

Land Optimalization for Food Security in South Sumatra (The Case of Rural Community nearby an Industrial Forest Company of PT. MHP)

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Abstract. The research was conducted in rural communities nearby an Industrial Forest Company of PT. MHP in South Sumatra. PT. MHP produces acacia wood. The Company, through its CSR program, is working with the community using sharing system. Farmers' income is only obtained once per production cycle (7 years), while farmers need income to meet the needs for daily life. The study was conducted to analyze resource availability and the dynamic of food demand that may affect the structure of crop farming which can produce maximum farmer's income in order to assure that farmers are in food security condition. The results showed that the optimization of land recommended for some commodities by using only family labor and Rp.1,000,000.00. additional capital per hectare. The recommended commodity are acacia, coffee and Cattle in the Cropping Seson Group (CSG) I, rice in CSG II and III, Eggplant in CSG II, cassava and sweet potato in the CSG III, Corn in CSG IV, chilies in CSG VI, string beans in CSG VIII, and water spinach in CSG IX. To implement this recommendation, the new system should be established. Acacia plantations will be more profitable if it is fully managed by the community with the provision of production should not decrease more than 15%.

Keywords: Optimalization, Food Security, Structure of Crop Farming

1. Introduction

Food security can be expressed at the different levels of socioeconomic life. Those are at the microeconomic level (household, village), at the macroeconomic level (nation) and at the regional level. Household Food Security (HFS) can be defined as a household having assured sets of entitlements – food availability, food accessibility, and food utility – such that in times of need they will be able to maintain sufficient nutritional intake for physical well-being. There are three important elements in determining household security: the average level of household income, the magnitude and probability of seasonal and annual fluctuation around the average and the value and from stocks a household can maintain (Maxwell, 2008).

The resources availability, especially for farming, is also related to population growth rate which was 1.2 percents per year (BPS, 2008). When the population progressively increases and farming land area is rarely available, the land optimalization becomes the most important issue which must be considered by farmer, agribusiness companies and also the government. This issue is being more important for agribusiness companies, while nowadays there were particular law regulations which force them to pay attention to the welfare societies through Corporate Social Responsibility (CSR) program which is very needed by people around forest area.

The CSR Role in South Sumatra has been conducted at dry farming land area by a company coordinating the cultivation of acacia tree to support the raw material of pulp factory for export. The company, PT Musi Hutan Persada (MHP), is a joint venture company between PT Inhutani V (state company) and Marubeni Corporation (Japan) concentrated on development and sustainable management of industrial forest plantation.

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Combination between food crops and non-food crops is already applied in this area, however not all farmer plant the combination of both non-food crop and food crop. The unification between food crops and non-food crops are expected can optimize this farming land considering goals and constrains. These strategies were done by optimizing the use of the existing resources like land, labors, capitals, and environments. The combinations will be conducted whether the conditions were technically available and suitable in order to increase and improve their income (Yamin, 2003).

The optimalization in this research is not only focus on planting time and resource availability constrains, but also focus on goal of demand fulfillment in food supply. Thus, the unification food crops and non food crops which will be recommended are in appropriate balance condition. The implementation is not only should be done by farmers, but also by government institutions or other private sectors. The greater the potencies, the bigger infestation opportunities of private sectors, especially for the agribusiness sectors to increase farmers' income and to provide job opportunities. According to the description, the main problem is how the resources availability and the dynamic of food demand that may affect the structure of crop farming which can produce maximum farmer's income in order to assure that farmers are in food security condition.

2. Analytical Tools

The collected data from sample has been classified in tabulation and than has been describe descriptively. The objective is answered by using statistical and goal programming approaching models which is use AB:QM program. It is determine both goals and constrain.

