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Evaluation of post-harvest coffee to conform with good manufacturing practices (GMP) to develop entrepreneurship

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Abstract. Coffee has good prospects in agroindustry despite overproduction worldwide. Indonesia is ranked 4th in the world's main coffee producer after Brazil, Vietnam, and Colombia. One of the regencies of coffee-producer regions is Ngawi Regency which is located on the slopes of Lawu Mount. Coffee quality is the main criterion to compete with other coffee producers. The way to improve the quality of Indonesian coffee is by upgrading post-harvest handling processes. The aim of this study was the evaluation of the process of post-harvest coffee to conform with GMP (Good Manufacturing Practises) to develop farmers entrepreneurship. The research respondents were 50 coffee farmers obtained by purposive sampling method. The results showed that coffee farmers in Ngrambe Subdistrict, Ngawi District, use the dry process in the process of stripping coffee beans (81.35%). The quality of the coffee picking process is low (53.62%). Generally, coffee farmers do not sort (71.23%). The coffee storage process is also low (52.35%). The efforts required to follow up this research including the dissemination of post-coffee harvest technology that is in accordance with GMP. Furthermore, it can improve the competitive advantages of the product.

1. Introduction

Coffee is one of the superior products in the plantation subsector in Indonesia. Indonesia is the fourth as the largest coffee producing country in the world. During the last six years (2006-2011), the average amount of coffee exported was 412.67 thousand tons, with a total value of 802.58 million US \$ with a total workforce involved reaching 2 million [1]. According to the International Coffee Organisation (ICO), coffee consumption increases each year so that the increase in coffee production in Indonesia has the opportunity to export coffee to major coffee consuming countries in the world such as the European Union, the United States, and Japan.

In general, the agricultural products of local farmers are of low economic value because they have not been processed and developed through SMEs [2]. Product innovation needs to be carried out in accordance with consumer innovativeness of processed coffee products so that the innovations of coffee beans produced are adopted by consumers [3]. Coffee beans produced by farmers need to be processed properly so that they meet the requirements to be accepted in coffee shops in the country and overseas franchises such as Starbuck and Quick Check.

Ngawi Regency is a coffee-producing area in the western part of East Java Province. But, so far the coffee has not been processed properly so that it does not have economic value. Hargomulyo Village in Ngrambe Sub-District, Ngawi Regency includes five main coffee-producing mountain areas in East



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Java. The area of coffee plantations in Ngrambe District reaches 620 ha. The type of coffee that is mostly planted is Robusta coffee with a total production of 1424 tons. Hargomulyo Village as one of the coffee-producing villages in Ngrambe Sub-District, Ngawi Regency, East Java, Indonesia.

Lately, a problem arises because more than 65% of Indonesia's coffee exports are Grade IV above and classified as low-quality coffee, which is subject to an export ban. The low quality of Robusta coffee production is mainly due to garden management, inadequate harvest, and post-harvest handling because almost all robusta coffee is produced by smallholder plantations.

Large coffee production, especially in the village of Hargomulyo, needs to be followed by an increase in the quality or quality of coffee. This is so that coffee products in the village of Hargomulyo can compete with coffee products from other regions so that farmers get attractive price incentives. To produce high-quality coffee, it is necessary to handle the right harvest and post-harvest based on GMP. The application of GMP (Good Manufacturing Practices) is a guarantee for consumers that the market products are derived from the results of a series of processes that are efficient, productive and environmentally friendly. Through the GMP process, coffee farmers will get added value in the form of incentives to increase prices and ensure adequate market guarantees. According to Lamerle C.[4], the quality of the harvest is used, and the quality. Most of the show's concern with quality and price, however, is that there is a lack of concern with the harvest techniques used and the price of quality.

Regarding the above, it is necessary to know the extent of harvest and postharvest handling that has been carried out by farmers so that appropriate corrective measures can be taken. This study aims to evaluate the post-harvest handling of coffee by farmers in the village of Hargomulyo, Ngrambe District, Ngawi Regency, East Java, Indonesia.

