Strategi Penerapan *Good Agriculture Practices* (GAP) pada Perkebunan Rakyat untuk Meningkatkan Produksi dan Kualitas Kopi Arabica di Kabupaten Enrekang, Indonesia

Strategy on the implementation of good agriculture practice (GAP) in smallholder plantation to improve the production and quality of arabica coffee bean in enrekang regency Indonesia

Irfansyah T, Ifayanti Ridwan*, Ambo Ala

Departmen of Agronomy, Faculty of Agriculture, Universitas Hasanuddin
**E-mail: ifayanti@unhas.ac.id*

Abstract

This study aims to determine the priority scale in the management of Arabica coffee plants based on Good Agriculture Practices (GAP) to increase the production, productivity and quality of Arabica coffee in smallholder coffee plantations. The research was conducted in three districts in Enrekang Regency, namely Baroko, Baraka, and Masalle District, respectively, from December 2017 to January 2018. The research was in the form of a survey (literature study, observation, and interviews), the sample selection was carried out using purposive sampling on 30 respondents from Agriculture and Plantation Office of Enrekang Regency, Extension officers, Famers Groups, and coffee plant experts. Quantitative descriptive data analysis using Expert Choice Version 11 was conducted on the survey results for determining the priority scale of GAP components for Arabica coffee. The study results show that the priority scale of applying GAP for coffee plants in Enrekang Regency was the cultivation aspect (46.7%) consisted of pruning, fertilization both types and application method of the fertilizer, pest and disease control, and varieties. Secon priority was the aspect of post-harvest (27.9%) followed by harvest aspect of 25.5%.

Keywords: Analytic Hierarchy Process (AHP), Coffea arabica L., Good Agriculture Practices (GAP).

INTRODUCTION

Arabica coffee is the oldest type of coffee known and cultivated in the world with its varieties. Arabica coffee has a requirement for subtropical climate with dry months for its flowering. In Indonesia, Arabica coffee plants are suitable to be developed in areas with an altitude between 800-1500 m above sea level and with an average temperature of 15-24ºC (Sihombing, 2011). Coffee is an annual plant that can reach a productive age of 20 years. Among factors that influence the success of coffee cultivation include the type of plant, land factors, cultivation techniques, post-harvest handling and marketing of the final product. Choosing the type of plant for coffee cultivation must be adjusted to the place or location of the land. The location of the land which is located at an altitude of more than 800 meters above sea level is suitable for planting Arabica. Altitude 400-800 meters above sea level can be planted with Robusta types. Coffee cultivation in the lowlands can consider the type of Liberika or Excelsa.

Good Agricultural Practices (GAP) is a work standard that is applied in every agricultural business so that production can meet international standards. The Ministry of Agriculture explained that the application of GAP through SOPs (Standard Operating Procedures) that are specific to location, specific for commodities and specific target markets, is intended to increase the productivity and quality of products produced by farmers in order to meet consumer needs and have high competitiveness compared to equivalent products from abroad (Ditjenbun, 2014). The conception of the GAP on Coffee must refer to the concept of sustainable

agriculture, which has begun to be heavily socialized in the last few decades. Sustainable agriculture is the successful management of resources for agricultural businesses in meeting changing human needs and at the same time maintaining or improving the quality of the environment and preserving natural resources.

RESEARCH METHODOLOGY

The research was conducted in Masalle District, Baroko District and Baraka District, Enrekang Regency, South Sulawesi Province. The research location was chosen purposively (purposive sampling) with the consideration that the selected area is a center for Arabica coffee production and has coffee production and productivity with good coffee plant development potential. The research took place from December 2017 to January 2018. The materials used in this study were questionnaires, supporting data from related agencies. While the tools used in this study were a computer device (laptop), writing instruments, a camera, a recording device, SPSS software version 16 and Expert choice software version 11.

The research was conducted in the form of a survey (literature study, field observation, and interviews). The respondents chosen were coffee farmers with a minimum farming period of 5 years and the condition of the coffee plants that were already in production. From the total population at the research location, 10 samples per district were determined, consisting of 5 farmers who have attended and implemented the Good Agriculture Practice (SL GAP) field school and 5 farmers who have not participated in the program so that there are a total of 30 respondents. Apart from farmer respondents, interviews were conducted with key respondents / stakeholders, namely: Head of the Enrekang District Agriculture and Plantation Office, extension officers, chair of farmers group in each sub-district and coffee experts.

