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## An Analysis of the utilization of *Gamal* Plant (*Gliricidia sepium*) as a shade for coffee plants

To cite this article: K Khusnul *et al* 2020 *J. Phys.: Conf. Ser.* **1563** 012014

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## Table Of Contents

Early detection of Indonesian financial crisis using combination of volatility and Markov switching models based on indicators of real exchange rate and M2/foreign exchange reserves *N Nafisah, Sugiyanto and H Pratiwi*

Financial crisis prediction in Indonesia using combined of volatility and Markov switching models based on real interest rate on deposit and nominal exchange rate indicators *D Rojanah, Sugiyanto and E Zukhronah*

The application of combined Markov regime switching and volatility model in detecting early financial crisis in Indonesia *A P Ratnasari, Sugiyanto and S Subanti*

The prediction of financial crisis in Indonesia based on the smoothed probability value from the combination of volatility and Markov switching models *S D Pratiwi, Sugiyanto and H Pratiwi*

Application of GSTAR kriging model in forecasting and mapping coffee berry borer attack in Probolinggo district *H Pramoedyo, A Ashari and A Fadliana*

Initial soil properties of the restored degraded area under different vegetation cover in UB Forest, East Java, Indonesia *M Yusuf, A A R Fernandes, S Kurniawan and E Arisoesilaningsih*

Combination of extraction features based on texture and colour feature for beef and pork classification *A M Priyatno, F M Putra, P Cholidhazia and L Ningsih*

Integration of photosystem I and photosystem II from tylakoid membrane of *spirulina sp.* for DSSC natural dye pigments *D Y Kusuma, Q Hidayah, A N Izziyah and B Purnama*

Response of seed germination and seedling growth of *Physalis* accession from East Java *R Mastuti, B Waluyo and J Batoro*

Designing video profile fashion program Malang State University using adobe premiere *N Aini, N Hidayati and S E P Rahayu*

Temperature and strain rate effect on flow stress of al2075/bottom ash composite *F D Supriyanto, H Seputro, H Rinaldi and H I Akbar*

E-commerce implementation in supporting business services strategy (case study at petshop gifaro evidence) *J T Purba, Hery and A E Widjaja*

Solid state organic photovoltaic devices using *spirulina sp* thylakoid membrane films as active material *Q Hidayah, D Y Kusuma, O R Aji, A N Izziyah and B Purnama*

An Analysis of the utilization of *Gamal Plant (Gliricidia sepium)* as a shade for coffee plants *K Khusnul, Suratno, J Prihatin and Sudarti*

An analysis of innovation on the utilization of cascara by coffee farmers *N Komaria, Suratno, J Prihatin and Sudarti*

## An Analysis of the utilization of *Gamal* Plant (*Gliricidia sepium*) as a shade for coffee plants

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**Abstract.** Indonesia is the largest coffee exporter in the world, which is in the fourth position after Brazil, Vietnam and Colombia. However, the productivity of coffee produced from year to year tends to decrease and not optimal. This happens because of many factors, one of which is the type of shade plants used. Inappropriate shade plants affect the growth and productivity of coffee plants. The purpose of this research was to analyze the utilization of *Gamal* plant (*Gliricidia sepium*) as a shade for coffee plants. The respondents of this research were 35 coffee farmers in Jember and Banyuwangi regencies. The research variables measured included the types of coffee shade plants, reasons for using shade plants and farmers' knowledge about *Gamal* plant as a shade for coffee plants. The data collection was carried out using survey, interview and questionnaire. The data collection was done directly with the primary source. The results of this research informed that the shade plants used by coffee farmers were varied, such as banana, *lamtoro*, coconut tree, *Gamal*, avocado and sengon trees. Most of the coffee farmers used bananas by 86%, avocados by 65%, and wood by 46% as a shade. They chose the plants because they were easier to maintain, cheap seeds and produced fruit and woods which could be sold. Based on the literature, the most effective shade plants for coffee plants were *Gamal* plants. However, *Gamal* plant (*Gliricidia sepium*) is still not widely used by coffee farmers because the seeds are too expensive and it does not produce fruit that can be sold. The conclusion of this research was that most of the coffee farmers were still unaware and did not use *Gamal* as a shade plants.

