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An Optimal Model using Goal Programming for Rice Farm

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Abstract

The Goal programming is used for formulization of the problems which have multiple goals. Rice farmlands usually have the ability of producing different crops. Multiple goals are considered for producing different crops in a high level of programming . In this paper the lexicographic linear goal programming (L.L.G.P.) model is considered for identifying the optimal compound of agriculture product in the rice farmland of Maydonsar Koshteli village from Babol county, a city in the north of Iran.

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1 Introduction

If some actions are related to contributive profit-seeking of the sources, the case of source allocation is put forward as a result of assigning the amount of actions. This case can be formulated by using a program so that the related math model to be obtained. If the related math model is totally a kind of math linear, it is called linear goal programming.

In the linear goal programming cases, the goal is to reach the maximum output or to reach the minimum cost. We notice that the fulfillment of this goal is conditioned with some limitations like source, equipment, talents and

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capital. In the linear goal programming one goal is only purposed. On the Contrary, providing one goal will create damages in future for organizations and companies which have complicated relations among themselves and their surroundings world. For example managers and programmers in farming programming are eager to optimize some opponent goals simultaneously in the most cases.

A profiteer instead of maximum the profit may be only interested in maximum income, providing assured food for himself, minimum the expenses and avoiding risk. Commercial farmers not only want to increase the program output but also want to reduce the amount of debt, to reduce the expense, to expand the size of the farm, etc. By deliberating in the above statements we see that it can not be possible to reach all these goals only by using the linear goal programming. Declaration of many goals in one case is possible with goal programming. This programming as math programming was presented and expanded by A. Charnes and W.W.Cooper (1961), Y. Igiri (1965), Mao (1969) and Lee (1972) for considering and deciding of multiple .

The presented methods for solving goal programming problems have the common part and their all goals is to minimum the unwanted division from the goals. The needed goal programming for this research is L.L.G.P.with considering P.A.G.P. method for solving the program and its usage is presented in identifying of optimal pattern of planting in the paddy field.

2 The goal programming model of case study

As explained before the needed model of goal programming in this research is L.L.G.P. that its general shape is as follow:

$$\begin{aligned} Lexico-mina &= (a_1, a_2, \cdots, a_k) = min\, a = \left[P_1(d^-, d^+), \cdots, P_k(d^-, d^+)\right] \\ s.t \quad & \sum_{j=1}^{n} c_{ij}x_{ij} + d_i^- - d_i^+ = b_i \\ & AX = a \\ & X_j \geq 0, \quad j = 1, \cdots, n, \\ & d_i^-, d_i^+ \geq 0, \quad i = 1, \cdots, m, \end{aligned}$$

where $X = (x_1, \cdots, x_n)^T$, $d^- = (d_1^-, \cdots, d_m^-)^T, d^+ = (d_1^+, \cdots, d_m^+)^T$ and $P_s(d^-, d^+)$, $s = 1, \cdots, k$ is (usually) a linear function of the weighted unwanted division variables at priority level S, and K is the lowest priority level. Show below:

$$P_s(d^-, d^+) = \sum_{i=1}^{m}(w_{s_i}^- d_i^- + w_{s_i}^+ d_i^+)$$

where x_j, c_{ij}, d_i^+ and b_i are j-th decision variable,coefficient of x_j in the i goal or rigid constraint, the positive division of goal or i-th rigid constraint and the right-hand- side for i-th rigid constraint or aspiration level for i-th goal respectively.