The types of data used in this study are primary data and secondary data. Primary data was collected through field information retrieval, filling out questionnaires (list of questions) systematically, and direct interviews with farmers, agricultural extension agents, the Head of the Department of Agriculture and other stakeholders. While secondary data were collected through literature study relevant to the problem being studied. The data collection techniques for this research were interview, observation, literature study and documentation. Interviews, namely by conducting direct questions and answers to the relevant stakeholders, stakeholders are divided into two, namely respondents and key respondents, then the results of interviews with respondents are recorded and recorded with guidelines on questions that have been prepared previously (questionnaire) and the results of interviews with key respondents are tabulated into a hierarchical chart. which has been prepared. Observation, namely observing directly the object of research so that the real conditions can be obtained. Literature study is collecting information and references or existing knowledge by reading literature related to the main problem to be studied. Documentation, namely supporting data obtained directly or through related agencies as a complement to this research.

The data and information collected in this study were tabulated and analyzed descriptively qualitatively and quantitatively. Data analysis for determining the priority scale in the application of GAP arabica coffee used the Analytic Hierarchy Process (AHP) approach through the Expert Choice program. In terms of measurement, AHP makes simple measurements, namely by using comparisons between elements.

RESULTS AND DISCUSSION

The analytic hierarchy process (AHP) were taking weights to compile a priority scale using Expert Choice 11 to several respondents namely Agriculture and Plantation Office of Enrekang Regency, Extension, Famers Group 1, Famers Group 2, Famers Group 3, and coffee plant experts. The hierarchical arrangement process is a way to get problem solving by considering criteria or components to achieve goals (Sangka and The participant scheme and the results of the AHP synthesis for each participant is shown in Figure 1d Muchsini, 2018) and Table 1. Participants come from different backgrounds according to their respective expertise ranging from farmer groups, extension workers, policy makers and coffee experts.

Several aspects regarding the dominant arabica coffee cultivation system are carried out by farmers which are then arranged according to their respective components in a hierarchical manner structured interviews with participants. The results of the AHP synthesis based on the weighting that has been carried out on the participants is presented in Table 1 below.

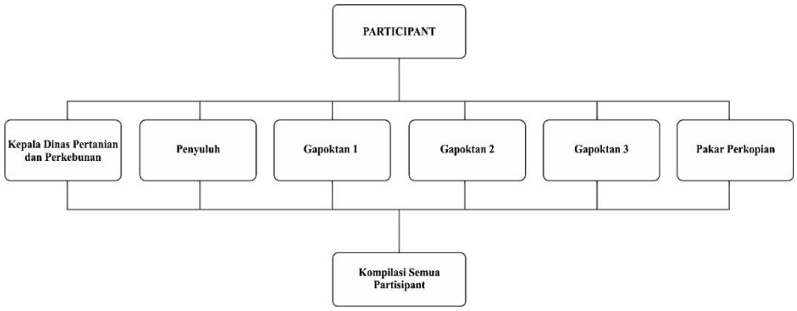
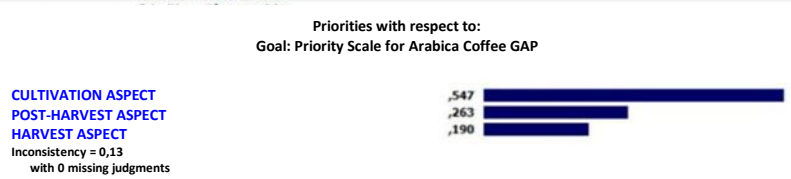
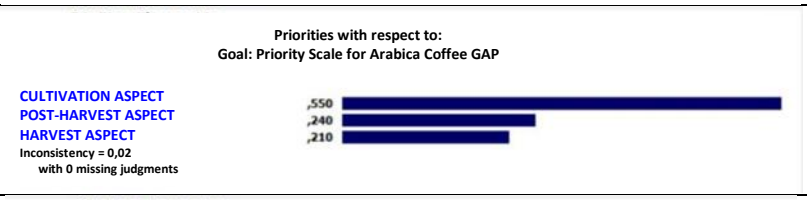
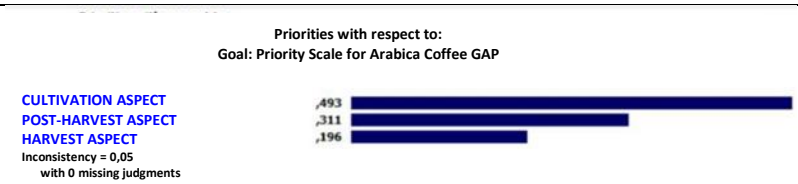
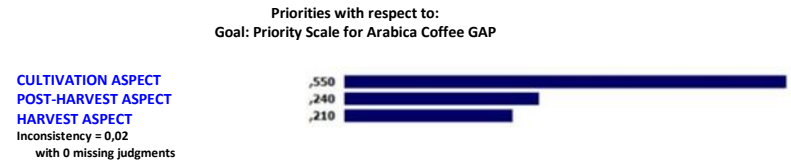
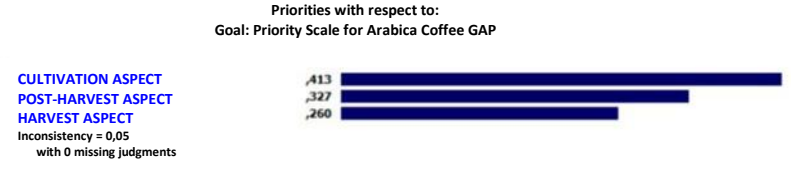
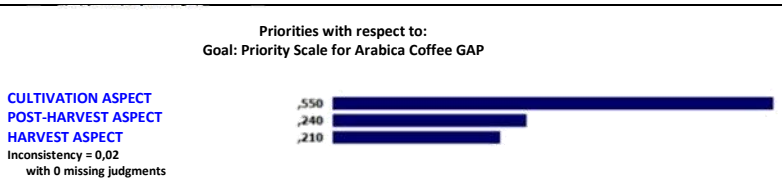


