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Managerial implication of cassava farming in Lampung Province Indonesia

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Abstract. The problem of low productivity, quality, and price of cassava keep occurring over the years, from 2016 to 2019. This situation affected farmers' income, both directly and indirectly, later causing reduction of welfare, especially of those in Central Lampung Regency, being the largest cassava production area in Indonesia. This study aimed to determine the level of optimal solutions in cassava farming, in Central Lampung Regency, while also ascertaining the managerial implications on farmers. Furthermore, the study was conducted between the period of October-December 2019, applying a survey method on 78 cassava farmers in Central Lampung Regency. The optimal planning method used was an analytical technique with linear programming model, and qualitative descriptive analysis. The managerial implications of optimizing cassava cultivation were meant to increase the performances of farming and supporting subsystems, based on the use of seeds, fertilizers (urea, NPK, TSP, KCL, and organic fertilizer), labour, land intensification, and management in other substructures.

Keywords: Managerial Implications; ooptimization; cassava farming

1. Introduction

Indonesia is the fifth largest producer of cassava in the world, behind Nigeria, Congo, Brazil, and Thailand, with the total harvested area and production of 778,664 ha and 19,046,000 ton, respectively, in 2017 (Pusat Penelitian dan Pengembangan Kementrian Pertanian RI, 2017). Furthermore, there are 8 (eight) provinces in Indonesia serving as cassava production areas, having contributed to 91.21% of total national. Lampung province is part of the largest cassava producin areas, which has the highest production share of 33.93%, with average harvested area and manufacture of 29,555 hectare and 7.74 million ton, respectively.

However, the problems of cassava agribusiness in Lampung have been discovered, and seems to be highly affecting the national cassava enterprise. The problems often encountered include: (1) The low productivity of cassava, with the current average productivity at only 23.5 ton per ha. This value is considered low, when compared to the potential productivity reaching 30-35 ton per ha. Therefore, farmers are advised to enhance cassava production to the optimal limit; (2) Decreasing harvested area, which occurred over the years should also be brought into consideration, despite the increasing cassava demand (CDMI, 2017). Information further confirmed that there are over 39 units of cassava processing factory in Central Lampung Regency, whose raw material usage depended on the crop's production; (3)

Price issue has always been a discouraging factor for farmers as well. The major problems now are fluctuative prices, which are extremely low, compared to the national cost (Mardika et al, 2017); and also (4) Poor cassava quality leads to a high price deduction (rafaksi) of above 20%.

This study aims to (1) determine the optimal solution level of cassava farming in Central Lampung Regency, and (2) identify managerial implications, for farmers to achieve an optimal cassava farming business. This article argues that optimization applied in cassava farming provides recommendation of optimal products, regardless of the limited resources. According to Rembun and Kassa (2016), optimal level of cassava production resulted in maximum profit for farmers.

2. Materials and Methods

This study applied the survey method conducted on cassava farmers in Central Lampung Regency, i.e. in the Bandar Sakti and Bina Karya Putra Village, of Terusan Nunyai and Rumbia Subdistricts in Central Lampung. Both villages are located in the subdistricts producing highest population of cassava, in Central Lampung Regency. Furthermore, a total of 78 samples of farmers were selected to help carry out this study (Sugiarto, 2003). The farming analysis was conducted every harvest month, from January to December 2019. A mixed method of quantitative and qualitative analysis was also used. The method of quantitative analysis was applied to answer the optimal planning model (optimization) in cassava farming (first objective), while that of the qualitative was the descriptive measurement (second objective).

2.1 Analysis of optimal planning model

Liner model programming was applied to solve the optimization problem in the mathematics model, used in this study. The linear programming is a measurement method, used to achieve the best plannings among possible actions, which are likely to be conducted.

The formulation model of objective function on cassava farming optimization in Central Lampung Regency is as follow,

$$\text{Max } Z_1 = a1X_1 + a2X_2 + a3X_3 + a4X_4 + a5X_5 + a6X_6 + a7X_7 + a8X_8 + a9X_9 + a10X_{10} + a11X_{11} + a12X_{12}$$

where:

Z_1 = The Value of Objective Function of Cassava Farming (Rp).

