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The effect of adoption of frequent harvesting, pruning, sanitation and fertilization on increasing cocoa production (case study: Tapango District, Polewali Mandar Regency)

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ABSTRACT

The lack of consistency of farmers in implementing good agriculture practice has led to the adoption of innovations o frequent Harvesting, Pruning, Sanitation and Fertilization are important to maintain the quality of the cocoa beans produced. This research was carried out in one of the cocoa centers in West Sulawesi, namely in the Village of Tapango, Polewali Mandar Regency with the aim of knowing the effect of the adoption of frequent harvesting, pruning, sanitation and fertilization on increasing cocoa production. This type of research is descriptive quantitative in which the determination of the sample is carried out by the Slovin method in order to obtain 65 cocoa farmers who apply the adoption of Frequent Harvesting, Pruning, Sanitation and Fertilization. The data analysis used in this research is simple regression analysis and the coefficient of determination. The results of the data analysis showed that the innovation adoption of Frequent Harvesting, Pruning, Sanitation and Fertilization to the increase in cocoa production was very influential with a percentage level or determination coefficient (R^2) of 96.8 percent. In addition, the results of the study also showed that through the adoption of innovation, the production of cocoa plants increased by 3.17 tons per hectare. Therefore, it is hoped that the implementation of the innovation adoption of Frequent Harvesting, Pruning, Sanitation and Fertilization to be continued to implement by cocoa farmers in a sustainable manner in Polewali Mandar.

Keywords:
Cocoa, Harvesting, Pruning, Sanitation, Fertilization

1. Introduction

The cocoa plant originated from the Americas and then spread to several countries including Indonesia. Decondole suggests that the cacao plant grown wild in the wilderness of the water basin upstream of the Amazon and Orinoco rivers. In 1560 the cacao plant was introduced by the Spaniards to Indonesia via Sulawesi and then spread to Minahasa. In 1845 the cocoa plants in Minahasa were destroyed due to the attack of the pod borer. In 1970, cocoa cultivation received wider attention in almost all parts of the archipelago in Indonesia connection with cultivation diversification efforts in various large plantations [1].

In West Sulawesi, Cocoa is a plantation commodity which contributed highly to the Gross Regional Domestic Product (GDRP) and a potential employment provider [2] in rural area. Actually, this is essential to supported by the government in order to move out the poverty of smallholder farmers in rural area [3]. Polewali Mandar is one of the cocoa production centers in West Sulawesi which has the largest production of cocoa plantation at 30,146.67 tons, followed by deep coconut at 20,069.49 tons. This is supported by the total area of smallholder plantations of 81,276.12 hectare. With a cocoa plantation area of 65,444.03 hectare. Cocoa is the most promising plantation crop from an economic perspective. The support of a wide and strategic area makes cocoa in Polewali Mandar has its main potential in the plantation sector. Therefore,

cocoa plantation plays an important role in agricultural development in Polewali Mandar Regency [4].

Tapango is a village located in Tapango District, Polewali Mandar Regency, West Sulawesi Province. The development period of the cocoa pods produced in Tapango from flowering to fruit maturity is an average of 5-6 months. The period of fruit development varies and is related to the average daily temperature. In cooler weather the pods grow more slowly than in summer. Harvesting includes the activities of taking ripe cocoa pods from the tree, breaking the fruit, and taking fresh cocoa beans. When ripe times, the color of the pods changes from green to yellow-orange, or from red to orange, especially in the grooves of the pods.

Most of the cocoa commercialized in West Sulawesi is the *Theobroma cacao* L. species, which is one of 22 species in the genus Theobroma, although there is also *T. pentagona* but its commercial value is still low. Apart from these species, there have been no other types that have been commercialized, for example *Theobroma glandiflora* which has a fragrant pulp so that it has the potential to be used as a beverage material.

The process of cultivating cacao plants is inseparable from efforts to maintain the health of the cocoa plants, more profitable production results, and cleanliness of the gardens around the cocoa plants. Frequent Harvesting, Pruning, Sanitation and harvesting are the adoption of innovations practiced by cocoa farmers. In fact, most farmers in West Sulawesi rarely implement innovations in cocoa because of a lack of understanding of the correct, appropriate techniques and use of inputs [5] for cocoa cultivation. The adoption of this innovation is important so that the resulting production is in accordance with market or consumer expectations, as well as it can increase farmers' income [6]. The decline in cocoa production is undeniably caused by many factors, one of the fundamental things is the lack of consistency of farmers in implementing GAP (Good Agriculture Practices) including frequent harvests, pruning, sanitation, and fertilization.