Figure 1. Analytic Hierarchy Process (AHP) Participants.

Table 1. Results of the Analytic Hierarchy Process (AHP) synthesis based on the weighting that has been carried out on the participants.

Participant	Analysis Hierarchy Procedure (AHP) synthesis
Agriculture and Plantation Office of Enrekang Regency	
Extension Officer	
Farmer group 1	
Farmer group 2	
Farmer group 3	

Coffee experts	

Source: Primary data, 2018. The inconsistency value <0.25 is within the acceptance limit.

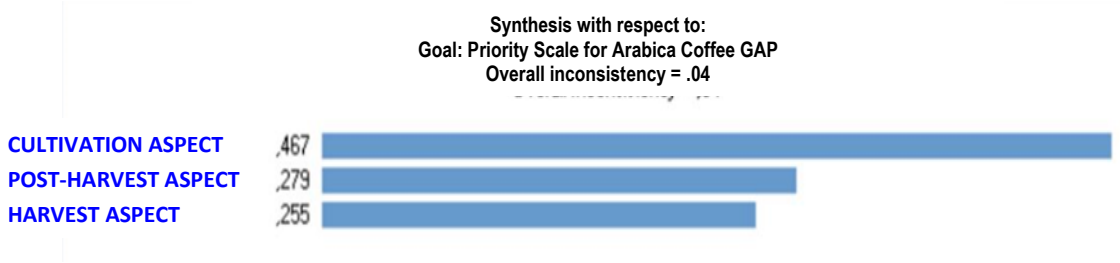


Figure 2. Synthesized diagram compilation of all participants on the priority of Arabica coffee cultivation in Enrekang district.

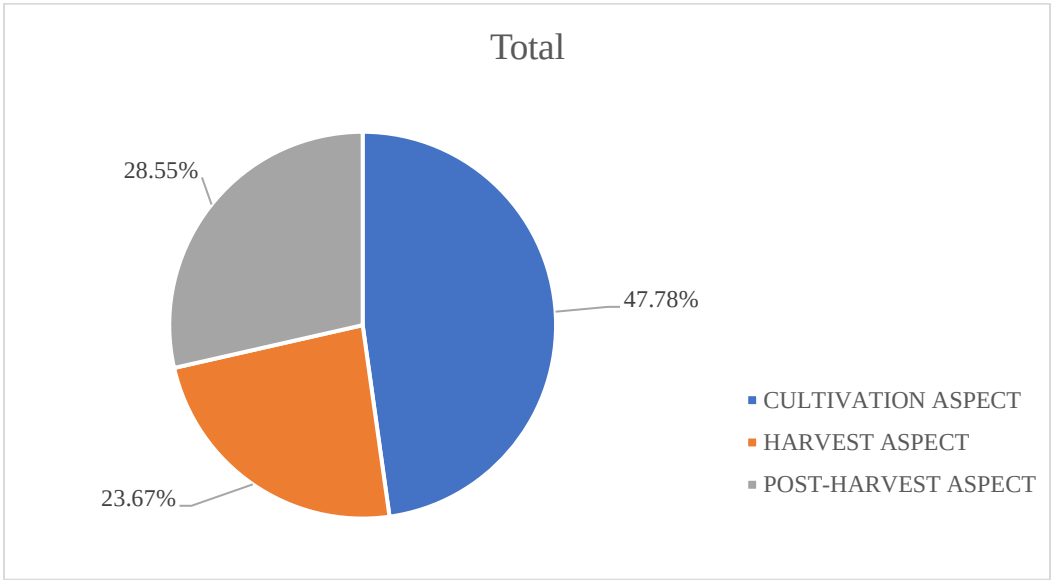


Figure 3. Diagram of the results of the synthesis of the compilation of all participants on the priority of Arabica coffee cultivation in Enrekang Regency in the form of dynamic sensitivity.