$a_{1\text{-}12}$ = Profit of cassava farming per month 1-12 (Rp/kg), obtained from the difference between revenue (Py) per unit of cassava and cost (Px) per unit of cassava.

$X_{1\text{-}12}$ = Quantity of cassava production per month 1-12 (kg).

As confirmed by the result of the pre-survey, the formulation model showed that some variables, such as seeds, fertilizers (urea, TSP, NPK, and manure), and land capability, become constraint in the optimization of cassava production. According to previous studies, Fachlevi et al (2018) stated that the variables of fertilizer, land, and labour, are all constraint factors. Moreover, Djafri et al (2017) also included seed as a constraint factor as well.

Therefore, this study strengthened the previous observations of Fachlevi et al (2018), that fertilizer, land, labour, and seed are the hindrance factors in the optimization of cassava production, in Central Lampung.

2.2 Managerial implications

Due to a planned optimal condition, the managerial implication is meant to be an implemented regulation. In cassava cultivation, optimal condition affects the improvement of farming management, with agricultural activity requiring an administration in all operations, in order to ensure the achievement of main objectives. According to Firdaus (2012), there were five functions of management, namely planning, organizing, commanding, coordinating, and controlling. In the planning process, an analysis was carried out to determine whether farmers strategize for their farming process. In the process of organizing and actuating, further analysis was carried out to determine the use of land resources, seeds, fertilizers, and labour, in cassava farming. However, in controlling, farmers' evaluation system was analyzed for their farming process.

3. Results and Discussion

3.1 Analysis of farm income

Based on the harvest months, the income analysis of cassava farming in Central Lampung Regency, are listed in Table 1 below,

Table 1. Selling price, total production cost, and profit based on total cost per kg of cassava farming in Central Lampung Regency

Harvest Month	Selling Price per kg (Rp)	Total Production Cost (Rp/kg)	Profit based on total cost (Rp/Kg)
January	975	539,01	435,99
February	1.000	565,29	434,71
March	1.150	582,06	567,94
April	1.083	605,59	477,75
May	1.121	621,01	500,42
June	1.133	748,35	384,98
July	1.314	745,94	568,06
August	1.403	627,92	774,58
September	1.464	722,33	741,30
October	1.113	714,33	399,01
November	1.229	566,60	662,82
December	1.289	611,82	677,07

Data Primary, 2019

Table 1 showed that the highest income respondents were obtained at the end of the year, i.e., in November and December, while downward trend occurred between January-June. Based on cash and total cost of cassava farming, the average income was 18,589,479 and 12,352,801 Rupiah per ha, respectively. Furthermore, R/C ratio showed that cassava farming in Central Lampung Regency, generated profit in every harvest time, with R/C > 1.

Iqbal et al (2014) on their study in Lampung Timur Regency, concluded that average income based on the total cost for the first planting season was 20,795,322 rupiah per ha with productivity of 36.115 kg per ha, while Prasetiaswati et al (2011) achieved an overall of 12,532,500 Rupiah per ha with 34.000 kg per ha. When the result of this research was compared with both studies, low income of cassava cultivation was observed, with causes due to low farming productivity of 22.489 kg per ha.

3.2 Optimization of cassava farming in Central Lampung Regency

Optimization of cassava farming determined optimal combination of the crop products every harvest time, therefore providing maximum profit for farmers in Central Lampung Regency. The result of this study showed the optimal solution generated by the planning model of linear *programming*. The optimal condition of average productivity that achieved 28.943 kg per ha with increases of 29% tend to improve profits for cassava farmers. In actual situation, the average profit obtained in 2018 reached 12,085,139 rupiah per ha, while in an optimal condition, it is likely to improve to 17,393,994 rupiah. This observation was in line with the study of Sholikah et al (2014), which confirmed that optimal condition should be achieved by increasing productivity, to further improve farmers' welfare and generate maximum income.