### 1. Introduction

Indonesia is the largest coffee exporter in the world, which is in the fourth position after Brazil, Vietnam and Colombia. There are two types of coffee varieties widely cultivated in Indonesia, namely Robusta and Arabica coffees (Anggraeni, 2016). Coffee production in Indonesia has been exported to several countries in the world, such as Germany, the United States, Italy, Japan, Egypt, Belgium and Russia. However, the productivity of coffee produced in Indonesia from year to year tends to decrease and not optimal. Coffee production statistics on the Ministry of Agriculture data in 2016/2017 stated that the development of coffee production from 2012 to 2016 tended to decrease as much as 691.16 tons, 675.88 tons, 643.86 tons, 639.31 tons, 637.54 tons respectively (Sedana, 2019). The decrease in coffee production was caused by various factors, one of which was the type of shade plants used since it affected the growth and the results of coffee production. The results of coffee production are varied according to the shade plants used. Each shade plants had different characteristics and different impacts on coffee plants (Davis, 2019).

Shade plants has important roles in the growth of coffee plants, which are reducing the amount of sunlight intensity exposure and affecting the coffee plants as well as increasing the nutrient cycle in the soil. Shade plants created a microclimate in coffee plants. With the presence of shade plants, sunlight does not affect the coffee plants directly. The sunlight intensity decreases based on the characteristics of the shade plants. The intensity of sunlight, the amount, and quality of sunlight are very influential on plants' physiology. Therefore, shade plants affected the growth, production and quality of coffee produced (Rigal, 2018). Shade plants that are used for coffee plants include *Falcataria mollucana* (*sengon*), *Leucaena leucephala* (*lamtoro*), *Erythrina lithosperms* (*dadap*), and



*Gliricidia sepium* (gamal). Shade plants are used as they have plant morphological characteristics that are in accordance with the requirements of shade plants for coffee plants (Premono, 2018).

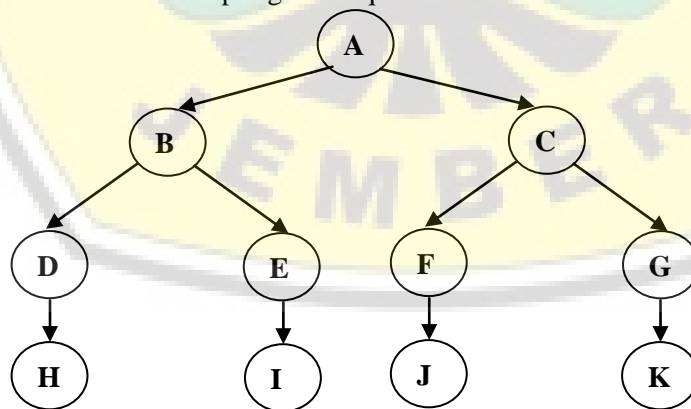
One of the good and effective shade plants that are able to increase and maximize coffee yield is *Gliricidia sepium*. This plant belongs to the tree group. A medium-size tree with trunks of 10m to 15m and has a wide canopy. This tree thrives in deep soil and has a good drainage. This tree also grow in shallow soils that had high calcium (Marak, 2018). This tree optimally regulated the amount and distribution of optimal sunlight for the growth of coffee plants (Marak, Reddy, 2010). *Gliricidia sepium*'s leaves are 2cm to 7cm long and 1cm to 3cm wide, so they provide light intensity that is suitable for coffee plants (Pratami, 2018). In addition, *Gliricidia sepium* naturally repairs damaged soil due to disaster succession, barren land and grow well on steep slopes. *Gliricidia sepium* grew fast and was multipurpose, so it was used in the improvement of ecosystems and agroforestry (Cherian, 2019).