Efforts to increase plant production and productivity carried out through the Analitycal Hirarchy Process (AHP) presented in bar charts, diagrams, and percentage of dynamic sensitivity shown in Figure 2 and 3. The data in Figure 2 and 3 indicates the priority scale of the Arabica coffee plant cultivation system to increase production and productivity in Enrekang district. The data shows that from 100% the weight of the cultivation aspect has the highest weight, namely 47.78%, then the post-harvest aspect is 28.55% and finally the harvest aspect is 23.67%. The implementation of a good Arabica coffee cultivation system will encourage increased production and plant productivity. In cultivation aspects that need to be considered starting from the variety, spacing, planting hole size, shade, fertilization, fertilizer application, pruning, sanitation and pest and disease control. Meanwhile, the harvest aspect focuses on the

plots with ripe fruits and the post-harvest aspect focuses on the grinding and fermentation process in coffee. From all aspects studied where a number of stakeholders view that implementing the Arabica coffee cultivation system appropriately needs to be done.

The results of the analysis used the AHP method with the Expert choice 11 program which presented a priority scale for the development strategy of arabica coffee plants to increase production and productivity in Enrekang Regency. The data shows that from 100% of the weight, the cultivation aspect has the highest weight, namely 46.7%, followed by the post-harvest aspect of 27.9 and the harvest aspect of 25.5%. The results of the analysis using the AHP method show that the main priority of the Arabica coffee plant cultivation aspect is the cultivation aspect. The aspect of cultivating the Arabica coffee plant is an inseparable package so that each aspect has its own role. However, priorities are needed that must be prioritized. In the cultivation aspect of pruning, fertilizing, applying fertilizers, controlling pests and diseases and varieties are 5 important things that need to be considered. In the aspect of harvesting, cooking picking is something that must be done in terms of improving the quality of coffee. Meanwhile, in the post-harvest sub-aspect, fermentation and milling need to be considered in terms of improving coffee quality. Following are the results of AHP using the Expert choice 11 program which presents detailed weights for each aspect of the cultivation system combined with the opinions of several stakeholders.

Cultivation Aspects

The priority scale for Arabica coffee cultivation from a combination of respondents' opinions is shown in Figure 4. While the synthesis results from all components of the cultivation aspect are shown in Table 2.

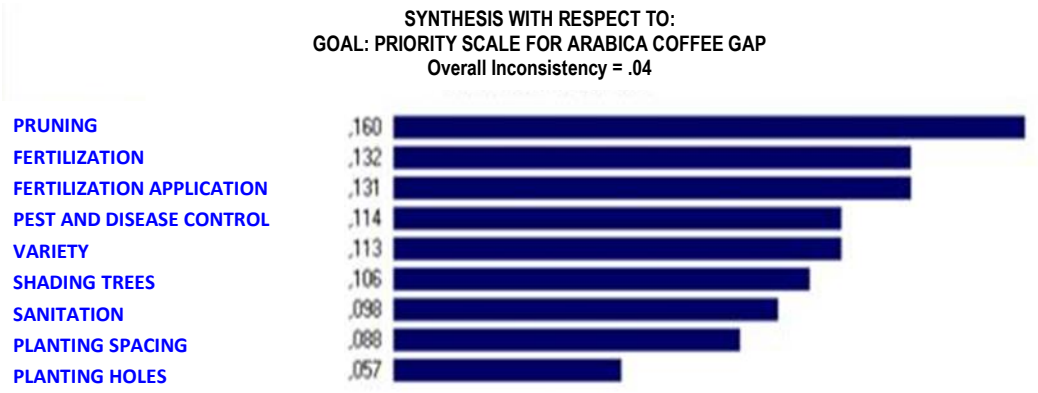
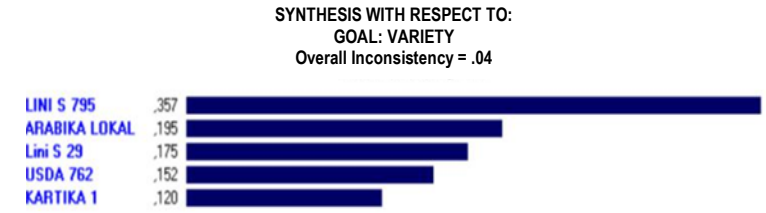
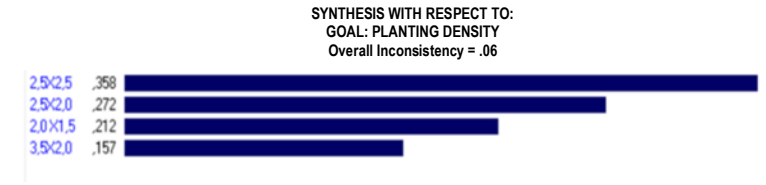
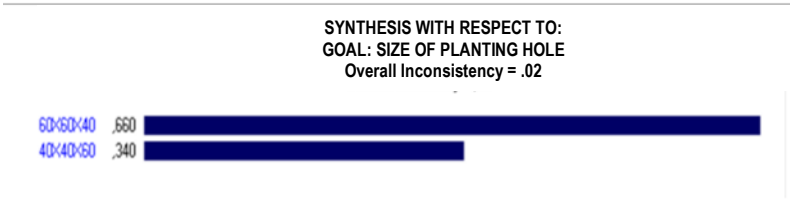