So in view of general model of L.L.G.P. and the taken data from the face-to-face interview and found information from the Maydonsar Koshteli village Rice Research Center study , the suggested L.L.G.P. model is as follow [1]:

$$
\begin{array}{l}
Lexico-mina=(a_1,a_2,\cdots,a_k)\\
\sum_{j=1}^{7} x_j+D_1-S_1=b_1,\\
\sum_{j=1}^{7}(\pi_j\, x_j)+D_2-S_2=b_2,\\
\sum_{j=1}^{7}(c_j\, x_j)+D_3-S_3=b_3,\\
\sum_{j=1}^{7}(Wt_j\, x_j)+D_4-S_4=b_4,\\
\sum_{j=1}^{7}(R_j\, x_j)+D_5-S_5=b_5,\\
\sum_{j=1}^{7}(O_j\, x_j)+D_6-S_6=b_6,\\
\sum_{j=1}^{7}(T_j\, x_j)+D_7-S_7=b_7,\\
\sum_{j=1}^{7}(P_j\, x_j)+D_8-S_8=b_8,\\
\sum_{j=1}^{7}(C_j\, x_j)+D_9-S_9=b_9,\\
\sum_{j=1}^{7}(Dm_j\, x_j)+D_{10}-S_{10}=b_{10},\\
\sum_{j=1}^{7}(B_j\, x_j)+D_{11}-S_{11}=b_{11},\\
\sum_{j=1}^{7}(H_j\, x_j)+D_{12}-S_{12}=b_{12},\\
\sum_{j=1}^{7}(Q_j\, x_j)+D_{13}-S_{13}=b_{13},\\
\sum_{j=1}^{7}(A_j\, x_j)+D_{14}-S_{14}=b_{14},\\
\sum_{j=1}^{7}(F_j\, x_j)+D_{15}-S_{15}=b_{15}, \quad ,\\
x_j\geq 0, \quad j=1,2,\cdots 7, \quad D_i,s_i\geq 0, \quad i=1,2,\cdots 15,
\end{array}
\tag{1}
$$

where $a_t = g_t(D,S)$ is (usually) a Linear function of the weighted, unwanted division variable at priority level t and k is lowest priority level. The specific form of $a_t = g_t(D,S)$ is typically;

$$g_t(D,S)=\sum_{i=1}^{15}(V_{it}D_t+W_{it}S_t)$$

Where: V_{it} The weight assigned to the (unwanted) negative division variable i at priority,
W_{it} The weight assigned to the (unwanted) positive division variable i at priority k,
b_i the value of ith goal or the aspairation level for goal i,
x_1 the allocaface of planted Tarom rice on the basis of Hectare,
x_2 the allocaface of planted Gholipour rice on the basis of Hectare,
x_3 the allocaface of planted Khazar rice on the basis of Hectare,
x_4 the allocaface of planted Amroullahi rice on the basis of Hectare,
x_5 the allocaface of planted Tarom Askary rice on the basis of Hectare,
x_6 the allocaface of planted Tarom Nemat rice on the basis of Hectare,
x_7 the allocaface of planted Tarom Neda rice on the basis of Hectare.

The goals of the problem are gross benefit, production costs, needed water, produced paddy, Urea fertilizer, Triple fertilizer, Potash fertilizer, Granule of stem borer, Dimicron of stem borer, Bieam Blast stem, Hynozan for blast disease, Cyvine pesticide, Botchlor herbicide and labor.

D_i: the negative devision respectively of ith goal;
S_i: the positive devision respectively of ith goal;
π_j: the Gross benefit of jth Crop in one Hectare (Toman[2]),
C_j : the production cost of jth Crop in one Hectare (Toman),
Wt_j: the needed water of jth Crop in one Hectare (m^3) ,
R_j: the produced paddy of jth Crop in one Hectare (kg) ,
O_j: the consumed urea Fertilizer of jth Crop in one Hectare (kg),
T_j: the consumed triple Fertilizer of jth Crop in one Hectare (kg),
P_j: the consumed potash Fertilizer of jth Crop in one Hectare(kg) ,
C_j: the consumed granule of stem borer of jth Crop in one Hectare (Lit)
D_j: the DiMicron of stem jth Crop in one Hectare ($Lit.$) ,
B_j: the bieam blast of jth Crop in one Hectare (kg) ,
H_j: the Hynozan for blast of jth Crop in one Hectare (Lit) ,
Q_j: the cyvine pesticide of jth Crop in one Hectare (kg) ,
A_j: the Botelor herbicide of$j$th Crop in one Hectare (Lit) F_j: the utilized human force of jth Crop in one Hectare on the basis of person-daytime worker
$j = 1, 2, 3, 4, 5, 6, 7. \quad i = 1, 2, \cdots, 14, 15.$

3 Optimal Solution of the Model

In this section, the optimal solution of model has been obtained using PAGD [2, 3] and the Lingo software.