Moreover, through econometric approach, Muizah et al (2012) discovered the variables that significantly affected income, namely fertilizer cost, production quantity, selling price, and land ownership. Along with the normative approach applied in this study, cost of fertilizers, production quantity, and selling price, also affected optimal productivity increase and maximum profit. For the variable of land, this study used the approach of capability, not ownership.

3.3 Managerial implications of cassava farming
In this study, the managerial implication of cassava farming indicated change of input use, including seeds, fertilizers, labour, and land capability. Moreover, managerial implication is described as follow,

3.3.1 Management of seed
In order to achieve optimal production, the planning of seed use was constructed. Optimal seed use is 250 bundles/ha or 40,000 cassava stems/ha. The planting distance applied was 50x50 cm, due to being the maximum measurement recommended by the Ministry of Agriculture. In actual condition, seed use only ranged from 100-120 bundles per ha. Furthermore, according to the study conducted by Simanjuntak et al (2019), the factors significantly and positively affecting cassava production without attaining allocative efficiency, included land area, number of seeds and phonska fertilizer. Therefore, with sweet potato having similar characteristics as cassava, optimization of seed quantity was necessary. The seed availability required to achieve optimal solution is 135 bundles per ha, at minimum.

Also, it is actually difficult to obtain seeds at the end of the dry season, which instantly leads to an increase of 9,500 rupiah per bundle. Therefore, the efforts of the government and private support, regarding the research and development process to produce cassava variety with high starch content and adaptability to dry season, was increasingly anticipated.

3.3.2. Management of fertilizer
The activity of fertilizer provision, including manure, urea, NPK/TSP, and KCL, should be controlled, in order to fulfil the requirement of 5T (appropriate in term of time, quantity, place, type, and procedure). Problems frequently observed, includes limited capital and late distribution of non-subsidized fertilizers. The easy access to capital and good fertilizer distribution help facilitate farmers to fulfil adequate stock for their farming business.

Also, optimal planning resulted in the optimum use of 3.324 kg/ha manure, while average use of urea fertilizer was 256 kg per ha. It was further calculated that the average optimal use of fertilizer per ha was 151 kg and 146 kg for NPK and TSP. Furthermore, the recommendation of fertilizer used, according to Badan Litbang Pertanian Kementerian Pertanian (2016) and Petrokimia Gresik (2019) is as follow: (1) Manure of 2-10 ton per ha was applied in moulding (depends on soil condition); (2) Basic fertilizer was provided for 1 month after planting, by using a pointed stick to make a hole (tugal), at distances of 10–15 cm from the stem base (100 kg Urea, 100 kg SP36, 25-50 kg KCl per ha); (3) Second fertilizer application was conducted at the age of 3–4 months after planting, at recommended doses of 100-175 kg Urea and 50 kg KCl per ha.

Recommendation of fertilizer usage from the Ministry of Agriculture and Petrokimia Gresik, was considered as an ideal condition, while referring to previous studies. However, it is observed in the field that there was an impact of decreasing land fertility, due to the continuous use of soil. Long term excessive use of chemical fertilizer have negative impact on a farmland, such as low organic matter, poor soil structure (hardened), and death of decomposing bacteria (PT NBI, 2019). Moreover, according to Yuwono (2002), the yield and growth of cassava, grown with organic fertilizer were higher, compared to those being developed inorganically. Therefore, the best alternative to this issue is to increase the frequency of organic use (manure and compost) in cassava farming. In terms of distribution, the billing system program implemented in several regencies/cities in Lampung Province, was also considered to successfully guarantee 5T, therefore requiring the beneficial extension of the service.