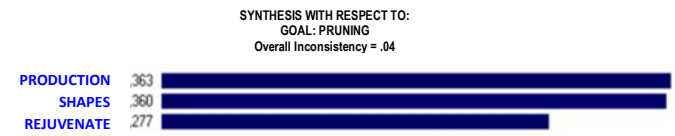
Figure 4. Analytic Hierarchy Process (AHP) synthesis results on the Arabica coffee cultivation aspect in Enrekang Regency.

The data above presents the weight of the AHP synthesis result on each component of the Arabica coffee plant cultivation aspect. In the cultivation aspect where the pruning sub-aspect had the highest weight, namely 16.0%, followed successively with the fertilization sub-aspect 13.2%, the fertilizer application sub-aspect 13.1%, the pest and disease control sub-aspect 11.4%, sub-variety aspect 11.3%, shade sub-aspect 10.6%, sanitation sub-aspect 9.8%, sub-spacing aspect 8.8% and finally the sub-aspect size planting hole size is 5.7%, as for the part of each sub aspects, namely the sub-aspects of the Lini S795 variety of 35.7%, local arabica of 19.5%, S-29 of 7.5%, USDA 15.2% and Kartika 1 of 12.0%. For the sub-aspect of spacing, the spacing of 2.5 x 2.5 was 35.8%, the spacing of 2.5 x 2.0 was 27.2%, the spacing of 2.0 x 1.5 was 21.2%, and a distance of 3.5 x 2.0 as much as 15.7%. Sub aspect of planting hole size, size 60 x 60 x 40 as much as 66.0% and 40 x 40 x 60 as much as 34.0%. The sub-aspect of shade, permanent shade is 68.9% and temporary shade is 31.1%. Sub-aspects of fertilization, organic fertilizer + chemical as much as 47.3%, organic fertilizer as much as 31.9%, chemical fertilizer as

much as 20.9%. Sub-aspects of fertilizer application, plate as much as 48.2%, blow as much as 29.6% and sown as much as 22.2%. The sub-aspects of trimming, cutting production by 36.3%, trimming shapes 36.0% and trimming rejuvenation 27.7%. Sub-aspects of sanitation, 69.2% weed weeding and 30.8% of placing coffee husk waste to the land. Sub-aspects of pest and disease control, biologically / mechanically, were 69.2% and chemically 30.8%.

Table 2. Results of the Analytic Hierarchy Process (AHP) synthesis from a combination of respondents' opinions on all components of Arabica coffee cultivation

Sub Aspect	Analytical Hierarchy Procedure (AHP) Synthesis
Variety	
Planting density	
Size of the planting hole	
Shade trees	
Fertilization	
Fertilizer application	

Pruning	
Sanitation	
Pest and disease control	

Selection of superior planting material is an important step in good coffee cultivation practice. In selecting superior planting materials, it is necessary to consider the suitability of the environment in which it is planted in order to obtain maximum taste quality and productivity (Iskandar et al., 2018). In coffee plants planting material can be in the form of varieties (propagated generatively) and in the form of clones (propagated vegetatively). Superior seeds in coffee plants can be obtained by seedling, cuttings, Somatic Embryogenesis (SE), and connection of superior clones. In areas that are endemic to parasitic nematodes, seed connections can be used with rootstocks of nematode-resistant Robusta BP 308 coffee clone, and then grafted with top stems of recommended Arabica coffee varieties or clones that have good taste and high productivity (Myers et al., 2020; Evizal et al., 2018). The superior varieties of Arabica coffee include: Old advice (> 10 years), namely AB 3, USDA 762, S 795, Kartika 1, and Kartika 2; The new recommendations (<10 years) are Andungsari 1 (AS 1), Sigarar Utang, Gayo 1, and Gayo 2. For Arabica coffee one superior clone has been recommended, namely Andungsari 2-clone (AS 2K).

