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THE PROBLEM OF OPTIMIZATION IN OBTAINING HIGH INCOME IN AGRICULTURE

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Abstract:

Land is one of the most important assets for agricultural farmers. Therefore, optimal use of agricultural land is necessary. This study aims to obtain the optimal composition of land use for maximum income. The optimization method used in this study is linear programming models. According to the results of the analysis, the rice area is 135,314 ha, the corn area is 11,798 ha, the soybean area is 2,290 ha, the land use structure for peanut cultivation is 2,818 ha, and the value of the farmers' income is 2,68000.0 thousand rubles. ,-/year. The results of this analysis can be considered by farmers when making decisions about cropping methods.

Keywords: Land, minimization, optimization, algorithm, linearprogramm.

QISHLOQ XO'JALIGIDA YUQORI DAROMAD OLISHDA OPTIMALLASHTIRISH MASALASI

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Abstrakt

Yer qishloq xo‘jaligi dehqonlari uchun eng muhim resurslardan biridir. Shuning uchun qishloq xo'jaligi yerlaridan optimal foydalanish zarur. Ushbu tadqiqot maksimal daromad olish uchun erdan foydalanishning optimal tarkibini olishga qaratilgan. Ushbu tadqiqotda qo'llaniladigan optimallashtirish usuli chiziqli dasturlash modellaridir. Tahlil natijalariga ko‘ra, sholi maydoni 135 ming 314 ga, makkajo‘xori maydoni 11 ming 798 ga, soya maydoni 2 ming 290 ga, yeryong‘oq yetishtirish uchun yerlardan foydalanish tarkibi 2 ming 818 ga. ga, fermerlar daromadining qiymati esa 2 ming ga. 68000,0 ming rubl. ,-/yil. Ushbu tahlil natijalarini fermerlar ekish usullarini tanlashda hisobga olishlari mumkin.

Kalit so'zlar: Landshaft, minimallashtirish, optimallashtirish, algoritm, chiziqli dastur.

Аннотация

Земля является одним из важнейших ресурсов для сельскохозяйственных фермеров. Поэтому необходимо оптимальное использование сельскохозяйственных земель. Целью данного исследования является получение оптимального состава землепользования для получения максимального дохода. Метод оптимизации, использованный в данном исследовании, — модели линейного программирования. По результатам анализа площадь риса составляет 135 тыс. 314 га, площадь кукурузы – 11 тыс. 798 га, площадь сои – 2 тыс. 290 га, структура землепользования под выращивание арахиса – 2 тыс. 818

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га. га, а величина дохода фермеров составляет 2 тыс. га. 68000,0 тыс. руб. ,-/год. Результаты этого анализа могут учитываться фермерами при принятии решения о методах выращивания сельскохозяйственных культур.

Ключевые слова: Ландшафт, минимизация, оптимизация, алгоритм, линейная программа.

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1. Introduction

Land is one of the most important assets for farmers. If a land has a good quality, it will have good potential also for the welfare of the surrounding population. If a land is used for non-agricultural development, it will cause some problems such as food self-sufficiency, environment, and employment. For example, declining agricultural yields, pollution from waste, floods, and increasing unemployment. Also bad for the health of local people, due to the pollution. In West Java, there are several types of land, namely Wetland, Non-Rice Farming Land, and Non-Agricultural Land. The paddy field consists of irrigated rice fields, which are not planted with rice, and while not cultivated. While non irrigated rice field consists of planted with rice, which is not planted with rice, and which temporarily not cultivated. A broad understanding of land is a surface area of the Earth whose characteristics encompass all the identifiers of both a sufficiently steady and predictable nature of the biosphere, atmosphere, soil, geology, hydrology and plant and animal populations, and the results of the activity human beings in the past and the present, as far as the identification marks have an influence over the human use of land in the present and future. [1]

Productive land use is crucial to the productivity of agricultural commodities, especially food crops, as a source of carbohydrates to ensure the food security of people in West Java. Food crops consist of grains and crops. Rice is one of the most important cultivation plants in civilization. Rice production in the world ranks third of all cereals, after maize and wheat. However, rice is a major source of carbohydrates for the majority of the world's population. [2]

A problem will be solved to obtain optimum results in accordance with the given constraints. If the problem is formulated appropriately, it can give the optimum decision variable value. Once the optimum solution is obtained, the problem is often re-evaluated under different conditions to obtain a new settlement. [3]

Previous research that discusses the optimization of land use linear programming is Bisschop. Discusses a farmer who owns a plot of land and must make a decision about what type of plant to plant in the field. Limitations used are the area of land, the amount of labor comprised of family labor, wage labor, and temporary labor, and also constraints of water limitations. The ultimate goal is to maximize profits.

In this paper discuss about how to formulate optimization model of agricultural land use in order to obtain optimal results.

2. The basic concept of optimization

Optimization is the act of getting the best results under certain circumstances. In the design, construction, and maintenance of engineering systems, engineers must take many technological

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and managerial decisions at several stages. The ultimate goal of all decisions is to minimize the effort required or to maximize the desired benefits. [4] In everyday life, whether consciously or unconsciously, people always do the optimization to meet their needs. The optimization done by ordinary people is more based on intuition than optimization theory.