The existence of *Gliricidia sepium* which has maximum shade increases the growth and productivity of coffee. The use of *Gliricidia sepium* as a good coffee shade plants has been proven and known as well as used by several countries in the world such as America, India, and has popularity in Asia, especially South Asia (Marak, Reddy, 2010, and Cherian 2019). Therefore, a research on the utilization of *Gliricidia sepium* as a coffee shade plants in Indonesia is needed. The purpose of this research was to analyze the utilization of *Gliricidia sepium* as a coffee shade plants.

## 2. Methodology

This research used mixed method approach that is a research approach which combines qualitative and quantitative methods. Qualitative research is a method that understands the meaning which is in some group or individual is assumed as a problem. Quantitative method is a method to test a theory by investigating the relationship between variables. This research employed a descriptive research method. Descriptive method explains, analyzes, and presents facts in the form of data systematically and accurately. The data collection methods were questionnaire and interview, survey and interview that were done directly to the primary source.

Survey and interview was carried out through snowball sampling technique. It is a non-probability sampling technique used to collect data in order to be able to answer the research problem. The principle of snowball sampling technique is to find out the information about a case. Survey and interview were done with one informant to another. Snowball sampling technique is a sampling method used to get the sample through a circular process from one respondent to another. The following Figure 1 is snowball sampling technique done in this research.



**Figure 1.** Snowball Sampling Technique.

Based on Figure 1, snowball sampling technique used in this research consisted of some steps. First, (symbolized with A) conducting interview with the first respondent in snowball sampling. After that, conducting interview with the second respondent about the utilization of shade plants (symbolized with B and C) and then so on until the last respondent.

The respondents of this research were 35 coffee farmers in Jember and Banyuwangi regencies. The research variables measured covered the types of coffee shade plants, reasons for using shade plants and farmers' knowledge about *Gamal* plant as a shade for coffee plants.

### 3. Result

The results of the research were types of coffee shade plants, reasons for using shade plants and farmers' knowledge about *Gamal* plant as a shade for coffee plants.

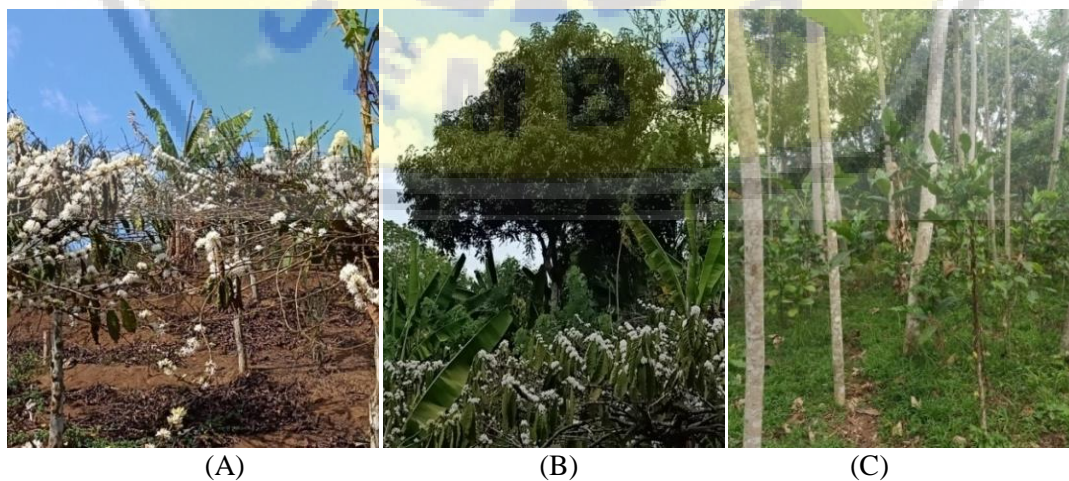
#### 3.1 The Type of the Coffee Shade Plants Used by the Farmers