Each region has different varieties or clones. This means that a clone or superior variety in one area is not necessarily superior in another area. Like Arabica types from other regions, they must have different characters from other regions. It can be in the form of aroma, and taste. Arabica coffee from Java is certainly different from Arabica coffee in Sulawesi, as well as those in Toraja even though the varieties or clones are the same. This also applies to Robusta coffee, although it is the same, but when grown in other areas, the results will also be different or not the same as the region of origin. Productivity clones must be tested for up to three generations. After that, coffee seeds that have been tested in a certain area should not be cultivated in other areas, just cultivated in the surrounding area where the coffee is being tested.The plant sources used in the cultivation of Arabica coffee are varieties of S 795, USDA 762, Kartika-1 and Kartika-2. Propagation of coffee tree seedlings can be done using generative and vegetative techniques. Generative propagation of beans is usually used for the cultivation of Arabica coffee, while Robusta coffee is more often used as vegetative propagation by cuttings (Research Center for Coffee and Cocoa, 2010).

Before starting coffee cultivation, the thing that must be prepared is planting shade trees. Shade trees are useful for adjusting the intensity of incoming sunlight (Ruslim et al., 2017). Coffee plants, including plants that require sunlight intensity is not full. Types of shade trees that are often used in coffee cultivation are dadap, lamtoro and sengon. Sengon type shade trees must be planted 4 years before coffee cultivation, while the type of lamtoro can be faster, about 2 years earlier (Yahmadi and Mudrig, 2007). In accordance with the GAP, the recommended spacing for coffee cultivation is 2.75 × 2.75 meters for Robusta and 2.5 × 2.5 meters for

Arabica. The spacing is varied with the height of the land. The planting hole is made with a size of 60x60x60 cm, making this hole 3-6 months before planting. When digging the planting hole, dig the top soil and the bottom dugout. Leave the planting hole open. Two months before planting, mix 200 grams of sulfur and 200 grams of lime with the bottom excavated soil, then put it in the planting hole. About 1 month before planting the seeds, mix 20 kg of compost with the top dug soil, then put it in the planting hole. Coffee seedlings that are ready to be planted should have their leaves removed until part is left to reduce evaporation. Remove the coffee seeds from the polybag, then dig a little of the prepared planting holes. The depth of the excavation corresponds to the length of the roots. For seeds that have supporting roots, try to keep the plant roots upright. Cover the planting hole so that the plant stands firmly, if necessary, add a stake to support the plant so it doesn't collapse.

Fertilizer for coffee plants can use organic fertilizers or artificial fertilizers. The purpose of fertilization is to maintain plant resilience, increase production and yield quality and keep production high. Fertilization in general on coffee plants must be on time, the dose and type of fertilizer and the method of application. It all depends on the type of soil, climate and age of the plant. Application of fertilizer can be placed about 30-40 cm from the main stem (Center for Plantation Research and Development, 2010).

One of the factors that greatly affects the production of coffee plants is the pruning aspect. According to the Center for Plantation Research and Development (2010), the benefits and functions of pruning coffee plants in general are to keep the tree low so that it is easy to maintain, form new production branches, facilitate light entry and facilitate pest and disease control. Pruning can also be done during harvest while removing unproductive branches, wild and old branches. Less productive branches are pruned so that the nutrients provided can be channelled to more productive stems. The morphology of the coffee cherries will appear at the branching, therefore it is necessary to obtain many branches. Pruning is done not only to produce branches (vegetative growth) but also to produce lots of fruit.

Arabica coffee requires sunlight intensity that is not full of regular irradiation. The existence of irregular irradiation will result in irregular plant growth and flowering patterns, the plants will bear fruit too quickly but only a little and the results decline too quickly. Therefore, coffee plants need shade trees that can adjust the intensity of sunlight according to what they want (Najiyati and Danarti, 2004). Besides being useful as a sunshine regulator, shade trees also have other benefits, namely, shade trees produce organic material in the form of leaves that can fertilize the soil, their roots contain nodules that can absorb N elements from the air so that they can fertilize the soil. The shade tree has deep roots so that it can absorb nutrients from the inner soil. These nutrients will fertilize the top soil and can be absorbed by coffee plants if the leaves of the shade trees fall off and decompose in the soil (Siahaan, 2018).

