Analysis of Management, Technology and Quality of Coffee Bean in West Sumatera

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Abstract. Coffee plant expansion in West Sumatra has been increasing for the past few years. However, the farm growth was not in accordance with the less significant improvement of coffee bean quality. Thus, identification of the source of the problem and appropriate solution was certainly needed. Therefore, a research had been conducted in some major coffee producer area in West Sumatra. The data were analyzed by using Analytic Hierarchy Process (AHP) to identify farmer motivations, coffee farm management and source of technology. Several farmer consideration to plant coffee had been discovered as follows: more profitable than other commodity (0.3983), land use compatibility (0.3590), other farmer success (0.2427). Coffee farm management was influenced by capital (0.3347), land area (0.3199), labor availability (0.1811), coffee bean price (0.1643). Farmer acquired technology from agricultural extension officers (0.4626), other farmers (0.4035), personal experience (0.1339).

1. Introduction

The Indonesian economy is strongly influenced by the development of the agricultural sector, including the plantation sub-sector. Plantation commodities that are widely planted include coffee. Based on data from the Indonesian Coffee Exporters Association, it is stated that the average volume of Indonesian coffee exports is 350 Tons per Year consisting of robusta coffee (85%) and arabica coffee (15%). Indonesian coffee export destination countries include the USA, Japan, Italy, Germany and the United Kingdom. In the ASEAN region, Indonesia is known as the second largest coffee producer and exporter after Vietnam. In terms of coffee exports, Indonesia is the fourth largest coffee exporter in the world after Brazil, Vietnam and Colombia. Indonesia experienced an increase in production in the period 1980-2016. The average growth of coffee production reaches 2.44% per year [6].

West Sumatra is one of the provinces in Indonesia which makes coffee as one of its leading commodities in addition to palm oil and rubber. West Sumatra coffee production continues to increase, based on data from the West Sumatra Office of Food Crops, Horticulture and Plantations, arabica and robusta coffee production in West Sumatra in 2016 reached 22,292 Tons per Year with a planting area of 32,461 Hectares. To maintain the productivity and quality of coffee beans produced, good cultivation is needed such as pruning and fertilization. In order for the quality of coffee beans to be better, it takes good post-harvest handling and determining the right harvest method. For this reason, good cooperation between coffee farmers and related institutions is needed [13].

Management of coffee gardens needs to be considered well. This is influenced by several things such as the background of the selection of commodities and the factors that influence the quality of the coffee beans produced. With this background in the selection of coffee commodities, it will be easier to make the right program for coffee farmers. In addition, it is also necessary to examine what factors influence the quality of coffee beans. This needs to be known by coffee farmers so they know the right way to produce good quality coffee beans.
2. Materials and Methods

Data from the research results were processed using the Analytic Hierarchy Process (AHP) program. This is done to determine the basis of the selection of commodities by farmers, technology sources and management of coffee plantation land. The aim is to determine the importance of each parameter based on its value. Each parameter in each component is tested in pairs. This test will show which parameters are more important. The level of importance of all parameters is determined based on the scale of interest. As a source of information, several experts and practitioners are used in coffee plantations. The results obtained are made as recommendations for improving the quality of coffee beans in the province of West Sumatra.

The response to the quality of coffee beans is used to develop a mathematical model that correlates with land management, maturity level of coffee beans, harvesters and postharvest handling based on the polynomial equation as follows:

\[ Y = \beta_0 + \sum_{j=1}^{3} \beta_i x_i + \sum_{ij=1}^{3} \beta_{ij} x_i x_j + \sum_{j=1}^{3} \beta_{jj} x_j^2 \]

In this case \( Y \) is the prediction of the response value, \( x_i \) and \( x_j \) represent the variables, \( \beta_j \) is a linear effect, \( \beta_{ij} \) is the interaction effect, \( \beta_{jj} \) is a quadratic effect.

3. Results and Discussions

3.1. Basic Selection of Commodities

Farmers choose coffee commodities with various considerations. This needs to be known to ascertain whether the purpose of selecting the coffee plant has been achieved or not. The results of data processing using the Analytic Hierarchy Process (AHP) program prove that the main consideration of farmers is to grow coffee because it is more profitable than other commodities, with a weight of 0.3983. The second consideration is due to land suitability with a weight of 0.3590, and the third consideration is due to the success of other coffee farmers with a weight of 0.2427 (Figure 1).

![Figure 1. The reason farmers grow coffee](image)

A better level of profit on coffee plants has resulted in more farmers in West Sumatra growing coffee. The types of coffee that are widely grown in West Sumatra are robusta coffee and arabica coffee. This coffee is very potential to be developed because it has very good market prospects in the international market. The flavour of robusta coffee and arabica which is widely grown in Indonesia has a "Brand Image" that is good in the international world [12].
3.2. Which affects farmers in managing coffee plantations

The management of coffee plantations is very influential on the coffee beans produced. For this reason, it is necessary to know what factors influence it so that an appropriate method can be determined to improve coffee plantation management. This study proves that coffee plantation management in West Sumatra is influenced by the capital owned with a weight of 0.3347, land area with a weight of 0.3199, labor availability with a weight of 0.1811), and the selling price of coffee beans with a weight of 0.1643.