2. Research Methods

2.1. Location

The study was conducted in Hargomulyo Village, Ngrambe District, Ngawi Regency. The selection of research locations is based on the consideration that Hargomulyo Village is one of the coffee centers in East Java, especially in western East Java, in the Hargomulyo village there is also a coffee cluster. Coffee farmers in Wonokerso Village generally process their own coffee until it becomes rice coffee.

2.2. Data collection and respondents

The study was conducted in May - June 2019. This research is an explorative descriptive study. Descriptive research intends to make a description systematically, factually and accurately about the facts and characteristics of certain populations [5]. To support the data description, coffee quality testing was carried out. Samples were taken using a purposive sampling technique that is a sampling scheme which aims to get subjects who have certain characteristics so that they can be analysed validly [6]. The samples taken were 30 farmers with the criteria: Head of the family (Father/Mother), Living in Hargomulyo Village, Farmers who cultivate Robusta coffee and conducting Robusta coffee post-harvest activities, having coffee plantations, understanding coffee farming and having coffee samples.

Data collection techniques used in this study used observation techniques, independent interviews and in-depth documentation. Furthermore, data analysis was carried out descriptively. Conformity Check Handling Post coffee harvest using a checklist. Assessment of the level of suitability (%) of each respondent in handling coffee is calculated using the following formula:

$$\frac{\text{Number of compatible answer}}{\text{Total of questions}} \times 100 \% = \text{GMP Conformity} (\%) \quad (1)$$

3. Results and Discussion

3.1. Characteristics of farmers

Table 1. shows the characteristics of coffee farmers who assessed the suitability of the practice of handling the harvest and post-harvest.

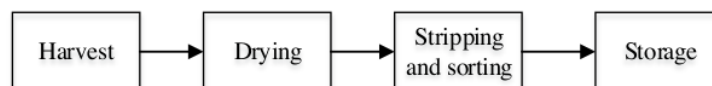
Table 1. Description of research samples

Description	Minimum	Maximum	Mean
Age	24	72	46
Farming Experience	4	49	23.05
Education	Elementary school	Scholar	Elementary school

Based on Table 1, it is known that the average respondent is 46 years old with farming experience of 4 - 49 years and the average education is elementary. Coffee cultivation is inherent culturally when viewed from its farming experience. Farmers generally begin to manage coffee plantations starting around the age of 24 years, the average is inherited from parents. Farm children want to succeed their parents on the farm. This means new activities in rural areas – agriculture combined with nature and water conservation, recreation, care or education. These ‘future farmers’ bring innovation and sustainability [7].

3.2. Post-harvest coffee handling

The post-harvest stages of coffee include harvesting, drying, stripping and sorting, storage can be seen in Figure 1 below:

**Figure 1.** GMP procedure of coffee post-harvest.

The following are described in each suitability level for harvest and post-harvest handling at each stage of treatment based on GMP (Good Manufacturing Practices) such as harvesting rate, drying, stripping and sorting, then storage.

3.2.1. Harvesting rate

There are four different methods of harvesting coffee, the first of the four types being the stripping method. This form of harvesting is done by hand, and it removes all of the berries, flowers, green berries and deeply over ripened berries. Table 2 shows the suitability level of coffee harvesting practices for farmers with GMPs.

Table 2. Suitability level of coffee harvesting practices for farmers with GMPs

No	Description	Compliance with GMP	
		Appropriate	Need improvement
1.	Use clean and adequate harvesting equipment	10	90
2.	Avoid physical damage to the fruit	75	25
3.	Avoid contamination by soil and other dirty materials	15	85
4.	Separate young ripe fruit and dry / fall on the ground	10	90
5.	Separate foreign objects and defective/damaged fruit	10	90
6.	Avoid hoarding fresh fruit	10	90
	Mean	21.67	78.33

Harvesting of coffee fruit is done manually by picking the ripe fruit and then putting it in a plastic sack. Based on the level of suitability of coffee harvesting practices, it is known that only 10% of farmers pay attention to the cleanliness of the equipment used during harvesting. Separation or sorting for young ripe and dry/falling fruits on average has not been done well. Sorting seeds to separate ripe fruit and young on average has not been done. However, many farmers now harvest the ripe fruit or red

pick. After finishing picking the coffee is not immediately dried so that the average stockpiling of fruit is still done by the farmers. Hoarding is generally carried out for 2- 3 days. According to Rachmanda [8], the thing to avoid is storing coffee fruit in plastic sacks or sacks for more than 12 hours, because it will cause pre-fermentation so that the aroma and taste of coffee beans are less good and foul-smelling (fermented).