One of the protective trees for coffee plants is Lamtoro and Sengon. Initially, lamtoro was widely used as a protector of coffee plants because it fulfilled almost all of the conditions for a protective plant. Meanwhile, sengon is the best alternative shade tree in the highlands and dry areas. Even so, it does not mean that Sengon has no weaknesses. The disadvantage is that it is susceptible to attack by stem borer and the wood is not strong enough to withstand the wind. To overcome this, usually sengon is mixed with lamtoro. In this case the function of the lamtoro is only as a windbreak, so that if there is a risk of being attacked by fleas, it will not cause great losses. Another drawback is that sengon can only be used when it is 3 years old, so it must be prepared long before planting coffee. To overcome this, auxiliary shade plants can be planted to protect coffee plants before the protective plants function (Najiyati and Danarti, 1997).

Pests that often attack coffee plants such as parasitic nematodes (*Pratylenchus coffea, Radopholus similis*), fruit borer pests, fruit borer or mealybugs *Planococcus citri, Coccus viridis* green tick, branch borer, and red stem borer *Zeuzera coffeae*, and rat pests. Diseases that are often found in coffee plants are *Hemileia vastatrix*, leaf rust disease, leaf spot, green fungus, fruit rot and branch rot, brown root fungus, and fallen stem disease. Coffee

plantations are also susceptible to attack by the nematode *Radopholus similis* Cobb. and *Pratylencus coffeae* nematodes. Methods of controlling pests and diseases can be carried out by improving technical culture, performing sanitation, mechanical and biological control, trimming traps, and chemical control (Rutherford & Phiri, 2006).

Harvest Aspects

The results of the synthesis from the harvest aspect are shown in Figure 5 below. In the aspect of harvesting, cooking picking was 59.8%, cooking and unripe picking was 21.9% and unripe picking was 18.4%. Plants that are cultivated intensively can bear fruit at the age of 2.5-3 years for Robusta and 3-4 years for Arabica. The first harvest is usually not too much, the productivity of the coffee plant will reach its peak at the age of 7-9 years. The harvest of coffee plants is carried out in stages, the main harvest can occur in 4-5 months with an interval of picking every 10-14 days. Harvesting and post-harvest processing will determine the quality of the final product.

Harvesting of coffee cherries is done manually by picking ripe fruit. The size of the fruit maturity is indicated by a change in the color of the fruit skin. When it's young, the skin is dark green, when it's half ripe it's yellow and when it's fully ripe it's red, and will turn blackish after it's over ripe. The ripeness of the coffee fruit can also be seen from the hardness and components of the sugar compounds in the fruit flesh. Ripe coffee cherries have soft and slimy flesh and contain relatively high sugar compounds so that they taste sweet. On the other hand, the flesh of the young coffee fruit is slightly hard, not slimy and does not taste sweet because the sugar compounds are still not fully formed. Meanwhile, the mucus content in overripe fruit tends to decrease because some of the sugar and pectin compounds have decomposed naturally due to the respiration process.

Figure 5. Analytic Hierarchy Process (AHP) synthesis results on the Arabica coffee harvest aspect in Enrekang Regency.

Post-Harvest Aspects

The results of the synthesis from the Post-Harvest aspect is shown in Figure 6. In the post-harvest aspect, fermentation was 73.3% and 26.7% without fermentation. In general, coffee fermentation is divided into two, namely dry fermentation and wet fermentation. The goal is the same, to improve the quality of coffee. However, there are differences in the process and the resulting coffee. But in general, the type of fermentation carried out by farmers in three sub-districts is wet fermentation. In wet fermentation, farmers or managers only choose coffee that is completely ripe and red to be pulped or separated from the skin, the time interval between harvesting and pulping is usually after being collected, the coffee beans are directly pulped in the garden and beans that have been pulped coffee beans separated from the skin and flesh, then soaked in water for 36 hours to release the mucilage. Wet fermentation does produce better quality coffee than dry fermentation.

