementary school experience was only 30 % and therefore the farmers holding certificate up to Junior and high school were the majority in the group that explained the good perception towards this program even though the demo plot to produce animal feed ingredient was carried out using sunlight drying and at the limited capacity of production (Pujiati et al., 2021; Untung, 2000).

During the execution of the program, it was found that the target farmers were enthusiastic to learn the introduced technology of CoP waste processing with the alkali chemical that had never been known before to improve its nutritive value and it thus feasible to be marketed as animal feed ingredient (Wardah et al., 2018; Yustendi et al., 2021). This notion is in accordance with the findings which concluded that the most influencial factors for innovation adoption by the coffee farmers were the level of knowledge which is related to the educational background, the availability of capital support, social interaction and marketing of the products (Rohma et al., 2023). Under current conditions the farmers in the area under study seem more concentrated on the coffee bean processing that already offers financial benefit rather than paying attention to the process of coffee waste such as CoP to avoid environmental pollution and generating a new income source by applying processing technology to make CoP for livestock feed ingredients or others. Nevertheless, this program has been supported by the University of

Brawijaya for continuation in this financial year by providing a drying machine to enable farmers to produce animal feed from CoP waste.

4. CONCLUSIONS

In conclusion, treating CoP with NaOH as feed ingredient had proven to increase the quality in terms of CP content and DMD that can be marketed at a higher price than the untreated CoP. This implies creating a new source of income for the coffee farmers whilst reducing the environmental pollution through improper CoP dumping in the area under study. Addutuionally, this activity has positive impact on the knowledge improvement of the coffee farmers on the diversity of CoP utilization other than organic fertilizers and cascara production. Nevertheless, bearing in mind of the enormous potency of CoP waste product in this area, further activities are required to capitalize the farmers which enable them to process and market it at a commercial level which increases the income and concomitantly reduce the environmental pollution significantly.

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