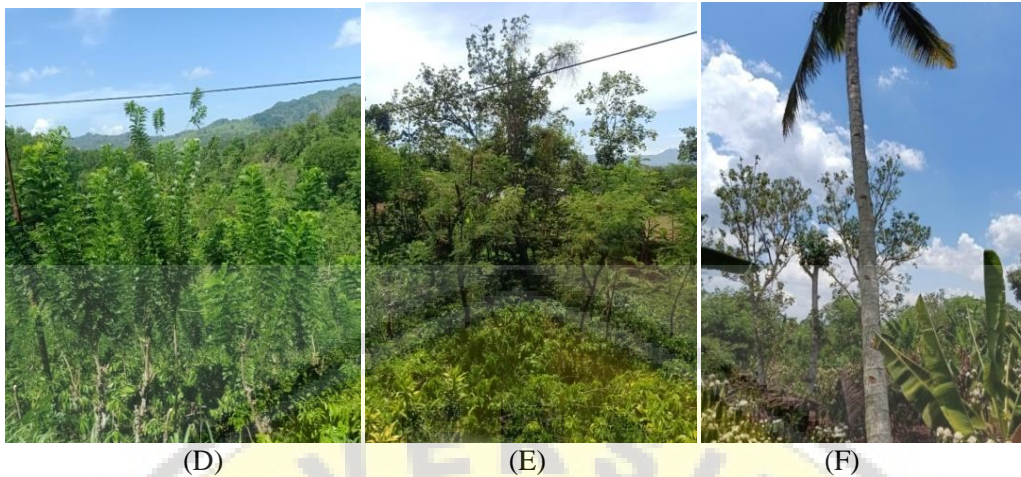
The following Figure 2 is the variety of the coffee shade plants used by the coffee farmers.



Figure 2. The type of coffee shade plants used by the farmers.

Based on figure 2 above, there are 6 types of shade plants used by coffee farmers namely *Persea americana* (Avocado) by 46%, *Musa paradisiaca* (Banana) by 86%, *Leucaena leucephala* (Lamtoro) by 14%, *Cocos nucifera* (Coconut) by 28%, *Gliricidia sepium* (Gamal) by 6% dan *Falcataria mollucana* (Sengon) by 65%. Based on the results, the shade plants that were mostly used by the farmers were *Musa paradisiaca* (Banana), *Falcataria mollucana* (Sengon) and *Persea americana* (Avocado) as many as 86%, 65% and 46% respectively.

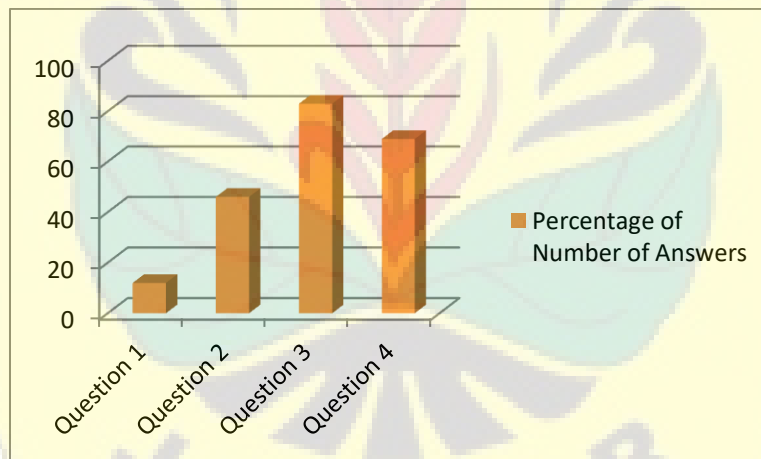




**Figure 3.** Crop Seed on Coffee Crops.  
 (A) *Musa paradisiacal* (B) *Persea Americana* (C) *Falacataria mollucana*  
 (D) *Gliricidia sepium* (E) *Leucaena leucephala* (F) *Cocos nucifera*

### 3.2 The Reason in Choosing the Shade Plants

The following Table 1 is some reasons in choosing the shade plants used by the farmers.



