PAPER • OPEN ACCESS

Physical quality improvement of coffee Robusta (*Coffee robusta Lindl*) in Argopuro Mountain, Jember

View the article online for updates and enhancements.

IOP ebooks™

Bringing you innovative digital publishing with leading voices to create your essential collection of books in STEM research.

Start exploring the collection - download the first chapter of every title for free.

Physical quality improvement of coffee Robusta (*Coffee robusta Lindl*) in Argopuro Mountain, Jember

N Kuswardhani, M Misbahudin and B H Purnomo

Department of Agriculture Industrial Technology, Faculty of Agricultural Technology, University of Jember, Jl. Kalimantan 37, Tegalboto, Sumbersari, Jember Regency, East Java, Indonesian

E-mail: nita.ftp@unej.ac.id

Abstract. Robusta coffee on the Slope of Mount Argopuro Jember Regency is cultivated through direct guidance by the Department of Agriculture, Plantation and Forestry sub-sector, Jember Regency. One of the obstacles was post-harvest constraints, that there was still a low quality of coffee because one of the main processing processes was in Badean Village, Bangsalsari District, Jember Regency. Improving the physical quality of Robusta coffee was done to obtain the physical quality attributes of green bean Robusta coffee by using the Quality Function Deployment (QFD) method, thus the priority actions can be taken on the technical response so that policy proposals should be taken by producers to improve product quality. The results obtained were the quality attributes that were the priority for improving the physical quality of Robusta coffee including uniformity in size, size of coffee beans, shape of coffee beans, weight of coffee beans, color brightness, intensity of broken beans, presence or absence, cleanliness of coffee beans, and moisture content. Then the prioritized quality attributes to be improved were attributes of water content, intensity of broken seeds, cleanliness of coffee beans, uniformity of size, and brightness of colors by improving technical responses sequentially based on rankings, seed sorting, drying, hulling, fruit picking, spindle sorting and breaking logs.

1. Introduction

Robusta coffee is often said to be second-class coffee, because the taste is more bitter, slightly sour and contains more caffeine than Arabica coffee. But Robusta coffee has advantages in terms of characteristics that are resistant to disease, has the strongest aroma and taste among other types of coffee [1]. Coffee is Indonesia's top 10 export commodities, and 5 main plantation commodities whose role is quite important to the national economy. About 96% of Indonesian coffee production comes from smallholder plantations with the number of farmer families involved as many as 1.9 million [2].

Based on data from the Forestry Office in 2013–2016 the sub districts that entered the Slope of Argopuro Mount Jember Regency area were Sumberbaru, Tanggul, Bangsalsari, Panti, Sukorambi and Arjasa. Of the five sub-districts, Bangsalsari is the district that has the highest productivity, namely the average production in 2014 and 2015 is 9.00 (Kw/Ha) while for the other 4 sub-districts is less than 9 (Kw/Ha), which is 5.77 –8.96 (Kw/Ha), while for 2016, despite the decline in productivity, Bangsalsari District still has the highest productivity.

Bangsalsari Sub district as the highest producer in the Argopuro Mountains slope in Jember Regency, apparently still faces various kinds of obstacles that can affect the sustainability of coffee farming, especially in Badean Village. One of the obstacles faced is post-harvest constraints that affect the price

of coffee. The low quality of Robusta coffee produced by farmers is generally caused by post-harvest processing efforts that still produce original coffee, namely green bean coffee beans produced by methods and facilities that are very simple, the water content is still relatively high and still mixed with other ingredients in amounts relatively much, so that the coffee produced is still sold at low prices by collectors and consumers, because it must go through a sorting process before being exported. Some of the most common post-harvest problems in the field are high water content which can reduce quality and affect selling prices [3]. Therefore, efforts to improve coffee productivity and quality was carried out so that coffee competitiveness in Indonesia can compete in the world market [4], and to find out and improve the quality of the green bean of Robusta coffee at the post-harvest level.

2. Methods

2.1 Research stages
This research was conducted in Jember Regency, Argopuro mountain range in Badean Village, Bangsalsari District. The selection of the research area was done purposively. Data collection was carried out by observation and interview directly in several places such as production units and consumer locations such as cafes with the help of questionnaires given to 60 respondents. The resulting data is then translated into Voice of Customer and then used to compile Customer Needs. To facilitate the interview, a questionnaire was used to obtain the required data, namely:
a. Customer needs and desires, for data on customer needs and the level of customer interest
b. for customer needs data and customer importance.
c. Customer satisfaction, for customer satisfaction Performance level data on products in the preparation of the planning matrix.
d. Technical response, addressed to respondents who own production units, to obtain data related to the production process such as factors that influence the processing of green bean Robusta coffee.
e. Correlation in the relation matrix and correlation between technical responses is given to the owner of the production unit to determine the relationship between customer needs and technical response and the relationship between technical responses.