2. Methods

This type of research is descriptive quantitative research through survey methods to cocoa farmers. This research was conducted from July to December, 2020 in Tapango District, Polewali Mandar Regency, West Sulawesi. The population in this study were all cocoa farmers who implemented the innovation adoption of frequent harvests, pruning, sanitation, and fertilization. Number of populations is about 185 cocoa farmers where the samples were determined using the Slovin formula technique [7,8].

The Slovin formula:

$$n = \frac{N}{1} + N(e)^2 \quad (1)$$

n: number of samples, N: number of population size e: tolerable percentage of allowance for sampling errors (e= 0.1). So, the number of samples were taken about 65 respondents.

The analysis used is simple regression analysis which aims to determine the effect of the application of innovation adoption of frequent harvests, pruning, sanitation, and fertilization on cocoa production. The equations that can be used are:

$$Y = a + bX \quad (2)$$

Y = Productivity of Cocoa Plants
a = Constanta
bX = Adoption innovation rate of frequent harvests, pruning, sanitation, and fertilization

In addition to simple regression analysis, this study also uses the coefficient of determination (R^2) analysis in essence measuring how far a model is capable of explaining the variation in the dependent variable. A fundamental drawback to using determination is the usual number of independent variables included in the model. Therefore, many researchers recommend using the adjusted R^2 value when evaluating the best regression model [9].

3. Results and Discussion

3.1. Production of Cocoa Plants before the Implementation of Frequent Harvests, Pruning, Sanitation, and Fertilization

Some of the reasons for the low productivity of cocoa in Polewali Mandar include high levels of pest attack (CPB, VSD), many old plants, suitability of land use, and low application of technology in farming activities. This problem will have an impact on the low income of cocoa farmers. On the other hand, there are many sources of income that can be managed to increase the income of cocoa farmers, including the abundant cocoa waste which has not been utilized optimally as compost. Increasing the cocoa production can be accomplished by developing tissue cocoa seedling, farmers' capacity building, agricultural practice in the field, and the cocoa bean improvement [9]. In addition, derivative or secondary products from cocoa have not been widely developed in West Sulawesi, for example chocolate bars, cocoa powder, chocolate paste, and others. Most cocoa in West Sulawesi sell in the form of raw materials and then processors and confectionary companies which process cocoa beans onto intermediate products such like cocoa powder, butter and liquor. Furthermore, it is managed by the industry into food and cosmetic products [9]. In fact, demand for cocoa butter which is used to make chocolate was increasing while the harvesting of coca beans was declining [10].

The following is data on large area, production, and number of cocoa farmers before the implementation of adoption frequent harvests, pruning, sanitation, and fertilization. Based on the data in table 1, it showed data on large area, and the total production in tons per hectare before the application of frequent harvests, pruning, sanitation, and fertilization. Cocoa farming in Tapango Village, Tapango District, Polewali Mandar Regency is produced by group system to determine costs and production yields for each family who owns cocoa land. The profit-sharing system is determined based on the number of capital and the area of land owned.

Table 1. Large area, production, and number of cocoa farmers before implementation of adoption frequent harvests, pruning, sanitation, and fertilization

Location	Group of farmers	Total farmers (People)	Large area (hectare)	Productivity (ton per hectare)	Average land ownership (hectare per farmer)
Tapango	Mawar	18	20.0	0.74	3.42
	Masiolo	22	23.0	0.85	2.21
	Mario	25	32.0	1.12	2.03
Total		**65**	**75.0**	**2.71**	**7.66**
Average		**22**	**25.00**	**0.90**	**2.55**

3.2. Production of Cocoa Plants after the Implementation of Frequent Harvests, Pruning, Sanitation, and Fertilization

The production of cocoa plants in Tapango Village, Polewali Mandar Regency is one of the highest plantation commodities available because it has an important role in increasing the income and welfare of most farmers. In this case, the cocoa plant production in research location is cocoa beans that have been dried. Cocoa is an annual plant that can begin to bear fruit at the age of four years, and if managed properly, the production period can last more than 25 years old.

Table 2. Large area, production, and number of cocoa farmers after implementation of adoption frequent harvests, pruning, sanitation, and fertilization

Location	Group of Farmers	Total Farmers (people)	Large Area (hectare)	Productivity (ton per ha)	Average Land Ownership (hectare per farmer)
Tapango	Mawar	18	20.0	1.59	3.42
	Masiolo	22	23.0	1.71	2.21
	Mario	27	32.0	2.58	2.03
Total		**67**	**75.0**	**5.88**	**7.66**
Average		**22.33**	**25.0**	**1.96**	**2.55**

The scale of cocoa cultivation in Tapango, Polewali Mandar Regency is relatively low about 50% of cacao production. It is lost due to pests on the cocoa pods. These pests caused the dry cocoa production of farmers to lose an average of 613.26 kg or Rp.7.51 million per household per year. Pests, diseases and old trees of cocoa impacted to the lower productivity [9]. Hence, farmers should encourage to improve best agricultural practice [12] through cocoa farming [13].