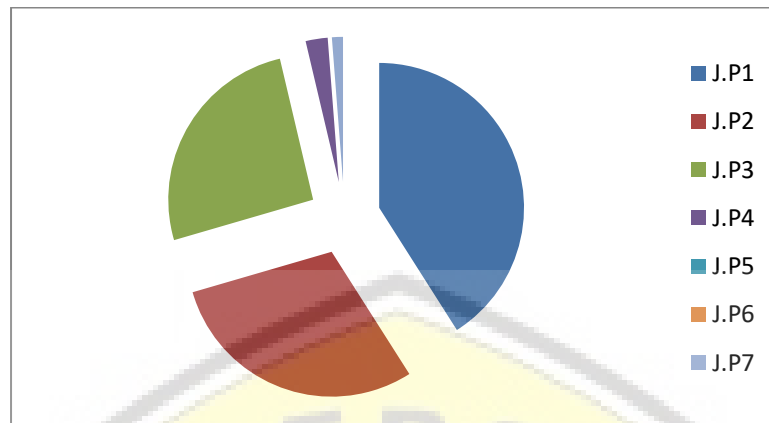
**Figure 4.** Reasons for Using Shade Plants.

Based on table 1, it can be seen that there were 4 questions proposed to the farmers pertinent to the reason for using certain shade plants.

The first question “to improve the coffee production” got answered as many as 12%. The second question “caring and handling that are not too complicated” got answered by 46%. The third question, “to take the fruit and stems to be sold” got answered by 83%. The fourth question, “use shade plants due to its cheap or free seeds” got answered as many as 69%. Based on the explanation above, it can be concluded that most of the coffee farmers chose shade plants that produced fruit and wood to be sold.

### 3.3 The Farmers' Knowledge about Gamal Plant as a Shade for Coffee Plants

The following table 2 is the farmers’ knowledge of *Gliricidia sepium* as coffee shade plants.



**Figure 5.** The Farmers' Knowledge of *Gliricidia sepium*; answer for question 1 (J.P1), answer for question 2 (J.P2), answer for question 3 (J.P3), answer for question 4 (J.P4), answer for question 5 (J.P5), answer for question 6 (J.P6), answer for question 7 (J.P7).

Based on table 2, the farmers' knowledge of *Gliricidia sepium* as the coffee shade plants presented in 7 questions. The first question "do you know that *Gliricidia sepium* can be used as coffee shade plants?" got results as many as 100%. The second question 'do you know that using *Gliricidia sepium* can increase coffee productivity?' was answered as many as 72%. The third question, 'do you know *Gliricidia sepium* is one of the shade plants that is very good for the growth and productivity of coffee plants?' got answered by 63%. The fourth question 'Do you use *Gliricidia sepium* on your coffee plantations?' got results as many as 6%. The fifth question 'do you know that *Gliricidia sepium* root can secrete secondary metabolites to inhibit the growth of weeds?' was answered as many as 0%. The sixth question 'do you know that *Gliricidia sepium* leaves can be used as a health benefit?' got answered as many as 0%. The seventh question 'do you know that *Gliricidia sepium* pruning can be processed and used as a natural pesticide to eradicate weeds?' got answered by 3%.

#### 4. Discussion

A plant is categorized as shade plants if it fulfills the requirement of shade plants' characteristics. The characteristics of shade plants are having shade that can reduce the amount of sunlight in order to avoid direct exposure to the coffee plant. Plants which are able to stabilize the temperatures of soil and air. Plants which had roots grown in the soil and leaves which were not too wide so that it would not cover the entire sunlight (Valladares, 2014). The results of this research showed that there were 6 types of plants usually used by the farmers, they covered 46% of *Persea americana*, 86% of *Musa paradisiaca*, 14% of *Leucaena leucephala*, 28% of *Cocos nucifera*, 6% of *Gliricidia sepium* and 65% of *Falacataria mollucana*. The most dominant shade plants used by the farmers included *Musa paradisiaca* (Banana), *Falacataria mollucana* (Sengon) and *Persea americana* (Avocado) as much as 86%, 65% and 46% respectively.