![Figure 2. Factors affecting farmers in managing coffee plantations](image)

To improve the management of coffee plantations in West Sumatra facilities are needed to make it easier for farmers to obtain business capital. The land area also affects the pattern of coffee plantation management. The same thing also happened in Ethiopia, in this country coffee plants are planted in various ways such as large and small scale plantations and industrial plantations. This cropping pattern results in differences in the quality of the coffee beans produced [2].

3.3. Technology Resources

Coffee farmers in West Sumatra get technology about coffee cultivation from various parties. From this study it can be concluded that coffee farmers in West Sumatra adopted technology from agricultural extension agents, from other farmers and from personal experience. From this study it can be concluded that agricultural extension workers need to improve coffee cultivation training. Coffee farmers who have participated in coffee management training and coffee cultivation can significantly increase coffee bean production [10].

The training carried out needs to pay attention to several things such as the level of education and the experience of farming. Adoption of technology is strongly influenced by the level of education and farming experience [3]. This is very necessary so that the adoption of technology can be done well by farmers. Experienced coffee farmers are easier to adopt technology [8].

3.4. Quality of Coffee Beans

To find out the factors that influence the quality of coffee beans in West Sumatra, surface response methods are used. In the predictive and actual plots it is seen that the residuals are taken randomly. Some points that are far enough from the line still meet the model if it is still within the chart area. Optimization in the form of actual value to predict responses from land management, level of fruit maturity, harvesting and postharvest handling. The value of Y shows the response activity to the quality of coffee beans. Predictive and actual values can be seen in Figure 4.
The quality of coffee beans is influenced by land management and the maturity level of the time seeds are harvested. Generally, coffee plantations in West Sumatra are long-standing gardens, then are

**Figure 3.** Source of technology for coffee farmers

**Figure 4.** Prediction vs Actual for Quality of Coffee Bean

The quality of coffee beans is influenced by land management and the maturity level of the time seeds are harvested. Generally, coffee plantations in West Sumatra are long-standing gardens, then are
continued for generations. Coffee gardens that are cultivated for generations require good regeneration in their management. The same thing happened in Kisii Kenya. Most coffee plants are cultivated from generation to generation, because it requires good succession so that the young generation has the will and good ability to manage the coffee plantations owned [4]. The response of land management to the quality of coffee beans in West Sumatra can be seen in Figure 5.

![Figure 5](image)

**Figure 5.** Respons Land Maintenance and Fruit Maturation Stages

Harvesting also greatly affects the quality of coffee beans. Coffee farmers in West Sumatra generally harvest without differentiating the level of fruit maturity. This results in low-quality coffee beans. Farmers have not sorted coffee beans well. Sorting during harvest and post-harvest time is very influential on the quality of coffee beans [8]. To get good quality coffee beans harvesting must be done selectively, so that only the perfect fruit is harvested. Selective harvesting affects the quality of coffee beans and the flavour of ground coffee [11].

The level of maturity and variety of coffee greatly affects the weight of coffee beans and their germination [9]. The coffee garden whose output is for export has paid attention to the level of maturity so that the aroma of coffee powder produced is better when compared to coffee sold on the local market. This good aroma coffee is favoured abroad, especially in Malaysia. West Sumatra coffee exports to Malaysia are influenced by the Revealed Comparative Advantage Index [13]. The response of harvesters to the quality of coffee beans can be seen in Figure 6.

Another factor that influences the quality of coffee beans in West Sumatra is postharvest handling. With good postharvest handling, the quality of coffee beans can be maintained. This postharvest confection affects water content. The quality of coffee beans is very much determined by water content, physical quality and flavour. The method of handling semi-wet and selective picking of harvesting time greatly influences the quality of coffee [7]. Coffee farmers in West Sumatra obtain knowledge about postharvest from extension workers. Therefore, it is necessary for a government policy to assign extension officers to conduct training with Good Handling Practices on post-harvest coffee. Government policy on postharvest, especially regarding the application of Good Handling Practices (GHP) greatly influences the improvement of the quality of coffee beans [5]. The storage factor is also very important for coffee farmers in West Sumatra, especially for coffee beans that are not directly sold. Many simple storage technologies can be determined by coffee farmers. The best storage is storage in hermetic packaging. Storage in this way can maintain the aroma of coffee [1].
4. Conclusions

Farmers in West Sumatra plant coffee because it is more profitable than other commodities. The management of the garden is influenced by the funds they have. They obtained technology from agricultural extension agents. While the quality of coffee beans in West Sumatra is determined by land management, harvesting and postharvest handling.
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