2.2 Data analysis in (quality function deployment (QFD)
Data analysis is carried out in accordance with the parts of the QFD that are drawn through the House of Quality, which in Figure 1 shows the parts of the quality house. The parts that are fulfilled are the Customer Needs, namely the input from the customer regarding the desired product attributes to the product. Technical Response, namely the technical ability possessed by the manufacturer to answer customer needs and desires
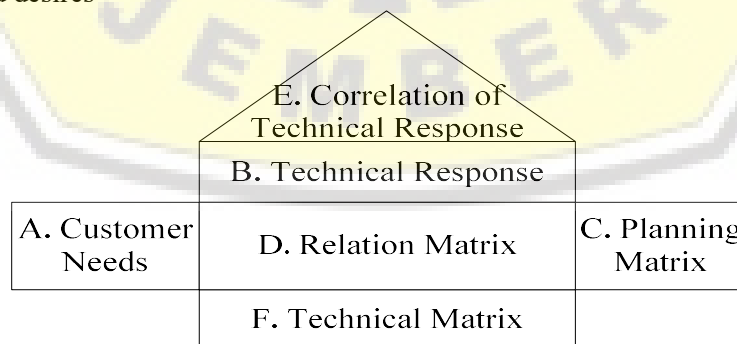

Figure 1. House of quality [5]

1) Customer needs. Determining customer needs and desires is done by interviewing consumers and green bean Robusta coffee swords. In conducting interviews, personal interview techniques are used. In conducting interviews, the questions asked were developed based on factors that influence the quality of physical Robusta coffee green beans.

2) Planning matrix
   a. Importance to customer
   b. Measurement of the level of customer satisfaction with the product (Customer Satisfaction Performance). Measurement of customer satisfaction is calculated by the formula.

$$\text{Weighted average performance} = \frac{\sum i \ [(\text{ number of respondents at performance value } i).i]}{(\text{Total number of respondents})}$$

   c. Goal, the highest score, ratio of consumers satisfaction performance to competitive satisfaction performance, to explain producer objectives in responding to the customer needs.
   d. Improvement ratio. The improvement ratio is calculated by the formula.

$$\text{Improvement Ratio} = \frac{\text{Goal}}{\text{current satisfaction performance}}$$

   e. Selling point. The selling point is the contribution of a customer's need to the selling power of a product by using a score of 1 = a weak selling point, 1.3 = a medium selling point, 1.5 = a strong selling point.
   f. Raw weight, is the value used for the process of further improvement in product development by formula.
      Raw Weight= (importance to customer) X (improvement ratio) X (sales point)
   g. Normalized raw weight, is the percentage values of standard weight and calculated by formula.

$$\text{Normalized Raw Weight} = \frac{\text{Raw Weight}}{\sum \text{Raw Weight}}$$

3) Technical response, is a matrix that is prepared based on the results of interviews with owners or producers regarding the stages and factors that can affect the results of processing
4) Relationship matrix is the determination of the relationship between each customer need and technical response
5) Technical correlation, explains the relationship between technical requirements one with other technical requirements on the technical response matrix and is at the very top of the quality house.
6) Technical matrix
   a. Contribution and Normalized Contribution, shows the strength of the technical response to overall customer satisfaction. Contributions determine the priorities of the producer's response to consumer responses. Normalized contribution shows the percentage of contribution value.

$$\text{Contribution} = \text{Technical Response Score to } i \ X \ \text{Normalized Raw Weight}$$
$$\text{Normalized Contribution} = \frac{\text{Contribution}}{\text{Total Contribution}}$$

   b. Benchmarking, is looking for an industry that has the best practice so as to produce the best performance.

$$\text{Benchmarking} = \frac{\text{Score relation matrix } i \ X \ \text{Customer satisfaction } i}{\text{Total score relation matrix}}$$

   c. Targeting, is a goal that the company wants to achieve to be able to meet the level of consumer needs by using the technical response it has.

7) House of Quality and Improvement Recommendations [6]

3. Results and discussions

Improving the physical quality of green bean Robusta coffee by using QFD analysis aims to determine the physical quality attributes expected by customers and to know the priority of improvements made to achieve customer expectations.