Concerning the characteristics of each dominant shade tree; one of them was banana tree, in general, its stems reach about 3m, has broad leaves and do not have shade shapes and has roots growing above the surface of soil (Vilhena, 2019). Regarding its characteristics, banana got no characteristics that suited the characteristics of shade plants, so that the use of bananas as shade plants gave less effect on the growth of coffee plants. Hence, the shade plants involved *Persea americana*, *Musa paradisiaca*, *Leucaena leucephala*, *Cocos nucifera*, *Gliricidia sepium* and *Falacataria mollucana*. *Gliricidia sepium* was considered as an appropriate and effective shade plants for coffee plant. It was in line with what other researches stated that a good and effective shade plants was able to increase and maximize coffee crops was *Gliricidia sepium*. *Gliricidia sepium* was defined as a living pillar of coffee plant because it was superfine and effective to provide shade to coffee plant (Chaverri, 2015).



Nowdays, most farmers are no longer used *Gliricidia sepium* as a shade plants, they choose *Musa paradisiacal*, *Falacataria mollucana* and *Persea americana*. It is due to several reasons as the farmers selected the shade plants in utilizing the fruits and stems, so that they are sold to as their side income. The farmers used the shade based on the cheap and free seeds. They chose the shade plants which are easy to handle. Most of them did not think of any shade plants which was able to increase the coffee production. Most of them took the shade trees to take fruit and stems to be sold as their side income, without even considering the growth of coffee by using the bad shade plants.

The farmers were lack of understanding about *Gliricidia sepium* as a good and effective shade plants for coffee. According to the results of the questionnaire about the understanding of *Gliricidia sepium*, all farmers understood that *Gliricidia sepium* was able to be used as a coffee shade plants. Some of them even knew how to use *Gliricidia sepium* as a shade crop in which it fostered the productivity of coffee and their answers percentage reached 72%. Their knowledge about *Gliricidia sepium* as one of the best shade plants for the growth and productivity of coffee plants reached 63%. However, only 6% of the coffee farmers used *Gliricidia sepium* in the coffee plantation. It was caused by the things that were already explained before, this crop was not capable in obtaining enough economic value as side income, this became a main reason why they did not use *Gliricidia sepium*.

Based on the literature, *Gliricidia sepium* is used as a drug-making material since its leaves contains compounds which are used for pharmacology (Oladunmoye, 2018). Other researches pointed out that *Gliricidia sepium* was used as a medicine for diarrhea since its leaves had flavinoid compound which reduced the growth of *Escherchia coli* bacteria (Sukumar, 2014). The coffee farmers still did not know that *Gliricidia sepium*'s leaves were used as a health interest. In addition, they were not aware that the roots of *Gliricidia sepium* released the secondary metabolites to inhibit the growth of weeds. The pruning of *Gliricidia sepium* was processed and used as a natural pesticide to exterminate the weeds. Only 3% of farmers figured out that *Gliricidia sepium* was used as a natural pesticide.

## 5. Conclusion and Recommendation

Based on the results and analysis of the data, the conclusion drawn was the coffee farmers intended to use other shade plants which was easier to maintain. They selected one that has cheap seeds and produced fruit, wood that were able to be sold. The literature said that the most effective shade plants for coffee plant was *Gamal* plants. However, this plant was not widely used by the community of coffee farmers as its seeds were too expensive and did not produce fruit which were able to be sold. Most community of coffee farmers still did not realize and use *Gliricidia sepium* as a shade plant. Thus, further research needs to be conducted regarding the processing of *Gliricidia sepium* so that it will have sale value, so the farmers will use *Gliricidia sepium* as a shade plants to increase the productivity of coffee in Indonesia.

## Acknowledgments

I would like to give my gratitude to University of Jember for facilitating this research. I also would like to thanks the research team of 2019 postgraduate and the Ministry of Research, Technology and Higher Education.

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