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3.3.3. Management of labour use

Labour use in cassava farming was calculated based on working hour (HOK). The optimal and average actual working hour in cassava farming is 74, and 57 HOK, respectively. An increase in HOK does not only affect the increasing production cost, it also enhances the productivity of cassava farming. A part of the facts obtained in the field, observed that farmers conducted farm maintenance with only minimal efforts. Also, farmers seemed to be ignorant of their cassava farms, due to the fact that majority had other side jobs, such as labor in private companies, trading, livestock breeding, and so on.

Furthermore, Umanailo (2019) stated that farmers applying such strategy to survive are of two types, namely double income (side job) and social network. Therefore, optimal planning suggested that farmers should be disciplined and strict towards their schedule of cassava farming. Also, the human resource training and development of cassava farmers in the research locations was observed to be extremely low, with no form of knowledgeable agricultural services conducted for the past 5 years. Even though farmers have enough farming experience, the current condition of soil fertility and climate is likely to be a different. Innovation, as mitigation efforts to recurring problems should also be taught to them.

3.3.4. Management of land capability

The production of cassava in terms of land capability, depends on soil fertility. In major harvest months, this factor showed that land is an active constraint, indicating that its increase is likely to significantly skyrocket farm income. Moreover, in terms of optimal planning, land capability is likely to highly increase for about 29%. Furthermore, the increase in land capability is directly proportional to soil fertility and water availability. Therefore, implications should be carried out, by increasing soil fertility and water distribution channel.

Also, regarding the fact land capability is a constraint, production is likely to increase at a certain limit, as ownership of larger area should obviously have huge impacts on cultivation. Therefore, since there are differences in the production iof 1 ha and 2 ha areas, further extensions should be carried out by farmers, either through renting or purchasing.

3.3.5. Management of support subsystem

In the planning stage, local government should have the road map of cassava developments, as means of strategies, in order to achieve a clear direction of improvement. Ariningsih (2016), reported that action plan preparation at the level of regency, concerning the development of cassava production areas, should be carried out. Also, RPJMDes at the level of villages should be able to dig and provide direction for the development local products, which in this case is cassava. Moreover, according to Nainggolan and Aritonang (2017), government should provide training and extension, incentive, information, and clear access to market, for the enhancement of farmers. As regards the stage of organizing, the function of farmer groups as learning class, facility of cooperation, and production unit, should also be optimized.

Furthermore, these groups are encouraged to be able to establish and develop business network for farmers. Also, the extension workers have very essential roles, considering the continuity of assistance program for farmer groups. Presently, farmer groups only focus on the distribution of production facility provided by the government, while also establishing themselves enterprises (several farmer groups). Sutisna and Motulo (2016), further explained that the assistance program for farmer groups was observed to be highly important. Also, the aspects that are easily noticed as an impact of farmer group training is administratively effective. However, through assistance program, farmer groups are encouraged to have active roles in managing farming system, including time management for conducting tillage, planting, harvesting, and sharing business profit. Also, Swanson and Rajalahti (2010) stated that participatory extension approaches are not yet applied in extension program, due to the model of technology transfer mostly used. Another important factor in supporting agribusiness system according to Jansen et al (2016), is the need to rapidly adopt state-of-the-art data and ICT technologies, with a focus on the requirement for different types of organizations, while also facilitating their developments.

Therefore, it is observed that the current existing extension practices are still unidirectional, narrow, and minimal in innovation. The use of BUMDES (Village-Owned Enterprises) and BUMD (Local-Owned Enterprises) to optimize cassava farming in Central Lampung Regency, should be imminently conducted. Also, BUMDES tends to play major roles in the provision of agricultural inputs, business capitals, farmer institutional empowerments, and more, therefore allowing institutions at the level of villages to synergize with each other, in order to improve community welfare.

Conclusion

This study concluded that the cassava production in an optimal condition increased from an average of 22.489 kg per ha to 28.943 kg per ha, with a mean profit increment from 12,085,139 to 15,552,484 rupiah per ha. This situation further indicated that actual profit increases up to 28.69%, is possible in an optimal condition. Also, optimized managerial implication of cassava farming in Central Lampung Regency, is directed towards the performance improvement in farming and support subsystems.

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