3.2.2. Drying level in dry coffee processing

The method of processing dry methods is mostly done considering the capacity of the processing is small, easy to do, simple equipment and can be done at the farmer's house. The process of processing Robusta coffee which is commonly carried out by farmers at the research location is twofold and broken by skin, some are doing both processing. However, the majority of farmers process broken skin. In the coffee, the harvested coffee fruit is immediately dried, while for the broken coffee before drying the coffee is ground using a coffee fruit breaking machine and then dried. The grains should be dried in order to reduce its 53% humidity; due to the current trading conditions, this percentage should reach a value between 10% and 12 % [9].

The limited drying area is overcome by drying coffee using public facilities such as paved roads. The drying process has on average been carried out according to the standard, namely the height of the coffee stack <4 cm so that the sun's heat can be received evenly in all parts of the coffee. Regular reversals are carried out in one day approximately 2-3 times so that the heat is received more evenly.

This is in agreement with the finding of Berhanu et al. [10] who reported the highest raw quality from sundried coffee dried on mesh wire, while coffees dried on bricks scored the lowest raw quality values. Similarly, Anteneh [11] reported that improper postharvest processing and handling practices (drying on bare ground) can induce fungus and foreign matters and deteriorate the quality of coffee. Based on the process that has been carried out to guarantee quality, supervision has been carried out on the drying process by farmers based on GMP which can be seen in Table 3.

Table 3. Level of conformity of coffee drying practices by farmers with GMPs

No	Description	Compliance with GMP	
		Appropriate	Need improvement
1.	Using a clean tool/drying floor, avoid direct contact with the ground	100	0
2.	Broken fruit with a clean breaker machine and immediately cleaned every time it is used up	10	90
3.	Use a coffee tray	80	20
4.	Immediately dry the fruit that has been broken with <4 cm thick, avoid stacking and turning regularly during drying. Do not dry the broken fruit skin directly on the ground	100	0
5.	Separate the dried coffee for each different level of drought	75	25
6.	Avoid re-wetting (splashed rain/dew) cover with plastic, give adequate ventilation at night	65	35
7.	The drying process continues to be completed until the moisture content is 12%	90	10
8.	Avoid the accumulation of fruit that has not dried because fungi will easily attack it	80	20
	Mean	75	25

Both in processing coffee logs and shells, all farmers have carried out a separation based on the level of drought. Generally, coffee beans require a longer drying time compared to broken coffee, for around 10-12 days of coffee while the coffee breaks the skin 5-7 days. Coffee that has been dried in the sun is first separated so that it is not mixed with coffee that is still wet or freshly dried. Meanwhile, the coffee fruit that has not been dried is also not piled up but left completely dry.

Although still relying on estimates of the traditional way farmers use it is quite effective because based on the results of laboratory tests, the average coffee sample has a water content below 12.5%, meaning that it meets the general quality requirements according to SNI. In the process of processing dry cracked coffee requires a coffee fruit breaking tool generally still manually. The condition of the average breaker machine has not been cleaned regularly. The results of the milling are then accommodated using a coffee container base or not directly on the ground. Based on the research of Cabrera et al. [12] all coffee trade is carried out on a wet weight basis, while in the scientific world, the dry weight basis is more often used. For this reason, both measurements are presented for greater clarification. The locations of the containers in the vessel corresponded to the deck, first floor, and hold, and the samples from the three regions of the container corresponded to the bottom, middle, and top.

3.2.3. Stripping and sorting

Farmers have not paid attention to the cleanliness level of the coffee peeler used or cleaning has not been done periodically. Cleaning is done when the performance of the tool has been disrupted. Separation of seeds with objects other than coffee beans such as coffee skin, stone, leaves, etc. generally, farmers have done well, meaning that this activity is quite routinely carried out even though sometimes coffee skin is mixed but the percentage is low and conformity level of stripping and sorting coffee by farmer showed in Table 4.