Formulation models are needed to solve the second objective. At the first, formulation of decision variable is needed. The second step is formulating the goal function. In this research, goal functions include income and demand of food crops.

$$\text{Maximize income: } Z = \sum_{i=1}^m w_{ki} P_1 (d_i^- + d_i^+) \quad k=1, 2, \dots, n$$

Where :

P_k = Primitive priority factor (in ordinal scale, $P_1 > P_2 \ggg P_k$, where $k = 1, 2, \dots, K$ / number of goal)

Z = Goal function value

w_{ki} = Differential weight, where m used to differentiating the deviation variable in the k priority.

d_i^-, d_i^+ = Deviation variables, where d_i^- shows negative deviation possibility while d_i^+ shows positive deviation possibility; (m = number of constrains)

Goal constraint

1. Profit target:

$$\sum_{i=1}^{16} \sum_{j=1}^{28} \sum_{k=1}^{13} c_{ijk} x_{ijk} + d_i^- - d_i^+ = C_1$$

C_1 = profit Target (Rp/year); c_{ijk} = Net Present Value (Rp/hectare/year); x_{ijk} = land acreage (hectare)

2. Demand of food crops target

$$\sum_{i=1}^{16} \sum_{j=1}^{28} \sum_{k=1}^{13} b_{ijk} + d_i^- - d_i^+ = B_1$$

B_1 = consumption (kg/capita/year); b_{ijk} = commodity productivity (kg/hectare)

Functional constraint

1. Land Constraint

$$\sum_{i=1}^{16} \sum_{j=1}^{28} \sum_{k=1}^{13} l_{ijk} x_{ijk} \leq L_1$$

L = available land (hectare); l = used land (hectare)

2. Capital Constraint

$$\sum_{i=1}^{16} \sum_{j=1}^{28} \sum_{k=1}^{13} a_{ijk} x_{ijk} \leq A_1$$

A_1 = available capital (Rp/year); a_{ijk} = cost production for each commodity (Rp/hectare/year)

3. Labor Constraint

$$\sum_{i=1}^{16} \sum_{j=1}^{28} \sum_{k=1}^{13} f_{ijk} x_{ijk} \leq F_1$$

F_1 = available labor (HOK/year); f_{ijk} = labor that needed for each commodity (HOK/year)

4. Non negative constraint : $x_{ijk}, d_i^-, d_i^+ \geq 0$

Where : l = commodity; m = production alternative planning; n = cropping season

3. Land Optimization in Initial Condition

In the initial conditions, the average farmer's capital is Rp.9,390,745.94 which is using labor within and outside the family (35071 HOK). Then, the target revenue used is Rp23,806,652.97. The results show that the capital has been used. Allocation of land use is recommending five decision variables from 28 variables. Sweet potato is the most widely planted crop in the CSG II and CSG III. Meanwhile, long beans are recommended as the narrowest planting areas at CSG VII and CSG VIII.

Demand for most commodities have not been fulfilled, whereby the value positive or negative deviation is not equal to zero, which means the objectives are not exactly achieved. Revenue targets also cannot be achieved at this initial condition. d^- is still has a value (75451.216), which means that the revenue target is not reached at that value. Demand for sweet potatoes, string beans and lime have been achieved even though there is excess value in this target. The capital resources used in the production activities of farmers land use MHR at the beginning of this scenario has been used up. Meanwhile, labor was not used at 34473.50 HOK. Area constraint wasn't also achieved.

4. Effects of Resource Availability Changing to Household Demand and Income Target

4.1. Scenario I (using Only Family Labor = 597.5 HOK)

In the first scenario, the average farmer's capital is Rp.9,390,745.94 and using only family labor (597.5 HOK). Then, the target revenue used is Rp23,806,652.97. The results show that the capital also has been used. Allocation of land use, on this scenario, is recommending nine decision variables of the 28 variables. Paddy is the most widely planted crop in the CSG II. Meanwhile, string bean and chili are recommended as the narrowest planting areas at CSG VI and CSG VIII.