Input data for the problem:

[2]Iranian Currency,$ 1=925 Tomans.

	$j=1$	$j=2$	$j=3$	$j=4$	$j=5$	$j=6$	$j=7$
π_j	1813672	1587360	1888216	1664520	1257051	1592100	1572202
C_j	602134	591447	658763	606478	655178	660247	666823
Wt_j	12500	14000	15500	12500	15500	17000	17000
R_j	3892	6614	5457	5337	5637	7076	6926
O_j	172	258	357	195	444	360	452
T_j	117	185	178	183	190	195	218
P_j	47	14.5	20	12.5	18	16	19
C_j	44	50	50	53	85	58	64
D_j	0.3	0	0.5	0	0.6	0.4	0.4
B_j	0.26	0.02	0.35	0.41	0.45	0.2	0.36
H_j	0.14	0	0.36	0	0	0.06	0.08
Q_j	0.2	0.016	0.18	0.13	0.78	0.26	0.4
A_j	3.5	4	4.5	4	5.1	5.2	5.1
Q_j	91	91	101	91	101	101	101

The Right hand side values of goals:

i	1	2	3	4	5	6	7	8
b_i	72	327347985	103788365	3207500	1277780	73425	38561	4532
i	9	10	11	12	13	14	15	
b_i	10761	72	57.11	17	62	957	19882	

In fact, these amounts are the data related to the suggested goals at the area which farmers gave me. Using input data of problem, we consider the object function of the problem as follow:

$$\begin{aligned} &Lexico-mina = S_1 + D_1 + D_2, \\ &S_3 + S_4 + D_5 + S_6 + S_7 + S_8 + S_9 + S_{10} + S_{11} + S_{12} + S_{13} + S_{14} + D_{15} \end{aligned} \tag{2}$$

With respect to the object function we see that:

1. At the first priority of this structure we deal to minimize the negative and positive variables by using of the planted surface and negative division of gross benefit.

2. At the second priority of this structure we deal to minimize Water, fertilizer, chemical poison, the cost of produce and negative division of producing paddy and human force.

That the optimal solution with using PAGD and the Lingo software is as follow: $S_2 = 14012290$ increasing Gross benefit of the area, $D_3 = 9515166$ decreasing production's cost, $D_4 = 35155.74$ economizing in using water, $D_5 = 0$, $D_6 = 7236.948$ economizing in using urea Fertilizer, $D_7 = 1513.112$ economizing in using triple Fertilizer, $D_8 = 747.1654$ economizing in using potash Fertilizer, $D_9 = 0$, $D_{10} = 2.506557$ economizing in using DiMicron of stem borrer, $D_{11} = 14.46205$ economizing in using bieam blast stem, $D_{12} = 0$, $D_{13} = 24.56933$ economizing in using cyvine pesticide, $D_{14} = 15.85630$ economizing in using Botclor herbicide.

It's seen that in the comparison of the suggested goal programming model with the planting pattern of the studied area, there is an increase in the goal of gross benefit, and a decrease in the cost of production, in using water, Urea fertilizer, Triple fertilizer, Potash fertilizer, Granule of stem borer, Dimicron of stem borer, Bieam blast, Hynozan for blast disease, Cyvine pesticide and Botchlor.

4 Discussion and Conclusions

With considering the available planting sample in this study and the found optimal sample from goal programming model of this region, we see that there are many differences among allocated surfaces in different rice. In general, it's obvious that in Maydonsar-e-Koshteli village's rice farmland planting operation, on the basis of optimized standard, the allocation of the source of the production isn't done among various crops. In other words, the planting sample in the region isn't an optimal sample, and owing to this, the difference among incomes of this region is too less than the cases can gain more because of the optimal using of the total production elements.

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