Linear programming is a way to solve the problem of allocation of limited resources such as labor, raw materials, machine work hours and the like in the best way possible to obtain optimal results. [5]

Linear programming has become the basis of manufacturing decisions, marketing, bank loans, stock quotes, taxi fares, coordination transport, telephone charges, computer access, optimization of land and other practical issues. [6]

The general form of Linear programming model can be described as follows:

Objective function: max/min (1)

$$Z = \sum_{j=1}^{n} C_j x_j$$

Subject to

$$\sum_{i=1}^{m} a_{ij} x_j \{\leq, =, \geq\} b_i$$

Table 1. Planting area (ha)

Rice	80.261
Corn	11.798
Soy	2.290
Peanuts	2.818
Total	**97.167**

Table 2. Cropping area (ha)

Rice	74.933
Corn	10.207
Soy	2.288
Peanuts	2.915
Total	**90.343**

Table 3. Analysis of Farming.

Commodities	**Result (kg)**	**Price (Rp/Kg)**	**Value of Results / Production (Rp)**	**Total Production Cost (Rp)**	**Farm Income (Rp)**	**R/C**
Rice	5.510	4.800	26.448.000	16.910.000	9.538.000	1,56
Corn	6.500	1.800	11.700.000	8.215.000	3.485.000	1,42
Soy	1.571	3.800	5.969.800	5.570.000	399.800	1,07
Peanuts	1.230	8.300	10.209.000	9.480.000	729.000	1,08

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Table 4. Total labor.

	Man			Woman			
	Hired worker	Family	Total	Hired worker	Family	Total	Total
Rice	118	16	134	85	6	91	225
Corn	70	13	83	58	4	62	145
Soy	54	12	66	-	1	1	67
Peanuts	120	22	142	144	6	150	292
Total	362	63	425	287	17	304	**729**

Table 5. Volume Fertilizer of each Commodity.

	Volume (Kg)				Total
	Urea	SP -36	KCl	NPK Phonska	
Rice	200	100	75	50	425
Corn	150	50	50	50	300
Soy	50	100	50	50	250
Peanuts	100	200	100	-	400
Total					**1.375**

Table 6. Price of Fertilizer.

Type of Fertilizer	**Price (Rp)**
Urea	1.800
SP-36	2.000
KCl	2.000
NPK	2.000

The purpose of this study is to maximize the profits of farmers for a year, with revenue from sales minus the costs incurred. While the obstacles used in this study are limited land, labor needs, and fertilizer needs.

Based on (1), and referring to [7], the above problem can be formulated as follows:

$$\sum p_c s_c - r^L V^L - r^P V^P - p^F f_c x_c$$

Max subject to:

$$\begin{aligned}
&\sum_c x_c \le L && \\
&\sum_c l_{tc} x_c \le L && \forall t \\
&\sum_c v_c x_c \le L\left(V^L + V^P\right) && \forall t \\
&\sum_c f_c x_c \le LF && \\
&x_c \ge 0 && \forall c \\
&V^P \ge 0 && \\
&s_c \ge 0 && \forall c
\end{aligned} \tag{2}$$

Based on data obtained from Dinas Pertanian, Peternakan, dan Perikanan Kabupaten Sumedang in 2016 which has been described above, it can be obtained a formula for Linear Programming optimization model as follows:

Objective function: Max:

$$z = 19128000x_1 + 6985000x_2 + 3149800x_3 + 1459000x_4$$

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subject to:

$$
\begin{aligned}
&x_1 + x_2 + x_3 + x_4 \le 152220 \\
&x_1 \ge 80261 \\
&x_2 \ge 11798 \\
&x_3 \ge 2290 \\
&x_4 \ge 2818 \\
&225x_1 + 145x_2 + 67x_3 + 292x_4 \le 110968380 \\
&425x_1 + 300x_2 + 250x_3 + 400x_4 \le 209302500 \\
&x_1, x_2, x_3, x_4 \ge 0
\end{aligned} \tag{3}
$$

Where

$x1$ = Rice land area
$x2$ = Corn land area
$x3$ = Soy land area
$x3$ = Peanuts land area

The optimal solution of equation (3) is obtained by using the simplex table is to arrange the equations in a table, the simplex table. The initial simplex table for this problem is as follows:

Table 7. First Simplex's Table.

VB	z	x_1	x_2	x_3	x_4	s_1	s_2	s_3	s_4	s_5	s_6	s_7	NK
z	1	-19128000	-6985000	-3149800	-1459000	0	0	0	0	0	0	0	0
s_1	0	1	1	1	1	1	0	0	0	0	0	0	152220
s_2	0	1	0	0	0	0	1	0	0	0	0	0	80261
s_3	0	0	1	0	0	0	0	1	0	0	0	0	11798
s_4	0	0	0	1	0	0	0	0	1	0	0	0	2290
s_5	0	0	0	0	1	0	0	0	0	1	0	0	2818
s_6	0	225	145	67	292	0	0	0	0	0	1	0	110968380
s_7	0	425	300	250	400	0	0	0	0	0	0	1	209302500

To achieve the optimal result, the above problem is solved with 4 iterations. Thus, using the Python program, the optimal results were obtained for rice area of 135,314 ha, corn area of 11,798 ha, soybean area of 2,290 ha, and groundnut area of 2,818 ha. The optimal income from the land sample is 2,682,020,000,000 IDR,-/year.

3. Summary

From the description above, it can be concluded that the income of farmers is 2,682,020,000,000 IDR,-/year, if farmers grow rice, corn, soybeans and peanuts on the following land areas:

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135314 ha of rice, 11798 ha of corn, 2290 ha of soybeans, 2818 ha of peanuts. Thus, it can be used as input from farmers in planning land use schemes.

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