4.2. Scenario II (using family labor and additional of capital = Rp 1,000,000.00 per hectare)

In the second scenario, the average farmer's capital is Rp.25,390,745.90 and using only family labor (597.5 HOK). Then, the target revenue used is Rp23,806,652.90. The results show that the capital also has been used. Allocation of land use, on this scenario, is recommending 11 decision variables of the 28 variables. Rubber is the most widely planted crop in the CSG I. Meanwhile, eggplant and string bean are recommended as the narrowest planting areas at CSG II and CSG VIII. The table shows that demand for most commodities have been fulfilled. The value positive or negative deviation is equal to zero, which means the target is exactly achieved. Demand for paddy and cow have been achieved even though there is excess value in this target.

Results of the three previous scenarios show that the acacia is not recommended, although all farmers in this study are the farmers who planted an acacia. Based on this case, Researcher wants to understand how the changes occur when acacia plantation is fully managed by farmers without the intervention of the company. The company only had a role as a director and provider markets for farmers. This can be seen in the next scenarios with the possibility of some changes that will occur due to changes in the system.

4.3. Scenario III (using family labor and adding capital = Rp 1,000,000.00 per year; acacia plantations fully managed by the community/NPV = 100%; Assumption: total production decreases until 15%)

In the third scenario, the average farmer's capital is Rp.28,300,031.65 and using only family labor (597.5 HOK). Then, the target revenue used is Rp27,245,387.26. The results show that the capital also has been used. Allocation of land use, on this scenario, is recommending 12 decision variables of the 28 variables. Acacia is the most widely planted crop in the CSG I. Meanwhile, string bean and eggplant are recommended as the narrowest planting areas at CSG VIII and CSG II. Target achievement level of demand in the fifth scenario show the value positive and negative deviation are equal to zero, which means the target is exactly achieved even though there are excess value in paddy and meat demand. In this scenario, acacia still has been recommended even though the possibility changes of production decrease until 15%. An important thing to note is the minimum acceptable production to decline. Therefore, the next scenario assumes that acacia is fully managed by farmers will decrease total production until 20%.

Based on three scenarios, third scenario is the best scenario when compared with the initial conditions and other scenarios. The third scenario was chosen because the target land concession for each CSG, commodity demand and incomes target of farmers in the research area has been reached. In addition, it has been the creation of a stable relationship between the target land concession, capital resources, labor, and consumption of commodities exertion in such scenarios.

Considering that the farmer is the MHR program participants who contribute in acacia plantation. Acacia plant is expected to be recommended to the sustainability of export of raw materials in this area. Farmers still can plant acacia in the requirement that management system in acacia plantation should be change. As described in the previous, MHR participant is only had a role as land owner while the company as implementer. Profits are shared between company and farmers (60% for MHP and 40% for farmer).

Apparently sharing system like this is not providing benefits to the community. This system can also make the communities become less productive. With these considerations, the third scenario can be selected. It means acacia plantation can still be cultivated through MHR program with the new system. Acacia plantations is fully managed by community as owner of the land, whereas the company can provide of inputs and markets for community, with a note that both the people and companies will maintain the quality and quantity of timber production which is not decrease until 15%.

MHR Participants' Land Used Strategy:

Initial Condition	Scenarios		
	I	II	III
Sweet potato (CS 1) = 1.338 ha	Paddy (CS 1) = 1.3380 ha	Rubber = 1.711 ha	Acacia = 4.669 ha
Sweet potato (CS 2) = 1.338 ha	Cassava (CS 1) = 0.6550 ha	Coffee (CS 1) = 0.019 ha	Coffee (CS 1) = 0.019 ha
String bean (CS 2) = 0.018 ha	Sweet potato (CS 2) = 0.0670 ha	Paddy (CS 1) = 1.336 ha	Paddy (CS 1) = 1.335 ha
String bean (CS 3) = 0.018 ha	Chili (CS 1) = 0.0180 ha	Paddy (CS 2) = 0.142 ha	Paddy (CS 2) = 0.103 ha
Lime (CS 1) = 0.398 ha	String bean (CS 3) = 0.0180 ha	Sweet potato (CS 2) = 0.014 ha	Cassava (CS 2) = 0.030 ha
	Water spinach (CS 2) = 0.2500 ha	Corn (CS 1) = 0.037 ha	Sweet potato (CS 2) = 0.014 ha
	Water spinach (CS 3) = 0.2500 ha	Chili (CS 1) = 0.012 ha	ha
	Water spinach (CS 4) = 0.2500 ha	String bean (CS 3) = 0.003 ha	Corn (CS 1) = 0.037 ha
	Water spinach (CS 5) = 0.2500 ha	Eggplant (CS 1) = 0.003 ha	Chili (CS 1) = 0.014 ha
		Water spinach (CS 5) = 0.029 ha	String bean (CS 3) = 0.003 ha
		Cattle = 0.029 ha	ha
			Eggplant (CS 1) = 0.003 ha
			Water spinach (CS 1) = 0.029 ha
			Cattle = 0.007 ha

Natural resources and land are the main resources of society in meeting the needs of everyday life. Moreover, if another job is difficult is available, and then the level of dependence on these resources will be higher. For the management model in this study, the recommended area would only be utilized in the form of initial conditions and three scenarios.

Target consumption in this study has been achieved in scenarios I to II. Only in scenarios I, is still an excess of labor resources, so the next scenarios should using only family labor. In the initial conditions and

scenarios I, the target cannot be achieved, due to lack of availability of capital for farmers to use their land. Based on each group scenarios, we can determine MHR farmer land management strategies at the research locations. Commodities are grouped into three types, namely perennial crops, food and horticulture.

Farmers' land use strategy formulation shows that the perennial crop commodities suitable and good for farmers land. They are acacia, coffee, and rubber. Commodity food crops should be cultivated are paddy, cassava, sweet potato and corn. Meanwhile, horticulture crops are chili, string beans, eggplant and water spinach. The recommended cultivation is expected to meet their needs or at least for household level.

Recommendations land area for perennial crops is larger than land area for food crops and horticultural commodities in each scenario. This is related to the physical condition of the local environment. In Subanjeriji village, soil type and fertility levels are relatively low, so that food and horticultural commodities is less suited to be run in that area. However, commodity food crops that have been recommended as possible to be cultivated in order to given the high demand for food needs.

Based on discussion above, the role of agricultural extension is necessary in order to provide knowledge of farmers about land management and cultivation of agricultural commodities as well as utilization of existing resources optimally. Moreover, considering the contribution of commodity crops, particularly acacia on agricultural land, PT MHP has a very big role as a provider of technical assistance to give capital and also provision of other public facilities. Thus, it will generate an sustainable atmosphere and good business opportunities between farmers and PT MHP.

Indirectly, this condition will support the creation of a stable relationship between the land target, capital resources, labor and the fulfillment of consumption to commodity farmers cultivated. Thus, the income of farmers in villages targeted will increase and the minimum necessities in the future can be met. So, it is expected to use existing resources optimally can improve the welfare of farmers in both villages.

5. Conclusion

Recommendation of plant combination on farmers (MHR participant) land will achieved maximum income, demand and land target. The commodities are acacia coffee and Cattle in CSG I, paddy in CSG II and III, Eggplant in CSG II, cassava and sweet potato in CSG III, Corn in CSG IV, chili in CSG VI, string bean in CSG VIII, and water spinach in CSG IX. Thus, there is no commodity which is recommended in CSG V, VII, X, XI, XII and XIII. Overall, revenue and demand targets are achieved in optimization. Labor and land resources are still left over, except family labor while the capital resources have been allocated. To implement these recommendations, the new system should be established. Acacia plantation should be fully managed by community with the provisions of production should not be decrease more than 15%. PT MHP, through its CSR program, can help community to manage its acacia plantations, while company can also work together in other forms, for example management services, inputs and market provider.

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7. References

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