Table 1. Customer needs and quality attributes

Customer Needs	Quality Attributes
Having a uniform size of coffee beans	Uniformity of size
Has a large size coffee bean	Size of coffee beans
Having oval shape	Shape of coffee beans
Having a heavy coffee bean	Weight of coffee beans
Has a bright color or grayish yellow	Color brightness
Having coffee beans are intact or not broken	Seeds intensity broke
Having a coffee bean intact and perforated	Presence of holes
Having a clean coffee beans from the droppings	Cleanliness of coffee beans
Having very little water content	Water content

Based on direct observations and interviews, it was found that customers expect green bean Robusta coffee (Table 1), thus it used as a base of customer needs it translates to customer needs.

1) Customer needs.

Based on the results of the identification of the parameters of the green bean physical quality of Robusta coffee that has been done, the resulting needs and desires of the customer can be seen in Table 1 as follows. Based on the results of the data obtained, the overall analysis results are submitted in the Robusta Coffee Bean House of Quality in Figure 2.

2) Planning matrix

a. Importance to customer

Preparation of the level of interest of customers using a Likert scale with a score of 1= very not important, score 2= not important, score 3= important, score 4= very important, which is then arranged based on the modus value.

Based on the results that have been obtained, it is known that there are 3 quality attributes that most customers want with a value of 4 (very important) is brightness of colour, level of cleanliness of coffee beans, and water content. The remaining attributes have the level of importance desired by the customer with a value of 3 (important) including size uniformity, size of coffee beans, shape of coffee beans, weight of coffee beans, intensity of broken beans, and presence or absence of holes.

b. Customer satisfaction performance

Measurement of the level of customer satisfaction of green bean products of Robusta coffee is done by assessing the quality parameters compared to 2 competitor products, these measurements use a Likert scale with a score of 1= very dissatisfied, score 2= dissatisfied, score 3= satisfied, score 4= very satisfied. Measurement of the level of customer satisfaction is done by using the sample code to obtain subjective data, the sample code is 895 which is a sample of production from Badean Village where the sample is a product sample conducted quality improvement analysis, while for sample code 327 and 614 are product samples the same competitors come from different sub-districts and are still in one district (Jember).

Based on the results of the measurement of customer satisfaction that has been done, it is found that the sample that has the highest value of total score is owned by the sample code 614 (competitor 2) with a total value of 1559, as well as the value of customer satisfaction that is proportional to the total score where The highest value of satisfaction level is owned by sample code 614 (competitor 2) with the number of satisfaction level value of 26.0, then in the sample code 327 (competitor 1) has a total score of 1541 and the total value of customer satisfaction is 25.7, while the 895 sample product has a total score of 1360 and the total value of customer satisfaction is 22.7.

c. Goal

The target value is taken from the highest value in the comparison of the level of customer satisfaction on the 3 sample products and based on the data generated that there is 1 attribute of physical quality that has met the target, namely the weight attribute of coffee beans with a value of 2.9, while for the remaining 8 physical quality attributes still do not meet the target.

d. Improvement ratio

Improvement ratio value is used in determining whether the quality attribute needs to be repaired or not. If the repair ratio is more than 1, then the attribute needs to be improved to meet the level of customer satisfaction, and if the repair ratio value is equal to 1, then the quality attribute has fulfilled the customer's needs.

Based on the data produced that there is 1 quality attribute that has fulfilled the needs and desires of the customer with the value of the improvement ratio equal to 1, that is the attribute of the weight of the coffee bean, while for the other 8 attributes it needs to be improved because it still has a repair ratio of more than 1. Top priority of the 8 quality attributes that need to be improved are attributes of broken seed intensity, then parameters of uniformity in size and moisture content, then the parameters for the presence or absence of holes, as well as the parameters of coffee bean size, coffee bean shape, color brightness, and cleanliness of coffee beans.

e. Sales point

The point of sale is the value that determines the size of the effect of a quality attribute on the level of sales of a product based on customer expectations. The point of sale is indicated by the value of 1.5 which states that the improvement of the quality parameter has a strong influence on the level of sales, a value of 1.3 states that the improvement of the quality parameters has a moderate influence on the level of sales, and a value of 1 state that the improvement in These quality parameters have a very weak influence on the level of sales products [7].