Data showed that Mario's group achieved an increase in dry cocoa production by 1.46 tons for every one hectare. Thus, the total production of dry cocoa plants before the application of the frequent harvests, pruning, sanitation, and fertilization technique was 2.71 tons per hectare, while the production of cocoa plants after the application of the frequent harvests, pruning, sanitation, and fertilization technique reached 5.88 tons per ha with a production difference of 3.17 tons per hectare.

Table 3. Comparison of cocoa production before and after implementation of frequent harvests, pruning, sanitation, and fertilization

Farmers Group	Before (ton per hectare)	After (ton per hectare)	Comparison (ton per hectare)
Mawar	0.74	1.59	0.85
Masiolo	0.85	1.71	0.86
Mario	1.12	2.58	1.46
Total	**2.71**	**5.88**	**3.17**
Average	**0.90**	**1.96**	**1.06**

The increase in production occurred as a result of the gradual, routine and continuous implementation of the frequent harvests, pruning, sanitation, and fertilization adoption. The application of frequent harvests, pruning, sanitation, and fertilization adoption is able to provide the cocoa plant production that is expected by farmers to achieve welfare. This is evidenced by the research data that has been obtained and is able to show the comparison of dry cocoa production before and after the implementation of frequent harvests, pruning, sanitation, and fertilization adoption Tapango District, Polewali Mandar Regency.

3.3. The Effect of Frequent Harvests, Pruning, Sanitation, and Fertilization Adoption to the Cocoa Production

To determine the effect of the application of frequent harvests, pruning, sanitation, and fertilization adoption on cocoa production, a simple regression analysis was used. Regression analysis was conducted to analyze the level of influence between the independent variables on the dependent variable, either simultaneously or partially [14]. The results of simple linear regression analysis can be seen in the table 4.

Table 4. The effect of frequent harvests, pruning, sanitation, and fertilization adoption on cocoa production

Model	Unstandardized Coefficients		Standardized Coefficients	t-Count	Sig.
	Beta	Std. Error	Beta		
(Constant)	0.968	0.133	0.000	8.721	0.000
Cocoa Production	0.499	0.049	0.982	9.983	0.000

The simple regression equation in table 4 showed that the intercept value or constant is 0.968 and the cocoa production value is 0.499. So that every 1 percent increase in the application of the frequent harvests, pruning, sanitation, and fertilization technique to cocoa plants will increase 0.499 percent of the growth in cocoa production. On the other hand, every 1 percent decrease in the application of the frequent harvests, pruning, sanitation, and fertilization technique will decrease 0.499 percent of the growth in cocoa production. Therefore, the application of frequent harvests, pruning, sanitation, and fertilization showed an influence on cocoa production in Tapango District, Polewali Mandar Regency.

3.5. The Coefficient of Determination of Frequent Harvests, Pruning, Sanitation, and Fertilization Adoption to the Cocoa Production

Analysis of the coefficient of determination (R^2) is used to determine the percentage of the contribution of the influence of the independent variable on the dependent variable. This coefficient showed how percentage of the variable is able to explain the dependent variable.

Table 5. Coefficient of determination of frequent harvests, pruning, sanitation, and fertilization

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate
1	0.988	0.968	0.958	0.048090880

Therefore, it can be seen that based on the percentage value of the determination coefficient, it shows that 98.8% of the Frequent Harvests, Pruning, Sanitation, and Fertilization program affects cocoa production. So that, the adoption of the frequent harvests, pruning, sanitation, and fertilization innovation is considered efficient for cocoa farmers to implement. Technical efficiency is also recommended to implement in cocoa production [13].

4. **Conclusion**

The conclusion that can be drawn is that the application of adoption to increase cocoa production in Tapango, Polewali Mandar Regency is very influential with a percentage rate of 96.8 percent based on the calculation of the coefficient of determination (R^2). In addition, the production of cocoa plants increased by 3.17 tons per hectare with a percentage of 56.73 percent after the adoption of Frequent Harvests, Pruning, Sanitation, and Fertilization on the cocoa farm managed by farmers. Thus, the adoption of the Frequent Harvests, Pruning, Sanitation, and Fertilization innovation is expected to be applied by farmers in the process of managing cocoa plants in a sustainable manner in Tapango Village, Tapango District, Polewali Mandar Regency.

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