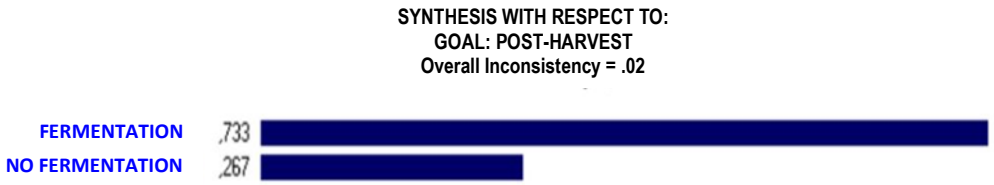


Figure 6. Analytic Hierarchy Process (AHP) synthesis results on the Arabica coffee post-harvest aspect in Enrekang Regency.

CONCLUSION

Based on the results of the evaluation research on the application of Good Agriculture Practice (GAP) that has been carried out in Enrekang district, it can be concluded that the priority scale of the application of GAP for coffee plants in Enrekang Regency in the cultivation aspect has the highest weight, namely 46.7%, followed by the post-harvest aspect of 27.9. % and aspects of harvest 25.5%. Efforts to increase the production and productivity of Arabica coffee plants should pay attention to the cultivation aspects, especially the cultivation aspects in the sub-aspects of pruning, fertilizing, applying fertilizers, controlling pests and diseases and varieties to be 5 important things that need to be considered. In the aspect of harvest, cooking picking is something that must be done in terms of improving the quality of coffee. Meanwhile, in the post-harvest sub-aspect, fermentation needs to be considered in terms of improving coffee quality.

DAFTAR PUSTAKA

Center for Plantation Research and Development, 2010 Pusat Penelitian Kopi dan Kakao Indonesia, 2010. Budidaya Kopi. Agromedia Pustaka, Jakarta

Ditjenbun, 2014 Direktorat Jenderal Perkebunan. 2014. Pedoman Teknis budidaya Kopi Yang Baik (Good Agriculture Practies/GAP On Coffee). Jakarta: Sekretariat Direktorat Jenderal Perkebunan.

Evizal, R., Sugiatno, Utomo, S. D., Pujisiswanto, H., Widagdo, S., Prasmatiwi, F.E., and Stiawan, A. D. 2018. Growth Performance of Mature Trees Resulted from Intra and Inter-specific Grafting on Robusta Coffee. Planta Tropika: Jurnal Agrosains (Journal of Agro Science) Vol. 6 (2): 77-83 DOI: 10.18196/pt.2018.083.77-83.

Iskandar, B S., J Iskandar, R Partasasmita, R L Alfian. 2018. Planting Coffee And take care of forest: A case study on coffee cultivation in the forest carried out among people of Palintang, Highland of Bandung, West Java, Indonesia. Biodiversitas Vol. 19 (6) 2183-2195. DOI: 10.13057/biodiv/d190626

Lisnawati, A., Lahjie, A. M., Simarangkir B.D.A.S., Yusuf S. & Ruslim Y. 2017. Agroforestry system biodiversity of Arabica coffee cultivation in North Toraja District, South Sulawesi, Indonesia. Biodiversitas 18 (2): 741-751. DOI:10.13057/biodiv/d180243

Myers, R., Kawabata, A., Cho, A., & Nakamoto, S. T. 2020. Grafted Coffee Increases Yield and Survivability, HortTechnology hortte, 30(3), 428-432. Retrieved Jun 19, 2021, from https://journals.ashs.org/horttech/view/journals/horttech/30/3/article-p428.xml

Najiyati dan Danarti. 2004. Kopi Budidaya dan Penanganan Lepas Panen, edisi revisi. Penebar Swadaya. Jakarta.

Rutherford, M. & Phiri, N. 2006. Pests and Diseases of Coffee in Eastern Africa: A Technical and Advisory Manual. CAB International. Wallingford, UK.

Sangka, B K and B Muchsini. 2018. Accommodating Analytic Hierarchy Process (AHP) for Elective Courses Selection. Indonesian Journal of Informatics Education Vol. 2 (2): 135-144

Siahaan, A. 2018. Identification of Arabica Coffee Production in Altitudes Place in Lintong Ni Huta of Humbang Hasundutan. International Journal of Environment, Agriculture and Biotechnology (IJEAB) Vol. 3 (1): 249-255. DOI: 10.22161/ijeab/3.1.31

Sihombing, 2011 Sihombing, T. P., 2011, Studi Kelayakan Pengembangan Usaha Pengolahan Kopi Arabika (Studi Kasus PT. Sumatera Specialty Coffees). Skripsi: Institut Pertanian Bogor (internet) (diakses 1 Juli 2017)

Yahmadi and Mudrig, 2007 Yahmadi dan Mudrig, 2007. Budidaya Tanaman Kopi. PT. Gramedia Pustaka Umum. Jakarta