Based on the point of sale value, it is known that the improvements made by the producer on quality attributes will have a strong influence on sales with the selling point value of 1.5 is the attribute of quality uniformity, coffee bean shape, intensity of broken beans, cleanliness of coffee beans, and water content. The rest of the quality attributes with moderate influence on the level of sales with a selling point value of 1.3 are attributes of the quality of coffee beans, the weight of coffee beans, the brightness of the color and the presence or absence of holes.

f. Raw weight

The quality attributes of a product with the greatest absolute weight value, the quality attribute must be prioritized for improvement. Based on the value of absolute weight, the product quality attributes must be prioritized to improve the water quality attribute. Increasing the parameters of water content quality can be done by controlling the water content in coffee beans after the drying process is done using a measuring instrument of coffee bean moisture content and refers to the maximum limit of water content in accordance with INS which is 12.5% of the mass fraction. The next quality attributes that must be corrected sequentially are attributes of the quality of broken seeds, the level of cleanliness of coffee beans, uniform size and brightness of colour, then the attributes of the quality of coffee beans, the presence or absence of holes, the size of coffee beans, and the weight of coffee beans [8]

g. Normalized raw weight

The absolute weight value will be used to determine the value of the contribution to the technical matrix.

3) Technical responses

The technical response matrix is a matrix compiled based on the results of interviews with owners or producers of green bean Robusta coffee regarding the stages and factors that can influence the results of processing, the technical response can be seen in Table 2 as follows.

Table 2. Technical Response

No.	Technical response
1	Picking fruit
2	Sorting the logs
3	Crack the logs
4	Drying
5	Hulling
6	Sorting seeds

4) Relationship matrix

The relation matrix shows information that allows for optimal processes. Relationships in this matrix are represented by different symbols on customer needs with technical responses. The symbol will also determine the value in the technical matrix.

Based on the relation matrix, it was found that the most influential technical response to customer needs was the seed sorting process with 46 relationship values, then the drying process with the number of relationship values 37, hulling with the number of relationship values 25, then quoting the fruit with the number of relations 24 sorting spindles with the number of relationship values 23, and breaking spindles with the number of relationship values which is 14.

5) Technical correlation

Correlation of technical responses shows the relationship between technical requirements one with other technical requirements. Based on the correlation of the technical response, it was found that the technical response that had the strongest correlation was picking the fruit with the total value of the relationship that is 45, then the correlation of the technical response of hulling with the total value of the relationship is 37, then the correlation of the technical response of seed sorting with the total value of the relationship is 33, then the correlation of the drying technical response with the total value of the relationship is 33, then the correlation of the technical response of the spindle solving with the number of relationship values is 33, and the correlation of the last technical response is the sorting of logs with the number of relationship values that is 25.

6) Technical matrix

The technical matrix has three main parts, namely contribution, benchmarking and targeting obtained from the results of calculations in the previous section, including the following.

a. Contribution and normalized contribution

Value of contribution and normal contribution is a value that shows the priority of technical response that will be carried out to meet the needs and desires of the customer. Based on the value of the contribution and the normal contribution produced, the prioritized technical response for improvement is seed sorting with a contribution value of 5.41, then drying with a contribution value of 4.27, and then hulling with a contribution value of 2.97, then picking fruit with a contribution value of 2.66, then sort the spindles with a contribution value of 2.52, and the last is the breakdown of spindles with a contribution value of 1.66

b. Benchmarking

Benchmarking is a way to determine the level of technical response based on the level of customer satisfaction on the physical quality attributes of products developed with competitors. Based on the value of the predicted stake, it was found that the green bean of Robusta coffee produced by the village of Badean had a lower value of stakes compared to the 2 competing products, therefore repairs and improvements in product quality needed to be done.

c. Targeting

The target value is taken from the highest benchmarking value of the 3 sample products and based on the target value produced, the estimated value of the product is lower than the target to be achieved, indicating that the process or technical response carried out by the producers of the products developed still does not meet the target, so that improvements are needed in the technical response to meet the quality attributes according to the needs and desires of the customer.