Table 4. Level of conformity in the practice of stripping and sorting coffee to farmers with GMPs

No	Description	Compliance with GMP	
		Appropriate	Need improvement
1.	The dried coffee/shells are peeled using a good, clean peeler	0	100
2.	Separation of objects other than coffee beans	100	0
3.	Uniformity in the size of coffee beans by sifting according to the applicable size	10	100
4.	Separation of visible seeds according to standard defects needed	10	90
5.	Maintain cleanliness of coffee grinder and sorting tools	0	100
6.	Using a sack that is clean and free of odor or foreign material (oil, medicine, etc.)	95	5
	Rata-rata	33.8	66.2

All farmers generally do not make the uniform size of seeds by multiplying according to the applicable size. Based on the size of dry processing robusta coffee is divided into two, namely large and small. The large size with the criteria does not pass the sieve with a diameter of 6.5 mm (number 16 sieve, while the small size is the coffee beans that pass the 6.5 mm diameter sieve but do not pass the sieve 3.5 mm in diameter (size No. 9).

The existence of products that deviate from the standard provisions cannot be mixed with a good product because it will contaminate the product as a whole. Separation of physically deformed seeds can reduce ochratoxin contamination. Thus, it is recommended to separate defective seeds, especially black seeds, fungus or other defective seeds [9-10].

3.2.4. Storage

Most farmers have stored coffee separately between coffee beans, coffee broken skin and coffee beans. Long-term storage in the form of spindle coffee or shelled coffee beans is rarely done by farmers, generally long-term storage in the form of rice coffee that is completely dry. The stored coffee beans on average have met the standard maximum water content set at 12.5% based on the results of the water content tests that have been carried out fulfilling SNI.

Good coffee storage owned by farmers is in the form of coffee, not in the form of rice coffee (green coffee) with water content ranging from 14-16%. With this level, the coffee spindle is stored for 2-3 years. If at the time of harvest the price of coffee is low, farmers can save it until prices improve. During

the rainy season, the average farmer protects dried coffee, such as by closing coffee using plastic or tarpaulin, so that the coffee beans are not exposed to direct rain or bring coffee to a protected place so that the coffee beans remain dry. Inspections or checks on the quality of coffee have been carried out by some farmers while others have not routinely checked because farmers assume storage is only temporary or in the short term, when the selling price is appropriate the product will be sold immediately. The average storage done by farmers is <1 year or ranges from 3-4 months. Dry storage area room or area designated for the storage of packaged or containerized bulk food that is not potentially hazardous time/temperature control for safety [11].

Table 5. Level of conformity of coffee storage practices to farmers with GMPs

No	Description	Compliance with GMP	
		Appropriate	Need improvement
1.	Separate storage of coffee with shelled coffee and coffee beans	80	20
2.	Long-term storage (several months) Coffee should be stored in the form of logs or coffee beans that are completely dry	100	0
3.	Coffee storage is carried out if the water cadre is sufficiently low (12% maximum)	100	0
4.	Avoid storing coffee together or close to smelly objects such as oils, spices, medicines and chemicals because the smell will be absorbed into the coffee beans	30	70
5.	Storage areas must be dry, clean, and have adequate ventilation	45	55
6.	The sack pile is arranged on a wooden / plastic pile and is spaced against the wall and between the piles	0	100
7.	Avoid wetting seeds or splashing rain	80	20
8.	Inspections are carried out regularly to prevent greater damage	0	100
	Mean	54.4	45.6

4. Conclusions

The highest level of suitability for post-coffee handling was in the drying activity (75%) and the lowest for harvesting (21.67%) followed by stripping and sorting activities (33.8%), while the storage level was 54.4%. Related to the low level of harvest and post-harvest handling, it is necessary to socialise to farmers how to handle harvest and post-harvest coffee in accordance with GMP, especially at the harvesting level. Kinds of efforts conducting for this research i.e. need for dissemination of post-coffee harvest technology that is in accordance by GMP. Furthermore, it can improve the competitive advantages of the product.

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