7) House of quality

Quality house is a technical design to describe the characteristics of the product desired by the customer. In the house quality includes information that must be done by the producer in order to improve quality based on the needs and desires of the customer effectively and efficiently. The house quality matrix can be seen in Figure 2.
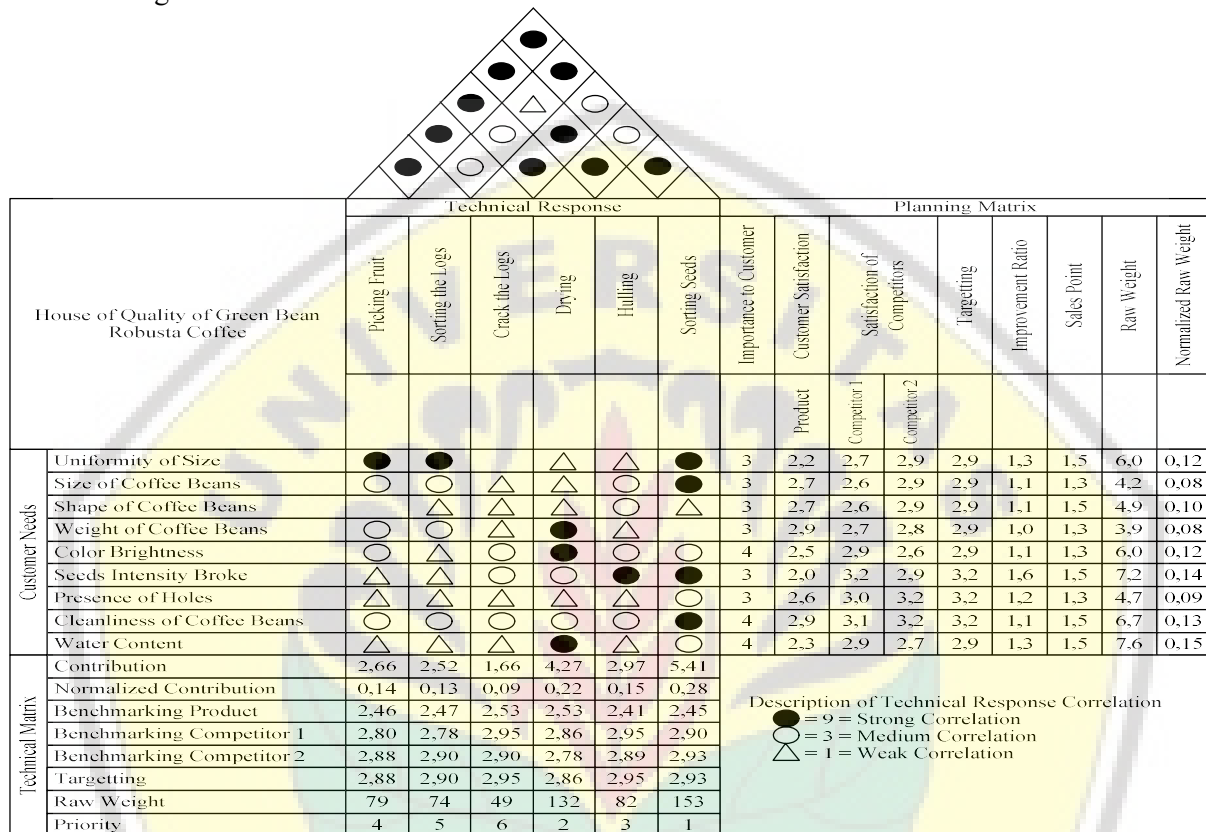

Figure 2. House of quality of green bean Robusta coffee

Based on further analysis on the quality house matrix (Figure 2) that an increase in quality attributes is done by improving the technical response that has a close relationship with these quality attributes. Quality attributes that are prioritized for improvement are quality attributes that have raw weight values more than equal to 6, namely water content quality attributes by improving the technical response to the drying process, then the quality attributes of the seeds broken by improving hulling and seed sorting processes, while attributes the quality of the cleanliness of coffee beans is by improving the seed sorting process, and the attributes of quality uniformity are by improving the fruit picking process, spindle sorting, and seed sorting, while the color brightness attribute is to improve the drying process.

4. Conclusion

There are 9 quality attributes in the process of improving the quality of green bean Robusta coffee and the quality attributes that are prioritized to be repaired are moisture content, intensity of broken beans, cleanliness of coffee beans, uniformity of size, and brightness of colors, while improving quality attributes need to be improved are all technical responses, but the technical response that is most preferred to be repaired is in the process of seed sorting, drying, hulling, picking fruit, and sorting logs.

Acknowledgment

References
[1]   Hakim L and Septian A 2011 *Agrisep* **12**
[2]   Novita E 2012 *Desain Proses Pengolahan pada Agroindustri Kopi Robusta Menggunakan Modifikasi Teknologi Olah Basah Berbasis Produksi Bersih* PhD Thesis (Jember: Sekolah Pascasarjana Institut Pertanian Bogor)
[3]   Novita E, Suryaningrat I B, Andriyani I and Widyotomo S 2012 *Agritech* **32**
[4]   Rahardjo P 2012 *Guide Cultivation and Processing Arabica and Robusta Coffee* (Jakarta: Penebar Swadaya)
[5]   Nasution M N 2005 *Manajemen Mutu Terpadu (Total Quality Manajemen)* (Jakarta: Ghalia Indonesia)
[6]   Selfiyana A, Rohayati Y and Fashanah A 2015 *E–Proceeding of Engineering* **2**
[7]   Suryaningrat I B 2013 *Agroindustrial Journal* **2**
[8]   Andriani D R, Heru S and Rendra W T 2012 *Agrise* **7**